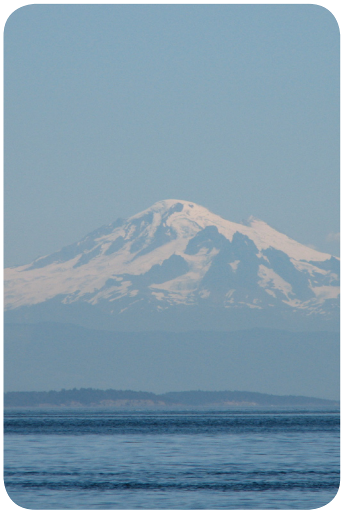

VOLUME

1

REPORT

North Cascades and Pacific Ranges Ecoregional Assessment

November 2006

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Washington Department of Fish and Wildlife

North Cascades and Pacific Ranges
Ecoregional Assessment
Volume 1 – Report

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North Cascades and Pacific Ranges Ecoregional Assessment

November 2006

Prepared by
Nature Conservancy of Canada
The Nature Conservancy
And
The Washington Department of Fish and Wildlife

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EXECUTIVE SUMMARY

Ecoregional assessments provide a regional scale, biodiversity-based context for implementing conservation efforts. The intent of the assessments is to create a shared vision for agencies and other organizations at the regional, state and local levels to form partnerships and ensure efficient allocation of conservation resources. The assessments identify a portfolio of sites for conservation action with a goal of protecting representative biodiversity and ecologically significant populations. These assessments are the result of rigorous analysis, incorporating expert review, and are the most comprehensive and current efforts that support spatially explicit priority setting at an ecoregional scale. Biodiversity conservation in the ecoregion will attain its fullest potential if all conservation organizations coordinate their strategies to protect and restore biodiversity according to the priorities identified in this process.

The North Cascades and Pacific Ranges ecoregional assessment resulted in the selection of 341 conservation targets, including 152 terrestrial plant and animal species, 132 freshwater species targets, and 57 ecological system targets. These system targets are the major ecological systems that make up the terrestrial and freshwater environments.

Conservation goals were set for each target, defining the abundance and spatial distribution of viable target occurrences necessary to adequately conserve those targets in an ecoregion, as well as provide an estimate of how much effort will be necessary to sustain those targets well into the future. Separate terrestrial and freshwater suitability indices were utilized to determine the areas of the ecoregion that had the highest likelihood of successful conservation. This facilitated choosing amongst assessment units (the units of analysis), when multiple units contained conservation targets. The suitability indices incorporated biological and non-biological "factors": land use (agriculture, urban, mining, timber harvest, intensive recreation); management status (GAP status); urban proximity; dams; water extraction; fish stocks; road/stream crossings; riparian disturbance; and road density (Maps 11, 12, 13). Conservation goals and the suitability index contributed to the development of a portfolio of priority conservation areas (PCAs), or NCC/TNC portfolio sites, that depict characteristic landscape settings, supporting all of the ecoregion's biodiversity.

The terrestrial portfolio (Map 22) includes 155 PCAs with a combined area of 1,687,001 ha (4,168,665 ac), representing 35% of the total area of the ecoregion. The freshwater portfolio (Map 24) includes 121 priority conservation areas, with an area of 1,453,965 ha (3,592,821 ac) within the ecoregion boundaries and representing 39% of the ecoregion. The terrestrial and freshwater portfolios were overlaid to demonstrate the area of overlap, which represents 15% of the ecoregion (Map 26). These portfolios include the last places where many of the ecoregion's most imperiled species occur and the last, large expanses of relatively intact natural habitat. The sites included in these portfolios are those regarded as having the highest likelihood of successful conservation according to the suitability factors utilized in the assessment. While integration of the North Cascades and Pacific Ranges terrestrial and freshwater portfolios was not achieved, future iterations of this assessment will strive to produce a fully integrated portfolio.

Threats to biodiversity in the ecoregion were compiled through assessment team members' experience and on-the-ground knowledge of the ecoregion, interviews with experts knowledgeable about the area and through literature review. The major threats to biodiversity identified in the North Cascades and Pacific Ranges Ecoregion include:

- Forestry practices
- Urban growth and associated land conversion

- Hydropower development
- Transportation and utility corridors
- Invasive species, pests and pathogens
- Climate change
- Recreational development and use

Approximately 40% of the terrestrial portfolio is currently in designated protected areas (Table 20); while approximately 26% of the freshwater portfolio (to the extent of the terrestrial assessment units, not EDUs) is currently in designated protected areas (Table 24). Assuming the biodiversity values within the portions of the portfolios that coincide with protected areas (GAP 1 or 2) are already protected, an additional 21% of the terrestrial portfolio and 27% of the freshwater portfolio requires some form of conservation action in order to conserve the full portfolios (Maps 23 and 25).

This assessment resulted in a series of products useful to those involved in the conservation of biodiversity in the North Cascades and Pacific Ranges Ecoregion. These products can be used alone, in conjunction with one another, or with other information to enhance on-the-ground conservation and communication about biodiversity values in the ecoregion. The main products developed are:

- Terrestrial and freshwater ecological systems classifications.

- Terrestrial and freshwater conservation portfolios, showing the most important and suitable areas for conservation of ecoregional terrestrial and freshwater biodiversity, respectively. A summary of known target occurrences, land cover, land use, etc. is provided for each PCA along with an illustration of relative priority based on biodiversity value and suitability for conservation.

- Irreplaceability maps showing the relative conservation value of all places in the ecoregion.

- Overlaid terrestrial and freshwater portfolios, showing the area of overlap between the two portfolios.

- Three scenarios for biodiversity conservation, representing different levels of risk.

The conservation portfolios and utility maps are useful for a full range of biodiversity conservation strategies. Conservation projects occurring within portfolio sites and high value assessment units should receive special consideration. We therefore encourage government agencies, NGOs and other conservation practitioners to consider the portfolio and utility maps in their work. To date, the Washington Department of Fish and Wildlife has committed to using the conservation utility maps to guide their development of a State Comprehensive Wildlife Conservation Strategy (SCWCS) in coordination with other governmental and non-governmental organizations. The Nature Conservancy of Canada and The Nature Conservancy use portfolio sites to focus all of their on-the-ground conservation and policy work. Similar ecoregional assessments are being prepared for other ecoregions in support of Washington's and Oregon's SCWCS. In British Columbia, provincial government agencies will use the assessment to inform their decision-making. The ultimate vision of the ecoregional assessment process is to facilitate the thoughtful coordination of current and future conservation efforts by the growing number of federal, provincial/state, local, private and non-governmental organizations engaged in this field.

Figure 1. North Cascades and Pacific Ranges Ecoregion Boundary.

Chapter 1 – Introduction

The mountainous North Cascades and Pacific Ranges ecoregion extends south from Toba Inlet in British Columbia to just south of Snoqualmie Pass in Washington State. The entire region encompasses some 3,817,320 ha (9,432,787 ac or 14,739 square miles [sq. mi.]) with 65% (2,499,324 ha/6,175,955 ac) situated in British Columbia. In the BC portion of the ecoregion, human land use - mainly forestry - has been relatively intense, especially in the lower to mid-elevation areas. In the Washington portion, more than 96% is uninhabited and uncultivated, and has the lowest human impact of any of the state's terrestrial ecoregions. Large areas are protected in North Cascades National Park, Ross Lake National Recreation Area, and several wilderness areas, but logging has occurred widely at lower elevations.

The goal of this ecoregional assessment is to identify a suite of conservation areas in which the long-term survival of all native plant and animal species and natural communities in the North Cascades and Pacific Ranges ecoregion (hereafter referred to as the North Cascades) can be maintained. The North Cascades Ecoregional Assessment is the product of a partnership initiated in 2004 to identify priority conservation areas (PCAs), or NCC/TNC portfolio sites, in the ecoregion. The primary partners were the Nature Conservancy of Canada (NCC), The Nature Conservancy (TNC), and the Washington Department of Fish and Wildlife (WDFW). The Washington Department of Natural Resources' Natural Heritage Program (WNHP) and the British Columbia Conservation Data Centre (BC CDC) were major contributors of technical expertise and data. Many other scientists and conservation experts acted as team members and expert reviewers.

The purpose of this assessment was to integrate the best available information about the ecology of the region and to identify the lands and waters most necessary for the maintenance of the biodiversity of the ecoregion. Assessment products include: (1) a terrestrial portfolio and a freshwater portfolio of priority conservation areas, showing places of exceptional biological value and/or the most likely places for conservation to succeed based on their current condition or status; (2) maps depicting the relative irreplaceability of all sites across the entire ecoregion; and (3) "lower" and "higher" risk portfolios depicting a wide range of options for the conservation of biodiversity.

Assessment Methods

This assessment uses an approach developed by TNC (Groves et al. 2000, 2002) and other scientists to establish conservation priorities within the natural boundaries of ecoregions. Similar assessments have been completed for 14 ecoregions in Canada, over 45 of the 81 ecoregions in the U.S., and several other ecoregions around the world. The objective is to complete assessments throughout the U.S. (and in many parts of Canada and other countries) by 2008. TNC and NCC are leading a number of these assessments, while others are led by partner organizations or agencies which are using the same basic methodology.

Seven technical teams collaborated on a series of analyses. Three teams covered the terrestrial environment's plants, animals and ecological systems. A fourth team studied the ecoregion's freshwater systems and a fifth its freshwater species. The sixth team assessed human impacts to biodiversity in the ecoregion, while the seventh team handled geographic information systems (GIS) and data management tasks. The terrestrial and freshwater teams began by selecting the species, communities and ecological systems that would serve as the conservation targets. Conservation targets are those elements that are determined by the teams to be representative of the biodiversity necessary in priority conservation areas (that represent optimal concentration of biodiversity).

A computer program, MARXAN, was used to select a set of sites that meet the goals for target species and habitat types at the lowest "cost", or suite of economic, social and environmental factors. Cost was minimized by selecting the sites rated as most suitable for long-term conservation. Site suitability was described using an index of existing land management status, land uses, urban proximity, and road density. MARXAN compared each part of the ecoregion against all others and analyzed millions of possible site combinations to select the most efficient portfolio. Separate portfolios were created for terrestrial and freshwater biodiversity. MARXAN outputs were also used to generate maps that rated the conservation value and depicted the relative irreplaceability of all sites across the ecoregion.

The technical teams then worked with the MARXAN outputs to refine both the terrestrial and freshwater portfolios based on expert review. Sites in both portfolios were prioritized for action based on the irreplaceability and suitability values encompassed by each site. These portfolios highlight areas of high conservation value for terrestrial and freshwater species and systems. The terrestrial and freshwater portfolios were then overlaid in order to demonstrate areas of overlap.

Using the Assessment

The North Cascades Ecoregional Assessment is a guide for natural resource planners and others who are interested in the status or conservation of the biological diversity of this ecoregion. This assessment has no regulatory authority; it is simply a guide for prioritizing work on the conservation of habitats that support the extraordinary biological diversity of the ecoregion. It provides a tool that should be used in conjunction with other biological information, particularly at more local scales, as well as with information about social and economic priorities.

The Report

The North Cascades Ecoregional Assessment consists of four separate volumes. The main report contains an overview of the ecoregional assessment process, the methods used, and presents the results of the assessment. Details of the methods, a glossary, lists of participants, and references have been placed in separate appendices. Maps of the ecoregion, the terrestrial and freshwater classifications, and the portfolios are in a separate volume of maps. Summary reports for each of the priority conservation areas identified in NCC/TNC's preferred portfolio can be found in the site summary volume. These four volumes are also included on an interactive CD that contains an ESRI ArcReader project and data.

The results of this assessment are available to all parties interested in conserving biodiversity in the North Cascades ecoregion. The Nature Conservancy of Canada, The Nature Conservancy, and the Washington Department of Fish and Wildlife will use the assessment results and those of similar assessments to prioritize their projects and funding allocations. Governments, land trusts, and others are encouraged to use the assessment as a resource to guide conservation strategies.

1.1 Ecoregion Overview

General Description

The mountainous North Cascades ecoregion extends south from Toba Inlet in British Columbia to just south of Snoqualmie Pass in Washington State. In BC, the ecoregion extends from Desolation Sound at the mouth of Toba Inlet on the northwest boundary to the

Lillooet glacier on the northeast and then south and east thus encompassing the Resort Municipality of Whistler; Garibaldi Provincial Park; the District of Squamish; the North Shore mountains north of the heavily populated Lower Mainland and City of Vancouver; Pitt, Stave, and Harrison Lakes; the Fraser River; City of Chilliwack, and the Town of Hope. From there the ecoregion extends south into Washington State and encompasses North Cascades National Park, Mount Baker, and the communities of Concrete, Darrington, Hamilton, and Index (Map 1a). The ecoregion contains over 26,000 km (16,156 miles) of streams and rivers, including the upper reaches of a number of major (third order or larger) rivers and portions of some estuaries and inlets where the ecoregion borders the Strait of Georgia in British Columbia. Major water bodies in the ecoregion include Powell, Pitt, Lillooet, Stave, and Harrison Lakes in British Columbia and Baker, Shannon, and Ross Lakes in Washington. In BC, the northwestern edge of the ecoregion borders the coast and includes portions of Howe Sound, Jervis Inlet and Toba Inlet.

Currently, 27% of the ecoregion is classified as GAP 1 or GAP 2; and an additional 61% is classified as GAP 3 (refer to Appendix 1 - Glossary for GAP descriptions). This mountainous ecoregion is also relatively sparsely populated: approximately 122,000 people live in the BC portion; about 8,000 live in the Washington State portion. Much of ecoregion is relatively intact and dominated by semi-natural or natural vegetation. Most human impacts have been due to logging and road building; however, it is anticipated that the area between Vancouver, Whistler, and Pemberton will rapidly undergo development, particularly road building and housing development, as a result of Whistler/Vancouver hosting the 2010 Winter Olympics.

1.1.1 Biogeographical setting

Physiography

The North Cascades Ecoregion encompasses 3,817,320 hectares [ha] (9,432,787 acres [ac] or 14,739 square miles [sq. mi.]). It includes highly dissected, glaciated mountain terrain that is mostly between 300 and 2,100 m (approx. 1,000 and 7,000 ft) in elevation and is punctuated occasionally by large, composite volcanoes rising to over 3,048 m (10,000 ft) (Map 1b). The Washington portion of the ecoregion contains the greatest concentration of active glaciers in the conterminous United States.

Valley bottoms in the ecoregion extend down to 152 m elevation (500 ft). Glacially carved U-shaped valleys and cirques are prominent features. Some of these have been dammed to form large reservoirs, notably Ross and Baker Lakes. Watersheds typically begin as steep-gradient small stream drainages that feed major rivers leading out to the Fraser River delta and the Puget Sound Lowland. The major river systems in the Washington portion of the ecoregion—the Snoqualmie, Skykomish, Stillaguamish, Skagit, and Nooksack— flow toward Puget Sound (SAS 2005). In the BC portion of the ecoregion, the Squamish River, a short but very large drainage basin in the Pacific Ranges just north of Vancouver, enters the sea at the head of Howe Sound. Its main tributaries are the Cheakamus, Elaho and Mamquam Rivers. The Fraser River divides the ecoregion by Hope and flows through Vancouver to the Strait of Georgia.

Most of the ecoregion is encompassed by the high, rugged mountains of the Pacific Ranges, the southern-most mountain range in the Coast Mountains - and the Cascade Mountains north of Snoqualmie Pass and west of the crest extending northward into British Columbia.The Pacific Ranges include four of the five major coastal icecaps in the southern Coast Mountains (Demarchi 1996). The Garibaldi Ranges are the southwestern-most subdivision of the Pacific Ranges. The northern part of the Garibaldi Range, mostly comprised of Garibaldi Provincial Park, is primarily alpine and includes large icefields and numerous high peaks. To the south are the North Shore Mountains, which overlook Vancouver; to the southeast are the Douglas Ranges. Severe weather conditions in the North Shore Mountains often contrast dramatically with mild conditions in nearby Vancouver.

The ecoregion also encompasses the northern extent of the Cascades Volcanic Arc - a chain of tall volcanoes that runs north-south along the west coast of North America from Mount Garibaldi in British Columbia to the Shasta Cascade area of northern California. All of the known historic eruptions in the contiguous United States have been from Cascade volcanoes. The Garibaldi Volcanic Belt is the northernmost extension of the Arc; resulting from subduction of the Juan de Fuca tectonic plate beneath the North American tectonic plate, which meet just off the west coast of Vancouver Island. The volcanoes in this belt are generally stratovolcanoes[1] typical of subduction zone volcanoes; they include Mount Garibaldi (2,678 m [8,787 ft]), the Black Tusk (2,316 m [7,598 ft]), Mount Meager (2,680 m [8,793 ft]), Mount Silverthrone (2,957 m [9,700 ft]), Mount Baker (3,285 meters [10,778 feet], and Glacier Peak (3,213 meters [10,541 ft]) (Cannings and Cannings 2004). Mount Garibaldi was built by violent volcanic eruptions 15,000–20,000 years ago when the Squamish Valley was filled with a large glacier. Mount Meager is a dormant volcano that last erupted 2,350 years ago and deposited ash as far east as Alberta (NRC 2005). Mount Baker is the largest volcanic complex in the northern part of the Cascade Volcanic Arc. Its volume is estimated at 72 km^3, and it supports one of the largest geothermal fields in the Cascade Range. In the past 14,000 years, Glacier Peak has erupted at least a dozen times, most recently about 300 years ago (USGS 2005).

Climate

Climate in the ecoregion exhibits both maritime and montane influences (CBI 2003; McNab and Avers 1994). Due to its proximity to the Pacific Ocean, high precipitation typifies the ecoregion and varies from around 1,520 to 4,060 mm (60 to160 in.) per year. Most precipitation falls as snow or rain from October through April. High elevations in the mountains are covered with snow for many months. Middle elevations have significant snowpacks that fluctuate over the course of the winter with rain-on-snow events. Lower elevations within the ecoregion accumulate little snow or have transient snowpacks (Cassidy 1996).

The maritime climate of the Pacific Northwest, coupled with the large vertical relief of the mountains and volcanoes, produces frequent snowstorms and heavy snowfalls. The Cascades and Coast Mountains record some of the deepest snowfalls in the world (Cannings and Cannings 2004). It is not uncommon for some places in the Cascades to have over 5,500 mm (200 in.) of snow accumulation. The annual averages of nearly 17 m (700 in.) at some Cascades locations are some of the largest recorded at any measuring stations in the world. Inland precipitation decreases on the east side of the coastal ranges where less than 511 mm (20 in.) of precipitation accumulates per year (McNab and Avers 1994). Where the ecoregion borders the Strait of Georgia, the climate is characterized by generally mild temperatures that average 2–10º Celsius (36–50º F) throughout the year with summer means reaching 13.5º Celsius (56º F) in the Pacific Ranges. Rainfall is heavy, 770–3,800 mm (30–150 in.) per year, with a maximum in winter. Winters are short and mild with mean January

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[1] Typically steep-sided, symmetrical cones of large dimension built of alternating layers of lava flows, volcanic ash, cinders, blocks, and bombs. The essential feature of a stratovolcano (also called a composite volcano) is a conduit system through which magma from a reservoir deep in the Earth's crust rises to the surface. The volcano is built up by the accumulation of material erupted through the conduit and increases in size as lava, cinders, ash, etc., are added to its slopes (USGS, 2006).

temperatures of about -5º Celsius (23º F) and frost free periods of over 100 days (Cannings and Cannings 2004).

Biotic Communities

Climate is the major influence on vegetation types in the ecoregion. Vegetation is stratified by both elevation and precipitation. The windward slopes of the Coast Mountains and Cascades Range are covered in temperate rainforests. Conifers predominate and can grow to enormous size, especially on the moister, western slopes. The extreme variability of soils and geology, combined with extensive effects of glaciation and topography, have led to large localized differences in climate, species, natural communities and ecological systems (Cannings and Cannings 2004).

At low elevations, Coastal Western Hemlock (*Tsuga heterophylla)* forests dominate; in higher elevations, subalpine Mountain Hemlock (*Tsuga mertensiana*) forests are more common. Small areas of dry Douglas-fir (*Pseudotsuga menziesii)* forests are found on the leeward side of the mountains. Natural stand-replacement fires occur at irregular intervals of 90–250 years. Above timberline, alpine heaths, meadows and fellfields are interspersed with barren rock, ice, and snow (Cassidy 1996). Near Garibaldi Lake, BC, the heather meadows are broken by wide swaths of lupine (*Lupinus spp.*), cinquefoil (*Potentilla spp.*), valerian (*Valeriana officinalis*), and Subalpine Fir (*Abies lasiocarpa* Nutt.) (Cannings and Cannings 2004). The region also contains forested and open wetlands, and avalanche chutes dominated by Sitka alder (*Alnus crispa)*, vine maple (*Acer cirinatum*), and blueberries (*Vaccinium spp.*) (Cassidy 1996). In riparian forests, broadleaf species such as black cottonwood and red alder dominate over conifers (McNab and Avers 1994). Rare plant species in the ecoregion are often circumboreal species on the southern edge of their range and which have populations scattered in the high Cascades. This ecoregion is one of the few in Washington that supports a variety of large carnivores, including the gray wolf (C*anis lupus)*, grizzly bear (*Ursus arctos horribilis*), and wolverine (*Gulo gulo*). Salmon (*Oncorhynchus spp.*) are found in most of the large rivers (Cassidy 1996).

1.1.2 Socioeconomic Environment

Because their greater inaccessibility made it more difficult to cut and transport the timber, the Coast Mountains and Cascades Range were some of the last areas to be logged in the Pacific Northwest. Other than logging and a large ski resort at Whistler, most of the land in the ecoregion is relatively undeveloped; however, this situation is rapidly changing as the corridor between Vancouver and Pemberton undergoes development in preparation for the 2010 Winter Olympics. The fishing industry also plays a major role in the economy of the BC portion of the ecoregion, and historically, the Coast Mountains and Cascades were important areas for gold mining. Sand and gravel extraction operations are important economic contributors in the ecoregion (CBI 2003).

The North Cascades ecoregion contains some of North America's great outdoor recreation destinations. More than a dozen national, provincial, state, and county parks, monuments, and recreation areas are scattered throughout the ecoregion. Vast national forest lands in Washington also provide campsites and recreation areas. Some of North America's best Nordic and alpine skiing facilities are also found in the region (Britannica 2006).

In British Columbia, the ecoregion overlaps five Regional Districts (RD): Squamish-Lillooet, Sunshine Coast, Powell River, Fraser Valley, and Greater Vancouver (Figure 2). Located north of Vancouver along the eastern shore of Howe Sound, the Squamish Lillooet RD is comprised of four incorporated municipalities and four electoral areas. Within the ecoregion the main population centers are Squamish, Whistler, and Pemberton. Sunshine

Coast Regional District is located on the southern mainland coast across the Georgia Strait from Vancouver Island. It borders on the Powell River RD to the north, the Squamish-Lillooet RD to the east, and the Greater Vancouver RD to the south. Within the ecoregion, the RD encompasses the District Municipality of Sechelt, Town of Gibsons, and the Sechelt Indian Government District. The Powell River RD includes the District Municipality of Powell River and a number of unincorporated areas. It is bounded by the Squamish-Lillooet and Sunshine Coast RDs. The Fraser Valley RD is located in the southwestern portion of BC and is bordered by Whatcom County, Washington to the south, the Greater Vancouver RD to the west, and the Okanagan-Similkameen RD to the east. Within the ecoregion, the main population centers are the City of Chilliwack and District Municipality of Hope. The Greater Vancouver RD occupies the southwest corner of mainland British Columbia. Within the ecoregion it encompasses the District Municipality of North Vancouver. Table 1 provides details on populations and main industries in the Regional Districts.

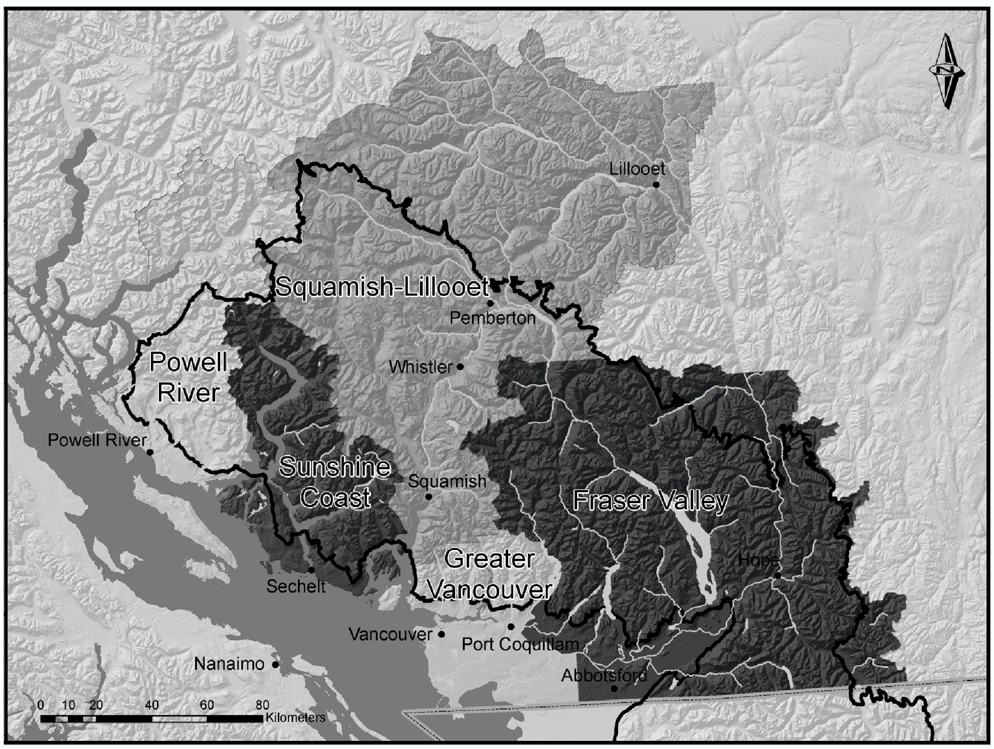

Figure 2. Regional Districts in Canada that overlap the North Cascades Ecoregion

Table 1. Regional District population and main industries (by labor force)

Regional District (RD)	% of RD in North Cascades	Population (Year)	Main Industries (by labor force)
Squamish Lillooet	46% (1,680,005 ha / 4,151,377 ac)	RD: 33,011 (2001).	Forestry, agriculture, and recreational tourism (BCStats 2006c)
		Squamish: 15,726 (2005)	Construction, manufacturing, logging and forest products, retail trade (BCStats 2006d)
		Whistler: 9,775 - permanent population; avg. of 31,351 in winter (2005)	Accommodation and food services, arts entertainment and recreation, and retail trade (BCStats 2006e)
		Pemberton: 2,517 (2005)	Construction, retail trade, arts, entertainment and recreation (BCStats 2006b)
Sunshine Coast	64% (542,587 ha/ 1,340,760 ac)	26,832 (2001)	Retail trade, health care and social assistance, manufacturing (BCStats 2004d)
Powell River	28% (680,194 ha/ 1,680,794 ac)	20,716 (2001)	Manufacturing, retail trade, health care and social assistance (BCStats 2004c)
Fraser Valley	75% (1,426,581 ha/ 3,525,152 ac)	RD: 237,550 (2001)	Retail trade, manufacturing, health care and social assistance. Agriculture is a major economic driver in the RD, accounting for approximately 32% of total provincial farm receipts (BCStats 2004a).
		Hope: 6,591 (2001)	Forestry and logging, construction, retail trade (BCStats 2006a)
		Chilliwack: 64,898 (2001)	Agriculture, manufacturing, and tourism (BCStats 2004a).
Greater Vancouver	27% (372,301 ha/ 919,973 ac)	RD: 1,986,965 (2001)	Retail trade, health care and social assistance, and manufacturing (BCStats 2004b).
		North Vancouver: 44,303 (2001)	Important shipping and rail centre and the site of a wide range of manufacturing and service operations.

In Washington State, the North Cascades ecoregion overlaps four counties: Whatcom, Skagit, Snohomish, and King (Figure 3). As of 1991, less than 2% of Washington's portion of this ecoregion had been converted to urban and agricultural development (Cassidy 1996). Although most of the area of these counties is located within the ecoregion, most of the population base is located outside, closer to the coast and urban areas such as Bellingham, Mount Vernon, Kent, and Seattle. Total population of the four counties within the ecoregion is less than 8,000. Most of the population lives along river/highway corridors that reach into the ecoregion or run from one side to another through mountain passes. Recreation and second homes have a significant influence on these developing corridors. Table 2 provides details on populations and main industries in the counties.

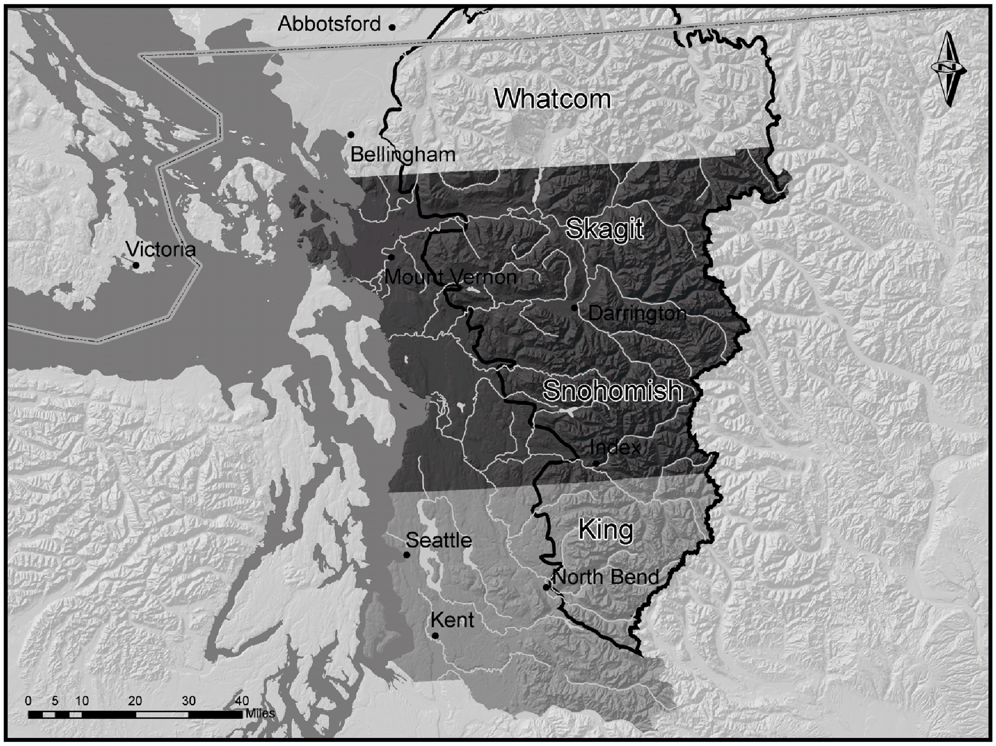

Figure 3. Counties in United States that overlap the North Cascades Ecoregion

Table 2. County population and main industries

County	% of County in North Cascades	Population (Year)	Main Industries
Whatcom	67% (648,392 ha/ 1,602,208 ac)	180,800 (2005)	Wholesale/retail trade, health care and social assistance, manufacturing (OFM 2006d)
Skagit	70% (497,389 ha/ 1,229,073 ac)	County: 110,900 (2005)	Wholesale/retail trade, health care and social assistance, manufacturing (OFM 2006b).
		Hamilton: 330 (2005)	Retail trade, health services, manufacturing.
Snohomish	61% (568,843 ha/ 1,405,639 ac)	County: 655,800 (2005)	Manufacturing, wholesale/retail trade, health care and social assistance (OFM 2006c)
		Darrington: 1,435 (2005)	Manufacturing, retail trade, agriculture, forestry, and fisheries.
		Index: 155 (2005)	Retail trade, manufacturing.

County	% of County in North Cascades	Population (Year)	Main Industries
King	31% (597,372 ha/ 1,476,136 ac)	1,808,300 (2005)	Wholesale/retail trade, health care and social assistance, manufacturing (OFM 2006a).
		Skykomish: 210 (2005)	Educational services, personal services, retail trade.

1.1.3 Land Ownership and Management

Sixty-five percent of the North Cascades ecoregion (2,499,324 ha/6,175,955 ac) is situated in British Columbia. Most of the BC portion (65%) of the ecoregion is provincial Crown land. Another 17% is in protected areas (GAP 1 and GAP 2), about 3% is privately owned land, and less than 1% is managed by conservation land trusts. Beginning in the late 19th century, concerns about logging led to the creation of government-protected lands. These formed the core of the present-day system of Crown lands in Canada and the national forests in the United States (Britannica 2006).

Human land use in the BC portion has been relatively intense, especially in lower to mid-elevation areas. Forestry, including pulp and sawlog forestry, has been extensive and accounts for most of the disturbed habitat in the BC side of the ecoregion. Transportation corridors are also extensive, particularly in the valleys south of Squamish. Recreation and tourism is increasingly becoming a major land use; hunting occurs throughout most of the BC side of the ecoregion. Other major activities include hydroelectric power production in the Pacific Ranges (CBI 2003).

More than 96% of the Washington portion of the ecoregion is uninhabited and uncultivated, and has the lowest human impact of any of the state's terrestrial ecoregions. Protected areas (GAP 1 and GAP 2) account for about 47% of this portion of the ecoregion. Large areas are protected in North Cascades National Park and Ross Lake National Recreation Area, and in several wilderness areas. Logging has occurred widely at lower elevations in the ecoregion. Recreational activities that occur in this portion of the ecoregion include hunting, fishing, hiking and snowmobiling (SAS 2005).

Less than 1% of the ecoregion is under Aboriginal/tribal landownership. In Washington, much of the ecoregion occurs within the ceded lands and usual and accustomed fishing areas of tribes. Usual and accustomed areas are judicially defined areas where tribal members have fishing rights based on their tribe’s historical use patterns. Tribes in Washington manage tribally-owned lands on reservations and are actively involved in monitoring, research and management activities on ceded lands. Tribes are also active participants in discussions about natural resources management and conservation activities within their usual and accustomed areas. In British Columbia, the North Cascades ecoregion is covered by 11 First Nations Statement of Intent areas. Statement of Intent areas are the delineations of traditional territory boundaries for those Nations involved in treaty negotiations with the provincial government. Refer to Map 2 and Table 3 for details of land ownership and management within the ecoregion.

Table 3. North Cascades Ecoregion Land Ownership and Management

	Area (ha)	Area (ac)	% of Ecoregion
British Columbia			
Federal lands			
Federal Land	65	162	<1%
Indian Reserve	10,426	25,762	<1%
Provincial lands			
Conservation Trust Land	1,207	2,982	<1%
Crown Land	1,634,334	4,038,520	52%
Provincial Park / Protected Area	427,806	1,057,130	14%
Tree Farm License	359,882	889,286	12%
Other lands			
Private Land	65,605	162,113	2%
Washington			
Federal lands			
National Park Service	212,355	524,740	13%
Forest Service: National Forest Wilderness Area	316,696	782,572	19%
Forest Service: National Forest non-Wilderness Area	388,530	960,076	23%
Bureau of Land Management	263	649	<1%
State lands			
Department of Natural Resources: Natural Area Preserve	831	2053	<1%
Department of Natural Resources: Natural Resources Conservation Area	14,546	35,945	1%
Department of Natural Resources: Other	123,965	306,323	7%
Department of Fish and Wildlife	561	1386	<1%
Parks and Recreation	2,140	5,289	<1%
Department of Transportation	17	41	<1%
Other lands			
Tribal Land	19	47	<1%
County or Municipal	11,590	28,640	1%
Private Land	246,483	609,071	15%

1.2 Biodiversity Highlights of the North Cascades Ecoregion

The rugged, mountainous terrain and extreme elevation gradients that characterize the North Cascades provide a unique array of habitats for terrestrial and aquatic species. The rock, ice, snow, and alpine habitats of the higher elevations are less hospitable to the diversity of species that occur in the forest habitats of the lower and mid-elevations; however, many of these higher elevation areas are protected as national and provincial parks and wilderness areas. Consequently, much of this area receives relatively little human use and provides important habitat for species that seek remote, undisturbed areas [e.g., grizzly bears, wolverines, mountain goats (*Oreamnos americanus*)]. While more accessible, the low- and mid-elevation forests, riparian areas, and aquatic habitats in river drainages support species that also tend to use more remote areas [e.g., northern spotted owls (*Strix occidentalis caurina*), northern goshawks (*Accipiter gentiles*), marbled murrelets (*Brachyramphus marmoratus*), gray wolves, fishers (*Martes pennanti*), and lynx (*Lynx canadensis*). Rivers within the ecoregion support a diversity of fish species, but most are known for the salmon and steelhead (*Oncorhynchus mykiss*) stocks they support. The Fraser River, which bisects the ecoregion, supports each of the Pacific salmon species and a population of white sturgeon (*Acipenser transmontanus*), which is imperiled in British Columbia. In Washington, the Skagit and Sauk Rivers are well known for supporting some of the highest densities of wintering bald eagles in the state.

At least 18 species of birds, mammals, butterflies and molluscs that occur within the ecoregion are federally, state, or provincially listed as threatened or endangered. In British Columbia, these species include the marbled murrelet, northern goshawk, peregrine falcon (*Falco peregrinus*), northern spotted owl, Townsend's mole (*Scapanus townsendii)*, Pacific water shrew (*Sorex bendirii*), mountain beaver (*Aplodontia rufa rainiei* and *Aplodontia rufa rufa.*), fisher, Johnson's hairstreak (*Callophrys johnsoni)*, blue-gray tail dropper slug (*Prophysaon coeruleum)*, dromedary jumping slug (*Hemphillia dromedaries)*, evening field slug (*Deroceras hesperium)*, Oregon forest snail (*Allogona townsendiana)*, and Puget Oregonian (*Cryptomastix devia*). Listed species in Washington include the marbled murrelet, bald eagle (*Haliaeetus leucocephalus)*, northern spotted owl, gray wolf, grizzly bear, fisher, and lynx. The Puget Oregonian, a snail that was native to British Columbia, Washington and Oregon, was last noted in British Columbia in the early 1900s and is now considered extirpated from Canada as a result of the loss of low elevation older forests. The grizzly bear, gray wolf and fisher appear to be extirpated in Washington. Many more species are listed as species of concern in the U.S. or Washington, are blue-listed in British Columbia, or are listed as species of special concern in Canada.

The decline of the northern spotted owl population in Washington and British Columbia has been well documented. Most of the remaining population (<10 breeding pairs) in BC occurs within the North Cascades Ecoregion. The decline of the northern spotted owl in British Columbia and Washington resulted from extensive habitat loss and fragmentation but was likely exacerbated by competition with the barred owl, which has invaded much of the historical range of the northern spotted owl. Protection of suitable habitat for the northern spotted owl is critical to the species' recovery, and it would likely protect habitat for other species, including the marbled murrelet and northern goshawk, which are associated with older coniferous forests. Much of the western half of the ecoregion provides habitat for the marbled murrelet, which is listed as threatened in Canada and the U.S. due to the loss of older forest habitats.

The ecoregion follows the geographical pattern of the North Cascades and Pacific mountain ranges. These ranges provide a significant habitat corridor, which historically allowed for demographic support among populations that traversed the British Columbia-Washington boundary area. Wide-ranging carnivores such as grizzly bears, gray wolves, wolverines, fishers and lynx depend on habitat corridors to maintain their large home ranges and provide demographic support among subpopulations. Mountain goats, northern spotted owls and northern goshawks also use expansive areas and depend on extensive habitat connectivity to maintain population viability. Development of the lower Fraser River bottomlands near Harrison Lake, however, has reduced the area of the corridor where the

Fraser River crosses the ecoregion and has affected its use as a travel corridor by terrestrial species. Construction of the Trans-Canada highway, Canadian National and Canadian Pacific railway lines, and a large power line corridor, all of which parallel the river as it bisects the ecoregion, has also affected the natural movement patterns of terrestrial species. Additional development and loss of habitat connectivity within the southern portion of the ecoregion in British Columbia may also impede animal movements through this corridor.

British Columbia supports populations of wide-ranging carnivores that are critically important to Washington. Washington supports populations of several species that are imperiled in BC. The North Cascades and Okanagan ecoregions are considered to be the most suitable areas in Washington for grizzly bears, gray wolves, wolverines and lynx; however, grizzly bears and gray wolves appear to be extirpated in Washington even though they are protected in the state and the rest of the United States. Protection for grizzly bears in British Columbia is limited, and gray wolves receive no protection. Sparse populations of these carnivores in southern British Columbia are unlikely to produce sufficient dispersers to reestablish populations in the North Cascades of Washington. Barriers or impediments to movement and loss of habitat connectivity may also affect the ability of grizzly bears and gray wolves in BC to reestablish populations in Washington. Habitat ranges of Townsend's moles, Pacific water shrews, and coastal giant salamanders (*Dicamptodon tenebrosus*) extend from Washington to just within the border of British Columbia. These species are relatively common in Washington but are considered at risk in British Columbia due to their small population sizes. Maintaining low-elevation valley bottom habitats for Townsend's moles, wetland and riparian habitats for Pacific water shrews, and streams surrounded by moist forests for coastal giant salamanders will be valuable in both Washington and British Columbia.

1.3 Ecoregion Boundary

The study area boundary corresponds with that of the North Cascades and Pacific Ranges Ecoregion. The boundary was originally delineated by Bailey (1995) and Environment Canada (Wiken 1986) and then modified by TNC and NCC for use in their Ecoregional Assessments in the continental United States, Alaska, Hawaii and Canada. The boundary was later modified from the original by the Coastal Forests and Mountains of Southeast Alaska and British Columbia Conservation Area Design (RRCS et al. 2003) and the Coast Information Team Ecosystem Spatial Analysis of Haida Gwaii, Central Coast, and North Coast of British Columbia (Rumsey et al. 2004). By modifying their study area boundaries these two projects encompassed the top third of the original TNC/NCC North Cascades and Pacific Ranges Ecoregion boundary. These modifications used Ecosection boundaries from the BC Ecoregional Classification scheme. Two Ecosections—Northern Pacific Ranges and Outer Fiordlands—were included in these two previous analyses and were therefore not re-analyzed for this assessment. Sections of the eastern boundary of the Ecoregion were also modified by the Okanagan Ecoregion Assessment based on updated vegetation mapping and review by ecologists with the Washington Natural Heritage Program and NatureServe (Pryce et al. 2006). Refer to Figure 4 for details of the ecoregion boundary modifications.

Figure 4. North Cascades Ecoregion Boundary Modifications.

The study area boundary used for this project also closely matches that of the Pacific Ranges Ecoregion in the BC Ecoregion Classification system. The BC classification scheme stratifies terrestrial ecosystem complexity into discrete geographical units at five hierarchical levels. The two broadest levels—Ecodomain and Ecodivision—place BC's ecosystems in a global context. The three lower levels—Ecoprovince, Ecoregion and

Ecosection— describe areas of similar climate, physiography, hydrology, and vegetation and are increasingly more detailed and relate ecosystems to each other on a provincial and state scale. Within the BC classification, the North Cascades Ecoregion falls within the Coast and Mountains Ecoprovince, which extends from coastal Alaska to coastal Oregon and consists of large coastal mountains, a broad coastal trough, and the associated lowlands, islands and continental shelf. This Ecoprovince is within the Humid Maritime and Highlands Ecodivision, which occurs along the Pacific coast from sea level to the height of land in the Coast Mountains. This Ecodivision contains some of the world's largest trees and densest coniferous forests. At the highest level in the hierarchy, the Ecoregion occurs within the Humid Temperate Ecodomain, which covers most of the mid-latitudes of North America from the east coast to the west. The climate in this Ecodomain is characterized by strong seasonal cycles of temperature and precipitation and distinct winters.

1.3.1 Terrestrial Ecosections

We divided the ecoregion into four sub-sections using the boundaries of the BC Ecoregion Classification's Ecosections. Ecoregional sections are an essential element of the ecoregional assessment as they are used to stratify the ecoregion along ecological lines. Stratification ensures that the distribution of priority conservation areas (PCAs) is a reflection of the distribution of the attributes of biodiversity that characterize the ecoregion. Using this approach, habitats and species distributed across the ecoregion will be represented in a series of potential conservation areas that correspond to their natural distribution, thus capturing the genetic diversity of species and the varied composition of habitats. By determining PCAs on a sectional basis, elements captured by the resulting conservation portfolio will be more representative of biodiversity across the ecoregion. The ecosections in the North Cascades are

- Northeastern Pacific Ranges in the northeastern portion of the ecoregion entirely within BC
- Southeastern Pacific Ranges in the central-eastern section of the ecoregion that spans the BC and WA border
- Southern Pacific Ranges in the northwestern portion of the ecoregion entirely within BC
- Northwestern Cascade Ranges in the southwestern portion of the ecoregion almost entirely within WA except for a small portion in the Lower Mainland of BC.

Refer to Map 3 and Appendix 7 for terrestrial ecosection descriptions.

1.3.2 Freshwater Ecological Drainage Units

Ecological Drainage Units (EDUs) are groups of watersheds that share a common zoogeographic history and physiographic and climatic characteristics (Map 4). We expect that each EDU will contain sets of freshwater systems with similar patterns of drainage density, gradient, hydrologic characteristics, and connectivity. This assumption is based on a large body of research that indicates that drainage basin and physiography strongly influence freshwater biodiversity patterns (Pflieger 1989; Maxwell et al. 1995; Angermeier and Winston 1999; Angermeier et al. 2000; Oswood et al. 2000; Rabeni and Doisy 2000). EDUs can be equated to terrestrial ecoregions largely because their biogeographic patterns and spatial extent are comparable. For our ecoregional assessment purposes, EDUs provide a means of stratifying freshwater systems and species in order to set appropriate goals for freshwater biodiversity conservation. The EDUs that intersect the North Cascades

Ecoregion are the Southern Coastal Streams in the northwestern part of the ecoregion, the Lower Fraser in the central part of the ecoregion, and the Puget Sound in the southern portion of the ecoregion (Maps 5 and 9).

The description of ecosections in Appendix 7 summarizes the physiography and climate of these EDUs. Appendix 9.1.2 also summarizes the zoogeographic history of these units.

1.3.3 Assessment Units

In order to use reserve selection algorithm MARXAN, the ecoregion must be divided into assessment units (AUs). AUs provide a spatially-explicit framework for compiling data on the occurrence and distribution of biodiversity features within the ecoregion (Warman et al. 2004). Determining the type and size of assessment units involves making a number of tradeoffs based on computing power, spatial resolution of the datasets, and eliminating bias in the modeling process (Appendix 13). Two types of assessment units were used for this project: 500 ha (1,236 acre) hexagons for the terrestrial analysis (Map 6), and third-order watersheds in BC (Map 9) and polygons comparable to HUC 6 watersheds in the Puget Sound EDU for the freshwater analyses.

Some ecoregional assessments have used watersheds for AUs while others have used rectangular cells, cadastral parcels, land management status, etc. Compared to watersheds or cadastral parcels, a hexagonal grid eliminates any biases due to large size differences among AUs. Compared to rectangular grids, hexagons allow for better aggregation of AUs because a hexagon shares a boundary with all its neighbours. The size of the hexagonal AUs provided sufficient accuracy in target locations while allowing for aggregation of ecological systems into extensive conservation areas (Neely et al. 2001). This analysis was selected in part to reflect the spatial resolution of the occurrence data. Large polygons, such as watersheds, can occasionally contain both high quality habitats and highly degraded areas. Smaller AUs enable only the high quality parts of the ecoregion to be selected in the portfolio.

The use of hexagons still required the team to overcome some deficiencies. For example, hexagons do not follow any ecological reality on the ground; they might split watersheds, forest blocks or other landscape patterns; and they can sometimes cause confusion during the expert review process because they are an abstract representation of the landscape. Further work will be required to refine these outputs in order to identify functional landscapes. This will entail incorporating more site-specific information on species and ecosystems and use of air photos and field inventories.

Chapter 2 –Assessment Process

This section provides a brief overview of the principal steps used in developing an ecoregional assessment. More detail on methods can be found in later chapters and appendices.

An assessment framework developed by The Nature Conservancy (TNC) and other scientists (Groves et al. 2000, 2002) was used by seven technical teams: terrestrial communities and systems; freshwater systems; terrestrial plant species; terrestrial animal species; freshwater animal species; human footprint and other impacts to biodiversity; and geographic information systems (GIS)/data management. Each team contributed to the steps described below and adopted innovations where necessary to address specific data limitations and other challenges. The technical teams were coordinated and directed by an overarching group called the Core Team, which was comprised of team leads and other scientists and conservation professionals. Refer to Appendix 2 for Core Team and technical team members and advisors.

2.1 Identify Conservation Targets

Conservation targets were selected to represent the full range of biodiversity in the ecoregion and to include any elements of special concern. In the 1970s, TNC developed the concept of coarse-filter and fine-filter conservation targets for use in conservation planning (Jenkins 1996; Noss 1987). This approach hypothesizes that conservation of multiple, viable examples of all communities and ecological systems (coarse-filter targets) will also conserve most species that occupy them. This coarse-filter strategy is a way to compensate for the lack of detailed information on numerous poorly studied invertebrates and other organisms.

Fine-filter targets are species and special features that cannot be assumed to be captured by coarse-filter targets. Special efforts are required to ensure that fine-filter targets are represented in the conservation assessment. These targets are typically rare or imperiled species, but they can include wide-ranging species that require special consideration or species that occur in other ecoregions but have genetically important disjunct populations within the ecoregion of concern.

Coarse-filter targets have to be defined before they can be selected. There are many different classifications for ecological systems and plant associations. The communities and systems teams developed classifications that could be used throughout the ecoregion, and then identified a subset of these ecological systems and vegetation associations that should be targets. The plant and animal species teams each developed criteria to guide their selection of fine-filter targets. Details of the criteria used in selecting coarse- and fine-filter targets are provided in Chapter 3 and Appendix 6.

2.2 Assemble Information on the Locations of Targets

One of the challenges of ecoregional assessments is finding data that cover the whole ecoregion. In some cases, datasets from different jurisdictions have to be combined to obtain complete coverage. In other cases, data for a target may not be available from either British Columbia or Washington; consequently, that target may not be included in the analysis.

Data on target "occurrences" (i.e., the location, and in some cases, spatial extent of a separate population or example of a species or community) were assembled from a variety of sources. Most data were gathered from existing agency databases. The teams filled in data gaps by gathering other available information and by consulting specialists for specific targets or target groups. The assembled data for plant and animal targets were screened based on the date and spatial accuracy of the record. Records that were deemed too old or spatially imprecise were omitted from the analysis.

Decisions were then made about the best way to describe and map occurrences of each target. Targets were represented as specific location points, such as rare plant population locations, or polygons that showed the spatial extent of fine- or coarse-filter targets. The data were stored in a GIS. Refer to Appendix 5 for the list of targets and Appendix 12 for a detailed description of representing occurrence data in the analyses.

2.3 Set Goals for Each Target

The computer program MARXAN (Ball and Possingham 2000; Possingham et al. 2000), used to select a portfolio of conservation areas, requires that goals be set for each target. Conservation goals define the abundance and spatial distribution of viable target occurrences necessary to adequately conserve those targets in an ecoregion and provide an estimate of how much effort will be necessary to sustain those targets well into the future.

For assessment purposes, "goal" is defined as a numerical value associated with a species or system that describes how many populations, nest sites, or breeding sites (for species targets), or how much area (for systems targets) the portfolio should include to represent each target. The goal also describes how those target occurrences should be distributed across the ecoregion to best represent genetic diversity and environmental variation.

Establishing conservation goals is a difficult task. Information on most targets is limited, which makes it difficult to estimate the number and distribution of occurrences that are needed to ensure the target's survival. Hence, the goals cannot be treated as conditions that ensure long-term survival of species. However, goals are useful tools for assembling a portfolio of conservation areas that captures multiple examples of the ecoregion's biodiversity. The goals also provide a means of gauging the contribution of different portions of the ecoregion to the conservation of its biodiversity, and the progress of conservation in the ecoregion over time.

The North Cascades teams used criteria developed by TNC and NatureServe (Comer 2001, 2003) to set goals for target species in the ecoregion. Targets were grouped according to their geographic range relative to the ecoregion. As endemism decreases, goals decrease in rough proportion to the ecoregion's share of the global distribution of that target. This is done to ensure adequate representation of targets that are rare or whose spatial distribution is more limited to the North Cascades ecoregion.

There is no scientifically established method for setting goals for coarse-filter targets; therefore, the professional judgment of ecologists from the technical teams, the provincial Conservation Data Centre and state Natural Heritage Programs was used. These ecologists have settled on a standard goal of 30% of the historical extent for matrix-forming, large-patch, and linear ecological systems. The historical extent was defined as that circa 1850 (Comer 2003). Refer to Appendices 6 and 19 for details of how goals were developed. These goals were later adjusted by the technical teams based on how MARXAN performed in capturing terrestrial systems. In cases where there was significant change from historical extent or an increase or decrease in the area of the system, the default goal was adjusted. Goals for freshwater ecological systems were set at 30% of current extent.

2.4 Rate Conservation Suitability of Different Portions of the Ecoregion

The ecoregion was divided into thousands of 500 ha hexagons which are also referred to as "assessment units" (AUs). These are described in Appendix 13 and shown in Maps 6 and 9. AUs were compared using a "suitability index". This was a set of factors the team and other experts selected to determine the relative likelihood of conservation success within each AU. The factors included the extent of roads and developed areas, and the presence of dams, which would likely impact the quality of the habitat for native species. Others factors that would likely impact the cost of managing the area for conservation were also included. These included such variables as proximity to urban areas, the percent of public versus private lands, or the existence of established conservation areas. The factors chosen for the suitability index influenced the final selection of conservation areas; a different set of factors could have produced a different conservation portfolio. Also, some factors used in the suitability index required consideration of what are traditionally policy questions. For example, setting the suitability index to favour the selection of public over private land presumes a policy of using existing public lands to meet goals wherever possible, thereby minimizing the involvement of private or Aboriginal/tribal lands. The suitability index factors chosen for this assessment are documented in Chapter 4 and Appendix 13. Chapter 5 includes a sensitivity analysis for the terrestrial portfolio that illustrates how changes in the suitability index shape the final portfolio.

2.5 Assemble Terrestrial and Freshwater Portfolios

An ecoregional assessment incorporates hundreds of different targets at thousands of locations. The relative biodiversity value and conservation suitability of thousands of potential conservation areas must be evaluated; consequently, experts cannot select the most efficient and complementary set of conservation areas through simple inspection.

In order to address the complexity and large amount of data used in the assessment analyses, the Core Team used the optimal reserve selection algorithm MARXAN. MARXAN has been used in various terrestrial and aquatic conservation assessments around the world. It uses an optimization algorithm that finds reasonably efficient solutions for selecting a system of spatially cohesive reserves that meet a suite of ecological and site suitability criteria (Ball and Possingham 2000; Possingham et al. 2000).

Target occurrence and suitability data were attributed to each AU. For the terrestrial portion of the assessment, 500 ha hexagons were used, and target occurrence data in the form of points and polygons were attributed to the hexagons. Third-order watersheds were used as assessment units in the freshwater portion of the assessment, and target occurrence data were attributed to them. Data on suitability factors were also attributed to each hexagon and watershed.

MARXAN is designed to meet target goals in the smallest area possible while maximizing suitability. The algorithm begins by selecting a random set of assessment units, i.e., a random conservation portfolio. The model then explores improvements to this first portfolio by randomly adding or removing hexagons. At each iteration, the new portfolio is compared to the previous one, and the best one is accepted. The algorithm uses a method called simulated annealing (Kirkpatrick et al. 1983) to reject sub-optimal portfolios, which greatly increases the chance of converging on the most efficient portfolio. Typically, one run of the algorithm consists of 2 million iterations, and each output scenario (portfolio) is the result of 10 runs. Refer to Appendix 8 for more details on the MARXAN model.

2.6 Refine and Overlay the Portfolios

The freshwater and terrestrial conservation portfolios generated by MARXAN were reviewed and refined by the Core Team and other experts who were familiar with the ecoregion in order to address gaps in the input data or other limitations in the automated production of the portfolios. Feedback received from the expert reviews was used to modify the computer-generated portfolios.

The terrestrial and freshwater portfolios were then overlaid to determine where they overlapped. Areas of overlap could be used to infer greater importance of certain priority conservation areas, as they have the potential to capture both terrestrial and freshwater targets in one place.

2.7 Expert Review

Throughout the planning process, each technical team solicited expert input at workshops and through personal interviews (see list of experts in Appendix 3). Experts were asked to (1) review draft target criteria, target lists and target distributions and recommend additions and deletions to the target lists; (2) provide recommendations on modifications to the freshwater and terrestrial portfolios; and (3) provide species, communities, or systems datasets, if available.

During the portfolio review, experts' comments regarding modifications to the portfolios were recorded. The experts were also asked to identify which assessment unit or group of assessment units might best represent a potential conservation area. Members of the Core Team then reviewed the experts' comments and made final changes to the portfolios.

The experts also identified several needs including the verification of the MARXAN model results, refining the portfolios using local knowledge, and listing shortcomings in the modeling approach due to data errors and gaps (Chapters 8 and 9 discuss data gaps). All teams received additional review comments from many people. These individuals are listed in Appendices 2 and 3.

2.8 Prioritization of Portfolios

Limited resources and other social or economic considerations may make protection of the entire portfolio impractical. This situation can be addressed two ways. First, attention should focus on the most important conservation areas within the portfolio. This can be accomplished by prioritizing conservation areas. Second, decision makers should be given the flexibility to pursue other options when portions of the portfolio are too difficult to protect. Assigning a relative priority to all conservation sites in the portfolio will inform decision makers about their options for conservation action.

To facilitate prioritization of conservation areas, MARXAN was used to generate two indices that reflected the relative importance of every assessment unit: irreplaceability and conservation utility. Irreplaceability is an index that indicates the relative conservation value of a place (i.e., an assessment unit). Conservation utility is a function of both biodiversity value and the likelihood (cost) of successful conservation. For conservation utility, MARXAN is run with the AU costs incorporating the suitability index. The irreplaceability index was also incorporated into an irreplaceability versus vulnerability scatter plot that was used to prioritize conservation areas within the portfolio. Prioritization was undertaken separately for the terrestrial and freshwater portfolios. The methodology used to prioritize portfolios is detailed in Chapter 7.

Chapter 3 – Targets

The ecoregional conservation assessment process identifies a suite of viable native species and communities as the elements to be represented in an ecoregional portfolio of sites (Groves et al. 2000; Groves 2003). As previously noted, this represents the coarse-filter/fine-filter approach to biodiversity conservation developed by The Nature Conservancy and partners and refined through experience and planning. Both terrestrial and freshwater coarse-filter targets were used in designing the portfolio of conservation areas for the North Cascades ecoregion. Refer to Table 18 for a summary of all targets used in the terrestrial and freshwater assessments for the North Cascades ecoregion. The planning team's strategy with respect to coarse-filter conservation was to develop a landscape portfolio of sites that captured the size and extent of natural communities and terrestrial habitats so that natural processes such as fire and flood could continue to function across the ecoregion.

3.1 Terrestrial Targets

This section describes the processes used to select the plant communities, plant species, and animal species targets for the terrestrial environment and the results of that selection process. It also describes the process of combining and refining the results to create a terrestrial portfolio.

3.1.1 Coarse-filter Targets

Technical Team

The terrestrial plant communities and ecological systems team included experts from TNC, NatureServe, and the WNHP, and an independent consultant. The team members were

Mike Heiner	TNC, Seattle, WA
Gwen Kittel	NatureServe, Boulder, CO
Rex Crawford	WNHP, Olympia, WA
Matt Fairbarns	Aruncus Consulting, Victoria, BC

3.1.1.1 Terrestrial Ecological Systems

The technical team used ecological systems to represent the vegetation and habitat types at the coarsest scale in the ecoregional assessment. A brief conceptual definition of ecological systems follows. More detailed information can be found in Comer et al. (2003)[2].

A terrestrial ecological system is defined as a group of plant community types (associations) that tend to co-occur within landscapes with similar ecological processes, substrates, and/or environmental gradients (Comer et al. 2003; O'Neill 2001). Ecological processes include natural disturbances such as fire and flooding. Substrates may include a variety of soil surface and bedrock features, such as shallow soils, alkaline parent materials, sandy/gravelly soils, or peatlands [as described and classified by Natural Resource Conservation Service, U.S. Department of Agriculture (1998)]. Finally, environmental gradients include local climates, hydrologically defined patterns in coastal zones, arid grassland, desert areas, montane, alpine or subalpine zones (e.g., Bailey 1998, 1995; Takhtajan 1986). A given terrestrial ecological system will typically occur in a landscape at intermediate geographic scales of 10s to 1,000s of hectares and persist for 50 or more years. This temporal scale is similar to the "habitat type" approach used to describe

[2] Available from NatureServe's web site: http://natureserve.org/publications/usEcologicalsystems.jsp

potential vegetation (Daubenmire 1952; Pfister and Arno 1980), but it differs in that no "climax" vegetation is implied, and all seral components are explicitly included in the systems concept. Ecological system units are intended to provide "meso-scale" classification units for resource management and conservation applications (Walter 1985). They may serve as practical units on their own or in combination with classification units defined at different spatial scales.

Upland and wetland ecological system units are defined to emphasize the natural or semi-natural portions of the landscape. Areas with very little natural vegetation, such as agricultural row crops and urban landscapes, are excluded from the ecological system classification. The temporal scale or ecological boundaries chosen also integrate successional dynamics into each system unit. The spatial characteristics of ecological systems vary on the ground, but all fall into several recognizable and repeatable categories. With these temporal and spatial scales bounding the concept of ecological systems, multiple ecological factors—or diagnostic classifiers—may then be integrated to define each classification unit, not unlike the approach of Di Gregorio and Jansen (2000)[3].

Multiple environmental factors are evaluated and combined in different ways to explain the spatial occurrence of vegetation associations. Continental-scale climate as well as broad patterns in phytogeography are reflected in ecological division units that spatially frame the classification at subcontinental scales (e.g., Bailey 1998; Takhtajan 1986). Bioclimatic categories were integrated to consistently characterize life zones (e.g., maritime, lowland, montane, subalpine, and alpine). Within the context of biogeographic and bioclimatic factors, ecological composition, structure, and function are strongly influenced by factors determined by local physiography, landform, and surface substrate. Some environmental variables are described through existing, standard classifications (e.g., soil and hydrogeomorphology) and serve as excellent diagnostic classifiers for ecological systems (Brinson 1993; Cowardin et al. 1979; NRCS 1998). Recurrent juxtaposition of vegetation communities provides an additional input for multi-factor classification (Austin and Heyligers 1989).

Ecological classification ideally proceeds through several phases, including qualitative description, quantitative data gathering, analysis, and field-testing. The approach presented here is qualitative and rule-based, thereby setting the stage for subsequent quantitative work. Available interpretations of vegetation and ecosystem patterns across the study area were relied on, and associations of the International Vegetation Classification/National Vegetation Classification (IVC/NVC) were reviewed in order to help define the limits of ecological systems concepts (NatureServe 2005). In recent years, NatureServe ecologists have also tested how well a systems approach facilitates mapping of ecological patterns at intermediate scales across the landscape (Comer et al. 2002; Hall et al. 2001; Marshall et al. 2000; Menard and Lauver 2002; Moore et al. 2001; Nachlinger et al. 2001; Neely et al. 2001; Tuhy et al. 2002).

North Cascades Ecological Systems

By using the NatureServe Ecological System Classification (Comer et al. 2003), ecologists from WNHP and NatureServe developed a list of 29 ecological systems that occur in the North Cascades ecoregion and its buffer area. Appendix 11 contains descriptions for the 29

[3] Diagnostic classifiers (categories and examples): ecological divisions (continental bioclimate and phytogeography); bioclimatic variables (regional bioclimate); environment (landscape position, hydrogeomorphology, soil characteristics, specialized substrate); ecological dynamics (hydrologic regime, fire regime); landscape juxtaposition (upland-wetland mosaics); vegetation (vertical structure and patch type, composition of component associations, abundance of component association patches).

ecological systems, and includes ecological attributes, concept summaries and component plant associations.

Due to a lack of available spatial data the set of mapped targets was reduced to 14 matrix-forming, large patch, small patch and linear systems. The technical team developed a GIS model to map these 14 system targets, as described in Section 3.1.1.4 and in Appendix 9 and illustrated in Map 7. Spatial patterns are defined in Table 4. Table 7 lists these mapped targets, their characteristic spatial patterns, and the corresponding conservation goals.

Table 4. Spatial patterns used to describe terrestrial ecological systems and plant associations (adapted from Anderson et al. 1999)

Spatial Pattern	Definition	Range in Size
Matrix	Communities or systems that form extensive and contiguous cover, occur on the most extensive landforms, and typically have relatively wide ecological tolerances.	2,000 - 500,000 ha
Large Patch	Communities or systems that form large areas of interrupted cover. Typically not limited by localized environmental features. Disturbance regimes and successional processes are typically important in the formation and maintenance of these systems or communities.	50-2,000 ha
Small Patch	Communities or systems that form small, discrete areas of vegetation cover typically limited in distribution by localized environmental features.	1-50 ha
Linear	Communities or systems that occur as linear strips and are often ecotonal between terrestrial and aquatic systems.	NA

3.1.1.2 Rare Plant Association Targets

The technical team mapped 17 terrestrial and wetland plant associations as conservation targets based on element occurrence information maintained by the BC CDC and the WNHP. The CDC and WNHP records were reviewed and revised by Matt Fairbarns (Aruncus Consulting) and Chris Chappell (WNHP). Records that were considered to be too old or erroneous were eliminated. The resulting set of terrestrial plant community targets is listed in Table 8.

Data Collection

Available information on the known occurrences of individual plant communities and ecological systems varied considerably in quantity and quality both among associations and ecological systems and across jurisdictions. The best available data were compiled from a number of sources. Data sources are listed in Appendix 4.

Plant Associations

Known locations of rare natural communities, also known technically as plant association occurrence data, were obtained from the WNHP and BC CDC databases. Very few occurrences were documented, as shown in Table 8. This is because data collection has tended to focus on rare plant and animal species rather than on plant associations. The classification, survey, mapping, delineation and documentation of individual stands of rare and of-concern plant associations are relatively new to science and conservation biologists. Many more stands are known to occur on the landscape than are documented in conservation databases. Nonetheless, these limited datasets were used to capture small scale and rare natural communities rather than depending solely on the results of the coarse-filter analysis to represent them.

3.1.1.3 *Ecological Systems and Other Coarse-filter Criteria*

Five GIS maps were developed to represent vegetation diversity across the ecoregion. Information on methods and data sources used to create these layers is presented in Sections 3.1.1.4 to 3.1.1.9 and Appendix 9.1. The following layers were developed:

- Vegetation Map of Ecological Systems: An ecoregion-wide map of ecological systems was created by combining several existing vegetative coverages. Fourteen of the 29 ecological systems known to occur in the ecoregion could be mapped on an ecoregion-wide scale. Some map units were a combination of small patch systems (for example, montane shrubland and alpine systems). Areas which had no vegetation coverage were filled in with coarser data, and agriculture and urban areas were mapped as such.

- Riparian Areas Map: Ecoregional data for small scale wetlands (bogs, fens, riparian areas) were lacking, so a coverage was created by modeling riparian areas.

- Stratified Matrix-Forming Ecological Systems: To represent topographic variation within one system, finer scale Ecological Land Units were modeled so more detailed variation within any one ecological system could be captured (e.g., north vs. south facing slopes). Refer to Appendix 9.1 for details of this modeling process.

- Old-growth Forest Map: Remaining old-growth areas, regardless of which ecological system they belonged to, were also mapped. This information was overlaid on the map of ecological systems and these forests were specifically targeted for inclusion in the portfolio.

- Minimum Dynamic Areas: Lower elevation forests and upper montane forests were combined into two aggregated units to be able to select entire and adjoining watersheds to meet a need for large, landscape-scale preserves that are at least 30,000 ha in size. This minimum dynamic area is the threshold size required to sustain a natural or near natural fire regime in the future.

3.1.1.4 Target Representation

Vegetation Map of Ecological Systems

The geographic distributions of 14 upland systems were modeled as intersecting combinations of climate zone and existing vegetation. After cross-tabulating maps of climate zone and existing vegetation type, the technical team assigned each possible combination to an ecological system map unit, resulting in a tabular decision matrix that was translated into a GIS map. The GIS decision matrix and map were then subjected to several iterations of review and revision by experts in BC and WA. The GIS decision matrix is shown in Appendix 9.2**.**

Available source data varied considerably between BC and WA. In BC, climatic setting was represented by Biogeoclimatic Ecosystem Classification (BEC); existing vegetation was represented by the Broad Ecosystem Inventory (BEI). Together these are known as Broad Ecosystem Units (BEU). In WA, climatic setting was represented by the Shining Mountains Mapping Project vegetation zones; existing vegetation was represented by a vegetation map developed for the North Cascades Grizzly Bear Ecosystem Evaluation (NCGBE) and by the National Land Cover Dataset (NLCD). In order to accommodate the difference in spatial scale between the BC BEU data and the WA land cover data, both the NCGBE and NLCD were re-sampled with a 50 ha moving window to better approximate the 50 ha minimum mapping unit of the polygonal BEU data. Refer to Appendix 4 for details of the data sources.

Several additional datasets from WA were incorporated to make the following adjustments:

- the two North Pacific Douglas Fir-Western Hemlock Forest systems were divided between the Dry-Mesic and the Mesic-Wet according to Plant Association Groups (PAGs) (Henderson 2001);
- the two North Pacific Western Hemlock-Silver Fir Forest systems were distinguished as the Dry-Mesic and the Mesic according to orographic zones[4] delineated on a map from Henderson (1992, page 10); and,
- an occurrence of East Cascades Mesic Montane Mixed-Conifer Forest and Woodland in the Ross Lake Valley was manually delineated.

Finally, to remove degraded or recently converted occurrences of these upland systems, several ancillary GIS sets, specifically Baseline Thematic Mapping (BTM) in BC and the National Land Cover Dataset (NLCD) and Land Use and Land Cover dataset (LULC) in WA, were compiled to identify areas that had been recently logged or converted to urban or agricultural land use. Any system occurrences that coincided with the recently logged, urban or agricultural areas were re-assigned as such.

Alpine and Montane Composite Targets

Mapping the seven defined non-forest systems, listed below, presented a unique challenge for two reasons. First, vegetation maps derived from satellite imagery, which were used to map systems in WA, generally are not accurate in distinguishing these large-patch and small-patch occurrences from recent timber harvests. This is because the spectral signature of early-seral vegetation is similar to that of native assemblages such as herbaceous balds and bluffs, montane shrublands and grasslands, montane dry tundra and avalanche chutes. Second, BEU, the GIS dataset of existing vegetation types in BC, follows a thematic classification of non-forest vegetation types that does not match the corresponding GIS dataset in WA. Therefore, it was not possible to map these individual ecological systems accurately and consistently across the international border. Instead, two new map units were defined that would represent composites of the alpine vegetated systems and the montane non-forested vegetated systems, as shown below. These two composite map units function as terrestrial coarse-filter targets in the automated site selection. Table 5 provides details of the composite map units.

Table 5. New composite map units created from alpine and montane non-forested vegetation systems

Composite Map Unit	Vegetated System
Alpine composite map unit	North Pacific Alpine and Subalpine Dry Grassland (Large Patch)
	North Pacific Dry and Mesic Alpine Dwarf-Shrubland, Fell-field and Meadow (Large Patch)
Montane composite map unit	North Pacific Herbaceous Bald and Bluff (Small Patch)
	North Pacific Montane Grassland (Large Patch)
	North Pacific Montane Shrubland (Large Patch)
	Rocky Mountain Dry Tundra (Large Patch)
	North Pacific Avalanche Chute Shrubland (Large Patch)

[4] Related to, or caused by, physical geography (such as mountains or sloping terrain).

3.1.1.5 *Riparian Ecological Systems*

To map riparian systems, riparian areas were initially delineated with a GIS model according to flow accumulation and local topography. Next, this preliminary delineation was edited based on photo-interpretation of GeoCover satellite imagery. Lakes and land currently under agriculture or urban land use were removed, according to land use/land cover as represented by the BTM, NLCD and LULC. Finally, the remaining riparian areas were assigned to a lowland or montane riparian ecological system based on climatic zones represented by the Shining Mountains vegetation zones. The technical details of this method are described in Appendix 9.1.

3.1.1.6 *Stratifying Matrix-forming Systems (Ecological Land Units)*

Of the 14 upland ecological systems mapped, 5 matrix-forming systems covered most of the mapped area. They spanned broad physical gradients and thereby encompassed significant ecological and genetic variability. To represent this variability, a cluster analysis was done to classify the landscape using four topographic indices that are known to correspond to vegetation patterns and that are readily mapped from a digital elevation model (DEM). The resulting clusters identified map units that function to stratify the matrix-forming systems and thereby influence the automated selection of potential conservation areas. The four topographic indices are topographic position measured by a moving window of 300 m radius; topographic position measured by a moving window of 2,000 m radius; an index of annual clear-sky insolation (SolarFlux) (Rich et al. 1995); and slope.

In each of the four ecoregional sub-sections, the landscape was classified into nine abiotic units or landforms. This produced 36 abiotic map units ecoregion-wide that were used to stratify matrix-forming systems in the coarse-filter analysis. By stratifying the large area of matrix-forming ecological systems the spectrum of diversity found on all landforms could be captured. The technical details of this method are described in Appendix 9.1.

3.1.1.7 *Old-growth Forest*

The historical extent of old-growth forest has been significantly diminished in the ecoregion. Because old-growth forest provides critical habitat for a number of declining native species, it was treated as a specific coarse-filter target. To accomplish this, a GIS delineation of existing late-seral forest stands was developed. In BC, the delineation was based on stand-level age attributes specified by forest cover (TEM 1997). In WA, the delineation was based on basal diameter (quadratic mean diameter [QMD]) specified by the Interagency Vegetation Mapping Project (IVMP 2002).

3.1.1.8 *Minimum Dynamic Area (MDA)*

The terrestrial systems team conducted a literature review to determine the minimum dynamic area (MDA) terrestrial systems historically required to ensure survival or re-colonization of the ecological system following a natural disturbance that removes most or all individuals. This is determined by the ability of some number of individuals or patches to survive, and the size and severity of stochastic events (Pickett and Thompson 1978). MDAs were used to determine the minimum patch size of each terrestrial system to be captured by the MARXAN site selection algorithm. These goals were later adjusted by the team based on how the algorithm performed in meeting the goals when capturing terrestrial systems. In areas with at least 30,000 ha of continuous forest, mapped ecological systems were generalized into lower elevation forests and higher elevation forests, and a goal of 30% of each of these aggregated systems was set. Table 6 provides details of the mapped ecological systems that were aggregated.

Table 6. Mapped ecological systems that were generalized into aggregated systems

Generalized Aggregated System	Mapped Ecological System
Aggregate Lower Elevation Forests	North Pacific Maritime Mesic-Wet Douglas-Fir-Western Hemlock Forest
	North Pacific Maritime Dry-Mesic Douglas-Fir-Western Hemlock Forest
	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest
	East Cascades Mesic Montane Mixed Conifer Forest
Aggregate Higher Elevation Forests	North Pacific Maritime Mesic Subalpine Parkland
	North Pacific Mountain Hemlock Forest
	North Pacific Mesic Western Hemlock - Silver fir Forest

3.1.1.9 Setting Goals

MARXAN requires that goals be set for conservation targets. Ideally, the setting of these goals is an attempt to capture ecological and genomic variation across the ecoregion and to ensure species persistence by including a number of viable populations, all of which reduces the risk of extirpation. As yet, there is no scientific consensus about how much of an ecological system or an area of habitat is needed to maintain most species within an ecoregion (Soule and Sanjayan 1998).

Conservation goals are established for ecological systems at the ecoregion level and for each ecosection. This is to ensure that targets are represented across their natural distribution in the ecoregion so that the natural diversity of each ecological system is expressed. For ecological systems with small patch distributions and for rare communities considered as conservation targets, goals were established as numbers of occurrences to be represented within the portfolio. The number of occurrences varied for systems and communities depending on their distribution relative to the ecoregion, with distribution being classified as Endemic, Peripheral, Limited, or Widespread:

- ***Endemic:*** ≥ 90% of the species' global distribution falls within the ecoregion
- ***Peripheral:*** < 10% of the species' global distribution falls within the ecoregion
- ***Limited:*** the species' distribution is limited to 2–3 ecoregions
- ***Widespread:*** the species' global distribution falls within > 3 ecoregions

All small patch ecological systems goals were set at 3 occurrences per ecological section. Most of the large patch and matrix systems goals remained at 30% except for those systems that were deemed to be peripheral to the ecoregion or were well represented in large protected areas (such as North Pacific Mountain Hemlock Forest). Goals for ecological systems in the North Cascades ecoregion are listed in Table 7 and Appendices 5 and 6.

3.1.1.10 *Summary of Terrestrial Ecological Systems and Plant Communities*

Table 7. Mapped Terrestrial Ecological Systems with spatial pattern, conservation goal and area distribution (ha)

Map Unit Name	Spatial Pattern**	Goal	Mapped ha
North Pacific Montane Massive Bedrock, Cliff and Talus	Large/Small Patch	30%	62,474
North Pacific Maritime Mesic Subalpine Parkland	Large Patch	30%	154,673
North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest	Matrix-forming	30%	189,359
North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest	Matrix-forming / Large Patch	30%	558,779
North Pacific Mesic Western Hemlock-Silver Fir Forest	Matrix-forming	30%	418,929
North Pacific Dry-Mesic Silver Fir-Western Hemlock-Douglas-fir Forest	Matrix-forming	30%	607,503
North Pacific Mountain Hemlock Forest	Matrix-forming	30%	1,081,246
Northern Rocky Mountain Subalpine Dry Parkland	Large Patch	30%	25,546
East Cascades Mesic Montane Mixed-Conifer Forest and Woodland	Large Patch	30%	47,921
North Pacific Interior Spruce-Fir Woodland and Forest	Large Patch	10%	732
Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest	Matrix-forming	10%	1,183
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Large Patch	30%	158,994
North Pacific Lowland Riparian Forest and Shrubland	Linear	30%	57,351
North Pacific Montane Riparian Woodland and Shrubland	Linear	30%	20,228
Alpine composite *	Large and Small Patch	30%	27,085
Montane composite *	Large and Small Patch	30%	100,006
Aggregated Systems	**Minimum size**	**Goal**	
Aggregate Upper Elevation Forests***	30,000 ha	30%	1,654,849
Aggregate Lower Elevation Forests***	30,000 ha	30%	1,403,563

* these map units represent a composite of systems; see Section 3.1.1.4 for explanation
** see Table 4 for definition of spatial pattern types.
*** see Section 3.1.1.8 for explanation

Table 8. Rare Plant Community Associations

Source	Scientific Name	Common Name	G rank*	S rank*	# Element Occurrences
WNHP	*Carex (livida, utriculata) / Sphagnum* spp. Herbaceous Vegetation	Pale, Beaked Sedge / Sphagnum spp	G1?	S1	1
WNHP	*Carex aquatilis* var. *dives - Carex utriculata* Herbaceous Vegetation	Sitka Sedge - Northwest Territory Sedge	G3G4	S2	1
WNHP	*Carex cusickii - (Carex aquatilis* var. *dives) / Sphagnum spp*. Herbaceous Vegetation	Cusick's Sedge - (Sitka Sedge) / Sphagnum spp	G2	S1	1
WNHP	*Carex interior - Hypericum anagalloides* Herbaceous Vegetation	Inland Sedge - Bog St. John's Wort	G2?Q	S2?	1

Source	Scientific Name	Common Name	G rank*	S rank*	# Element Occurrences
WNHP	*Carex lanuginosa* Herbaceous Vegetation	Woolly Sedge	G5?	S1	1
WNHP	*Deschampsia caespitosa* Herbaceous Vegetation (Provisional)	Tufted Hairgrass	G4	S2?	1
WNHP	*Eriophorum chamissonis / Sphagnum* spp. Herbaceous Vegetation	Russet Cottongrass / Sphagnum spp	G4	S1	2
WNHP	*Ledum groenlandicum - Myrica gale / Sphagnum* spp. Shrubland	Bog Labrador-tea - Sweetgale / Sphagnum spp	G2	S1	1
WNHP	*Picea sitchensis / Polystichum munitum* Forest	Sitka Spruce / Swordfern	G4?	S2	2
WNHP	*Rhynchospora alba - (Vaccinium oxycoccus) / Sphagnum tenellum* Herbaceous Vegetation	Beakrush - (Bog Cranberry) / Sphagnum spp	G3	S2	2
WNHP	*Spiraea douglasii / Carex aquatilis* var. *dives* Shrubland	Douglas' Spirea / Sitka Sedge	G4	S2	1
WNHP	*Thuja plicata - Tsuga heterophylla / Lysichiton americanus* Forest	Western Redcedar - Western Hemlock / Skunkcabbage	G3	S2	5
WNHP	*Tsuga heterophylla - (Thuja plicata) / Ledum groenlandicum / Sphagnum* spp. Woodland	Western Hemlock - (Western Redcedar) / Bog Labrador-tea / Sphagnum spp	G2G3	S2	2
WNHP	*Tsuga mertensiana - Abies amabilis / Elliottia pyroliflorus* Woodland	Mountain Hemlock - Pacific Silver Fir / Copperbush	G3?	S2	2
BC CDC	*Picea sitchensis / Rubus spectabilis* Dry	Sitka Spruce / Salmonberry Dry	GNR	S1S2	2
BC CDC	*Quercus garryana - Acer macrophyllum - Prunus* spp.	Garry Oak - Bigleaf Maple - Cherry Species	GNR	S1	1
BC CDC	*Populus balsamifera* ssp. *trichocarpa / Salix sitchensis - Rubus parviflorus*	Black Cottonwood / Sitka Willow - Thimbleberry	GNR	S2	1

* See Appendix 1 - Glossary for G- and S-rank definitions

3.1.2 Terrestrial Fine-filter Plant Targets

Technical Team

The terrestrial fine-filter plants technical team was composed of the following people:

Shane Ford	British Columbia Conservation Data Centre (BC CDC)
Matt Fairbarns	Aruncus Consulting
John Floberg	The Nature Conservancy (TNC), Washington Field Office
Florence Caplow	Washington Natural Heritage Program (WNHP)

Decisions about species composition and data screening criteria were agreed upon by the plants technical team, and the interim outcomes were reviewed by other botanical experts in Washington and British Columbia.

3.1.2.1 *Selecting Plant Species Targets*

Fine-filter plant species targets were selected based on established selection criteria (TNC 2000) and the experience of the technical team members. The technical team established the following species-selection criteria for species found within the assessment area:

1. Plants listed by NatureServe as globally imperiled or critically imperiled (G1-G2);
2. Plants listed as S1 to S2 in British Columbia or Washington as well as S2-S3 plants that are tracked on both sides of the border;
3. Plants that are listed or are anticipated candidates for listing by the U.S. *Endangered Species Act* and/or the Canadian *Species at Risk Act*;
4. Plants that are endemic to the North Cascades or are disjuncts in the ecoregion (i.e., are absent from all adjacent ecoregions) and are tracked by BC CDC and/or WNHP;
5. Plants that exhibit significant, long-term declines in habitat/and or numbers, are subject to a high degree of threat, or may have unique habitat requirements that expose them to great risk; and
6. Species that are restricted to the North Cascades ecoregion or are disjunct and determined by expert recommendations but NOT tracked by WNHP or BC CDC.

The draft target list and criteria were sent to experts to review and provide recommendations for additions and deletions. Their comments were evaluated by the team and changes were made to produce a final targets list. Authorities included: Malcolm Martin, Botanist, Vernon, BC; Frank Lomer, Botanist, New Westminster, BC; Dr. Adolf Ceska, Botanist, Victoria, BC; Dr. Hans Roemer, Botanist, Victoria, BC; Dr. Mike Miller, Botanist, Revelstoke, BC; Jenifer Penny, Botanist, BC CDC, Victoria, BC; Laura Potash, Botanist, USDA Forest Service, Mount Baker-Snoqualmie National Forest, WA; and Mignonne Bivin, Plant Ecologist, North Cascades National Park, Marblemount, WA.

A subset of at-risk mosses and lichens was included in the list of fine-filter plant species. In BC, mosses and lichens were added if they were listed under the federal *Species At Risk Act* since these taxa are not currently tracked by the BC CDC. Mosses and lichens are tracked in Washington by the Natural Heritage Program; they were selected based on the criteria established for vascular plants.

A set of criteria was used to assess occurrence records for inclusion in the dataset. Occurrence records were excluded from the plants dataset if they:

1. had a locational uncertainty ≥ 10 km;
2. were collected and unconfirmed over 40 years ago;
3. were located in areas that have been highly modified (e.g., the area became a major population centre in the last 40 years)

Criteria such as the condition of the occurrence record or the seed banking capabilities of a species were not used because the information was not uniformly available for all records or species.

3.1.2.2 Setting Goals

Once the list of target species was established, the team went through the occurrence records – a tabular and spatial record for a given species – to determine which occurrences would be used to meet the goals for that species. The Nature Conservancy and NatureServe (Comer 2001, 2003) recommend goals for protecting specific numbers of occurrences of target species based on the extent of their distribution (e.g., endemic, limited, widespread or disjunct, peripheral) and their global conservation rank. These goal recommendations were adopted by the North Cascades Core Team as the default conservation goals that would define the mid-risk conservation portfolio. Refer to Appendices 5, 6 and 19 for details of these conservation goals.

3.1.2.3 Results

In total**,** 98 vascular plants, 4 lichens, 3 mosses, and 2 clubmosses were selected as targets (Table 9); however, many of them lacked occurrence records. Despite its proximity to major urban centres, fewer floristic studies have been conducted in the North Cascades Ecoregion than in other ecoregions in Washington and southern British Columbia.

Table 9. North Cascades Fine-filter Plant Targets

Common Name	Scientific Name	ELCODE	G RANK
Nonvascular Plants			
Cryptic Paw	*Nephroma occultum*	NLLEC1C050	G3
Lescur's Bartramiopsis Moss	*Bartramiopsis lescurii*	NBMUS0T010	G3G5
Luminous Moss	*Schistostega pennata*	NBMUS6P010	G3G5
Navel Lichen	*Umbilicaria decussata*	NLLEC5N240	G3?
Oldgrowth Specklebelly	*Pseudocyphellaria rainierensis*	NLLEC3B060	G3
Poor Pocket Moss	*Fissidens pauperculus*	NBMUS2W0U0	G3
Witch's Hair Lichen	*Alectoria nigricans*	NLTEST7860	G5
Vascular Plants			
Alaska Harebell	*Campanula lasiocarpa*	PDCAM020F0	G5
Alpine Anemone	*Anemone drummondii var. drummondii*	PDRAN04061	G4T4
Arctic Aster	*Aster sibiricus var. meritus*	PDASTEB030	G5T5
Bearded Sedge	*Carex comosa*	PMCYP032Y0	G5
Black Lily	*Fritillaria camschatcensis*	PMLIL0V050	G5
Blue Vervain	*Verbena hastata var. scabra*	PDVER0N0E2	G5T5
Blunt-sepaled Starwort	*Stellaria obtusa*	PDCAR0X0U0	G5
Bog Clubmoss	*Lycopodiella inundata*	PPLYC03060	G5
Brandegee's Lomatium	*Lomatium brandegeei*	PDAPI1B040	G3?
Brewer's Monkey-flower	*Mimulus breweri*	PDSCR1B0N0	G5
Canyon Bog-orchid	*Platanthera sparsiflora*	PMORC1Y0N0	G4G5
Cascade Parsley Fern	*Cryptogramma cascadensis*	PPADI0B040	G5
Choris' Bog-orchid	*Platanthera chorisiana*	PMORC1Y030	G3G4
Cliff Paintbrush	*Castilleja rupicola*	PDSCR0D2U0	G2G3
Clubmoss Cassiope	*Cassiope lycopodioides*	PDERI07020	G4
Cooley's Buttercup	*Ranunculus cooleyae*	PDRAN0S010	G4
Corrupt Spleenwort	*Asplenium adulterinum*	PPASP02230	G3?
Creeping Snowberry	*Gaultheria hispidula*	PDERI0F010	G5
Curved Woodrush	*Luzula arcuata*	PMJUN02030	G5

Common Name	Scientific Name	ELCODE	G RANK
Dwarf Groundsmoke	*Gayophytum humile*	PDONA09050	G5
Elegant Jacob's-ladder	*Polemonium elegans*	PDPLM0E090	G4
Elmera	*Elmera racemosa var. racemosa*	PDSAX0B012	G4G5T4
Enander's Sedge	*Carex lenticularis var. dolia*	PMCYP037A3	G5T3Q
Few-flowered Sedge	*Carex pauciflora*	PMCYP03A50	G5
Field Dodder	*Cuscuta pentagona*	PDCUS01140	G5
Flat-leaved Bladderwort	*Utricularia intermedia*	PDLNT020A0	G5
Flowering Quillwort	*Lilaea scilloides*	PMJCG01010	G5?
Geyer's Onion	*Allium geyeri var. tenerum*	PMLIL02102	G4G5TNR
Giant Helleborine	*Epipactis gigantea*	PMORC11010	G3G4
Golden Draba	*Draba aurea*	PDBRA110E0	G5
Gray's Bluegrass	*Poa arctica ssp. arctica*	PMPOA4Z085	G5T3T5
Green-fruited Sedge	*Carex interrupta*	PMCYP036L0	G3G4
Kruckeberg's Holly Fern	*Polystichum kruckebergii*	PPDRY0R0C0	G4
Lace Fern	*Cheilanthes gracillima*	PPADI090B0	G4G5
Lance-fruited Draba	*Draba lonchocarpa var. thompsonii*	PDBRA111F2	G5T3T4
Lance-leaved Figwort	*Scrophularia lanceolata*	PDSCR1S050	G5
Large Canadian St. John's-wort	*Hypericum majus*	PDCLU03120	G5
Large-awn Sedge	*Carex macrochaeta*	PMCYP03820	G5
Leafy Mitrewort	*Mitella caulescens*	PDSAX0N020	G5
Least Moonwort	*Botrychium simplex*	PPOPH010E0	G5
Lesser Bladderwort	*Utricularia minor*	PDLNT020D0	G5
Long-styled Sedge	*Carex stylosa*	PMCYP03D50	G5
Marginal Wood Fern	*Dryopteris marginalis*	PPDRY0A0K0	G5
Menzies' Burnet	*Sanguisorba menziesii*	PDROS1L030	G3G4
Mountain Sneezeweed	*Helenium autumnale var. grandiflorum*	PDAST4L031	G5TNR
Nodding Saxifrage	*Saxifraga cernua*	PDSAX0U0B0	G4
Nodding Semaphoregrass	*Pleuropogon refractus*	PMPOA4Y080	G4
Olney's Bulrush	*Schoenoplectus americanus*	PMCYP0Q020	G5
Oniongrass	*Melica bulbosa var. bulbosa*	PMPOA3X031	G5TNRQ
Pacific Waterleaf	*Hydrophyllum tenuipes*	PDHYD08070	G4G5
Phantom Orchid	*Cephalanthera austiniae*	PMORC0F010	G4
Pointed Broom Sedge	*Carex scoparia*	PMCYP03C90	G5
Poor Sedge	*Carex magellanica ssp. irrigua*	PMCYP03G31	G5T5
Pull-up Muhly	*Muhlenbergia filiformis*	PMPOA480N0	G5
Purple-marked Yellow Violet	*Viola purpurea var. venosa*	PDVIO041S1	G5T4T5
Regel's Rush	*Juncus regelii*	PMJUN012D0	G4?
Scalepod	*Idahoa scapigera*	PDBRA1G010	G5
Several-flowered Sedge	*Carex pluriflora*	PMCYP03AT0	G4
Short-fruited Smelowskia	*Smelowskia ovalis*	PDBRA2D040	G5
Skunk Polemonium	*Polemonium viscosum*	PDPLM0E0M0	G5
Slender Gentian	*Gentianella tenella ssp. tenella*	PDGEN07072	G4G5T4
Slender Spike-rush	*Eleocharis nitida*	PMCYP09180	G3G4
Small Northern Bog-orchid	*Platanthera obtusata*	PMORC1Y0J0	G5
Small-fruited Willowherb	*Epilobium leptocarpum*	PDONA060F0	G5

Common Name	Scientific Name	ELCODE	G RANK
Smoky Mountain Sedge	*Carex proposita*	PMCYP03B60	G4
Smooth Willowherb	*Epilobium glaberrimum ssp. fastigiatum*	PDONA06091	G5TNR
Snow Bramble	*Rubus nivalis*	PDROS1K4S0	G4?
Soft-leaved Willow	*Salix sessilifolia*	PDSAL022Q0	G4
Spleenwort-leaved Goldthread	*Coptis aspleniifolia*	PDRAN0A010	G5
Stalked Moonwort	*Botrychium pedunculosum*	PPOPH010T0	G2G3
Steer's Head	*Dicentra uniflora*	PDFUM040A0	G4?
Stiff-leaved Pondweed	*Potamogeton strictifolius*	PMPOT03110	G5
Tall Bugbane	*Cimicifuga elata*	PDRAN07030	G2
Thompson's Chaenactis	*Chaenactis thompsonii*	PDAST200J0	G2G3
Three-leaved Lewisia	*Lewisia triphylla*	PDPOR040H0	G4?
Treelike Clubmoss	*Lycopodium dendroideum*	PPLYC010B0	G5
Triangular-lobed Moonwort	*Botrychium ascendens*	PPOPH010S0	G2G3
Umbellate Starwort	*Stellaria umbellata*	PDCAR0X120	G5
Ussurian Water-milfoil	*Myriophyllum ussuriense*	PDHAL040E0	G3
Vancouver Island Beggarticks	*Bidens amplissima*	PDAST18020	G3
Washington Springbeauty	*Claytonia washingtoniana*	PDPOR030U0	G2G4
Water Lobelia	*Lobelia dortmanna*	PDCAM0E0C0	G4G5
Water-pepper	*Polygonum hydropiperoides*	PDPGN0L170	G5
Western Mannagrass	*Glyceria occidentalis*	PMPOA2Y0D0	G5
White Wintergreen	*Pyrola elliptica*	PDPYR04040	G5
Woodland Penstemon	*Nothochelone nemorosa*	PDSCR1F010	G5
Woody-branched Rockcress	*Arabis lignifera*	PDBRA06120	G5

3.1.3 Terrestrial Fine-filter Animal Targets

Technical Team

The terrestrial fine-filter animals team was led by Jeff Lewis, Wildlife Biologist with the Washington Department of Fish and Wildlife. Many regional biologists, taxa specialists, data managers, and ecoregional assessment specialists were consulted during this assessment (Table 10).

Table 10. Experts who reviewed target species lists, provided data, and/or attended goal-setting meetings for the North Cascades Ecoregional Assessment

Expert	Title	Affiliation
Joe Buchanan	Wildlife Biologist	Washington Department of Fish and Wildlife
Mike Davison	District Wildlife Biologist	Washington Department of Fish and Wildlife
John Fleckenstein	Zoologist	Washington Natural Heritage Program, Olympia
Laura Friis	Species Specialist	BC Ministry of Water, Land and Air Protection
Lisa Hallock	Herpetologist	Washington Natural Heritage Program, Olympia
Jared Hobbs	Ecosystem Specialist	BC Ministry of Water, Land and Air Protection
Ronald Holmes	Ecologist	North Cascades National Park
Jeff Hoyt	Data Coordinator	BC Ministry of Water, Land and Air Protection
Pierre Iachetti	Director of Conservation Planning	Nature Conservancy of Canada
Bill Jex	Ecosystems Technician	BC Ministry of Water, Land and Air Protection
Gary Kaiser	Ornithologist	Nature Conservancy of Canada

Expert	Title	Affiliation
Robert Kuntz	Wildlife Biologist	North Cascades National Park
Jeff Lewis	Wildlife Biologist	Washington Department of Fish and Wildlife
Eric Lofroth	Ecosystem Specialist	BC Ministry of Water, Land and Air Protection
Kelly McAllister	District Wildlife Biologist	Washington Department of Fish and Wildlife
Erica McClaren	Ecosystem Biologist	BC Ministry of Water, Land and Air Protection
Ruth Milner	District Wildlife Biologist	Washington Department of Fish and Wildlife
Jesse Plumage	Forest Wildlife Biologist	Mt. Baker-Snoqualmie National Forest
Ann Potter	Wildlife Biologist	Washington Department of Fish and Wildlife
Leah Ramsay	Program Zoologist	BC Conservation Data Centre
Glenn Sutherland	Wildlife Biologist	Cortex Consultants, Vancouver, BC
Sairah Tyler	Consultant	Nature Conservancy of Canada
Ross Vennesland	Species at Risk Biologist	BC Ministry of Water, Land and Air Protection
George Wilhere	Wildlife Biologist	Washington Department of Fish and Wildlife
Elke Wind	Consulting Biologist	E. Wind Consulting, Nanaimo, BC

3.1.3.1 Terrestrial Animal Target Selection

Animal species were selected as fine-filter targets if they met one or more selection criteria including: globally imperiled species (G1-G3 ranked species; refer to Appendix 1 - Glossary for Global-rank definitions); federally listed threatened or endangered species; IUCN red list species; species of special concern (declining, endemic, disjunct, vulnerable, keystone, indicator, or wide-ranging species); species aggregations; and biodiversity hotspots. Two other selection criteria were added to this list. They identify sub-nationally imperiled species (S1-S3 ranked species) and bird species that have a Partners In Flight (PIF) conservation status score of ≥23 (see Panjabi et al. 2005). PIF conservation status scores are the sum of seven biological/ecological factors, and scores ≥23 reflect significant conservation concern for a species (Mehlman and Hanners 1999). Species with PIF conservation scores of 19–22 were also considered as targets if they had a score of 5 for either the breeding area importance factor or the population decline factor. While some criteria clearly indicated that a species should be selected as a target (e.g., federally listed as endangered), other criteria can be more subjective (e.g., vulnerable or declining) and thus require confirmation by experts.

Using the above criteria, a draft target list was developed that included information about species status by state, province and country; global and sub-national ranks; and distribution. The list included species from five taxonomic groups: amphibians, birds, mammals, butterflies and molluscs. The draft list and review instructions were sent to regional biologists and taxa experts in British Columbia and Washington (Table 10). The review comments they provided allowed the list to be refined, but they also raised questions about the inclusion of other targets. After extensive review and revision, the final target list included 81 target species (Table 12): 2 amphibians, 26 birds, 16 mammals, 13 butterflies, and 24 molluscs. While most species were selected based upon a rank or status criteria, a number of birds were selected because of their PIF score.

Terrestrial Animal Data Collection and Preparation

Species occurrence data for target species were collected across the ecoregion. Data for the BC portion of the ecoregion were provided by the BC CDC; the BC Ministry of Water, Land and Air Protection; and five independent researchers. Data for the Washington portion of the ecoregion were provided by the Washington Department of Fish and Wildlife, Mt. Baker-Snoqualmie National Forest, and Washington Natural Heritage Program. Refer to Appendix 4 for a full list of the data sources.

Most occurrence data were submitted in a GIS data format or were converted to a GIS data format. Occurrence data were screened to eliminate data that were >20 years old, spatially inaccurate (accuracy of >1 km), or incomplete. Data for several species (e.g., northern goshawk, marbled murrelet in Washington, golden eagle, great blue heron) were high-graded so that only documented occurrences of reproduction were included.

3.1.3.2 Setting Goals

The Core Team selected conservation goals for terrestrial animal targets based on modifications of TNC/NatureServe-derived goal scenarios (Comer 2001, 2003; Appendix 19). These TNC/NatureServe goals were used as a measure of representation of a species' occurrence data in the site selection analysis unless more specific recommendations, such as those found in population viability analyses, recovery goals, or a consensus recommendation by experts, were available. Because very few species had alternative recommendations for goals, the TNC/NatureServe goals were commonly used to represent target species. The goals used for this assessment were based on the goals that represent the "Mid-Risk" scenario in Table 11. For species represented by element occurrence data, goal values were based on either the number of populations (P), or the number of nests (N) for some bird targets. The TNC/NatureServe goals worked well for species represented by element occurrence data but were problematic for species represented by area data such as modeled habitat area, large population centres, or recovery zones. For these species, goals were based on the percent of the area to be captured in the site selection process based on recovery goals or expert recommendations. Refer to Table 11 and Appendices 5, 6 and 19 for further details on target goals.

Table 11. Conservation goals for terrestrial fine-filter animal targets (modified from Comer, 2003).

Distribution Relative to Ecoregion	Matrix, Large Patch and Linear Ecological Systems	Small Patch Ecological Systems, All Rare Communities, and Fine Filter Targets
	Area or Length, per Ecosection or Ecological Drainage Unit	Number of Occurrences
	"Mid- Risk" Scenario	"Mid- Risk" Scenario
Endemic	30% of historical	*P*: 50 *N*: 125
Limited		*P*: 25 *N*: 67
Widespread		*P*: 13 *N*: 38
Peripheral		*P*: 7 *N*: 23

3.1.3.3 Results

Data were available for 43 of the 81 (53%) target species in the site selection analysis (Table 12), although a number of these were represented by only one documented occurrence. Thirty-eight of the 43 (88%) species were represented by occurrence data, whereas 6 species were represented by area-based data (i.e., recovery zones, modeled habitat, critical winter range, population centres). Marbled murrelets were represented by occurrence and area-based data. Among those species represented by area-based data, two were represented by recovery zone data (grizzly bears and lynx), two by population centres and critical range (mountain goats and Roosevelt elk) and four by modeled habitat (fishers, grizzly bears, marbled murrelets and northern spotted owls).

Twenty-nine of the 38 (76%) species represented by occurrence data had too few occurrences to meet the TNC/NatureServe recommended goals. For those species, the site selection analysis sought to capture every occurrence. The goals for Fisher, Mountain goat, and Roosevelt elk were set at the TNC/NatureServe goal recommendation of 30% of habitat areas used to represent these species. The goals for Marbled murrelet in BC and Lynx exceeded the TNC/NatureServe recommended goal of 30% of habitat (Appendix 5). At the terrestrial fine filter animals experts workshop in WA, lynx goals were set to capture 75% of the lynx recovery zones that fall within the ecoregion in WA. There were no conservation goals set for lynx in BC as it is not a species of concern in the province. For Marbled murrelets, experts recommended a goal of 100% of the occupancy detections in Washington, and 85% of the modeled suitable nesting habitat in BC. The experts team in BC made this 85% recommendation based on the status and conservation concerns for the species. Refer to Appendices 2 and 3 for the lists of experts involved in the terrestrial fine filter animals analysis.

Table 12. Terrestrial fine-filter animal targets for the North Cascades Ecoregion

Common Name	Scientific Name	ELCODE	G RANK
Amphibians			
Cascades frog	*Rana cascadae*	AAABH01060	G3G4
Western toad ts	*Bufo boreas*	AAABB01030	G4
Birds			
Bald eagle nests	*Haliaeetus leucocephalus*	ABNKC10010	G5
Bald eagle roosts	*Haliaeetus leucocephalus*	ABNKC10010	G5
Band-tailed pigeon	*Columba fasciata*	ABNPB01080	G4
Barrow's goldeneye	*Bucephala islandica*	ABNJB18020	G5
Common Loon	*Gavia immer*	ABNBA01030	G5
Golden Eagle	*Aquila chrysaetos*	ABNKC22010	G5
Great blue heron	*Ardia herodius fannini*	ABNGA04010	G5T4
Harlequin duck	*Histrionicus histrionicus*	ABNJB15010	G4
Marbled murrelet	*Brachyramphus marmoratus*	ABNNN06010	G3G4
Marbled murrelet habitat	*Brachyramphus marmoratus*	ABNNN06010	G3G4
Northern goshawk	*Accipiter gentilis laingi*	ABNKC12061	G5
Northern spotted owl	*Strix occidentalis caurina*	ABNSB12011	G3T3
Northern spotted owl Nests	*Strix occidentalis caurina*	ABNSB12011	G3T3
Peregrine falcon	*Falco peregrinus anatum*	ABNKD06071	G4T3
Red breasted sapsucker	*Sphyrapicus ruber*	ABNYF05020	G5
Sandhill Crane	*Grus canadensis*	ABNMK01010	G5
Vaux's swift	*Chaetura vauxi*	ABNUA03020	G5
White-tailed ptarmigan	*Lagopus leucurus*	ABNLC10030	G5
Butterflies			
Arctic blue	*Plebejus glandon*	IILEPH0050	G5
Astarte fritillary	*Boloria astarte*	IILEPJ7120	G5
common branded skipper	*Hesperia comma*	IILEP65034	G5
lustrous copper	*Lycaena cuprea henryae*	IILEPC1020	G5
Melissa arctic	*Oeneis melissa*	IILEPP1100	G5
Vidler's alpine	*Erebia vidleri*	IILEPN8010	G4G5

Common Name	Scientific Name	ELCODE	G RANK
Mammals			
Fisher*	*Martes pennanti*	AMAJF01020	G5
Gray wolf	*Canis lupus*	AMAJA01030	G4
Grizzly bear a*	*Ursus arctos horribilis*	AMAJB01021	G4T3T4
Grizzly bear b*	*Ursus arctos horribilis*	AMAJB01021	G4T3T4
Lynx	*Lynx canadensis*	AMAJH03010	G5
Mountain goat	*Oreamos americanus*	AMALE02010	G5
Mtn beaver rainieri	*Aplodontia rufa rainieri*	AMAFA01014	G5T4
Mtn beaver rufa	*Aplodontia rufa rufa*	AMAFA01015	G5T4?
Roosevelt elk	*Cervus canadensis*	AMALC01010	G5T4
Townsend's big-eared bat	*Coryhorhinus townsendii*	AMACC08010	G4
Trowbridge's shrew	*Sorex trowbridgii*	AMABA01220	G5
Wolverine	*Gulo gulo*	AMAJF03012	G4
Molluscs			
Conical Spot	*Punctum randolphii*	IMGAS47050	G4
Northern Tightcoil	*Pristiloma arcticum*	IMGAS80120	G3G4
Oregon Forestsnail	*Allogona townsendiana*	IMGAS07060	G3G4
Pacific Sideband	*Monadenia fidelis*	IMGAS21020	G4G5
Pygmy Oregonian	*Cryptomastix germana*	IMGAS36120	G3G4
Robust Lancetooth	*Haplotrema vancouverens*	IMGASC7030	G5
Striated Tightcoil	*Pristiloma stearnsii*	IMGAS47050	G3
Western Flat whorl	*Planogyra clappi*	IMGAS80010	G3G4
Western thorn	*Carychium occidentale*	IMGAS93020	G3G4

* Denotes a retrospective analysis target (see Section 6.7). Retrospective targets were not used in the MARXAN analyses but were used in a post hoc assessment to see how well their habitats were captured by the portfolio results.

3.2 Freshwater Targets

This section describes the ecoregional assessment results for the ecosystems and animal species in the freshwater environment and the processes used by the assessment teams for producing them. The section also describes the process of combining and refining these results to create a freshwater portfolio.

3.2.1 Freshwater Coarse-filter Targets

Technical Team

The freshwater coarse-filter technical team was composed of the following people:

Bart Butterfield	GIS Consultant
Kristy Ciruna	Nature Conservancy of Canada
Dušan Markovic	MTS Consulting
Peter Skidmore	The Nature Conservancy, Washington Field Office

3.2.1.1 Freshwater Ecosystems

Freshwater coarse-filter targets are freshwater ecosystems that consist of a group of strongly interacting freshwater and riparian/near-shore communities held together by shared physical habitat, environmental regimes, energy exchanges, and nutrient dynamics. They vary in their spatial extent, have indistinct boundaries, and can be hierarchically nested within one another depending on spatial scale (e.g., headwater lakes and streams are nested within larger coastal river systems). The features that most distinguish freshwater from terrestrial ecosystems are their variability in form and their dynamic nature. Where they exist (e.g., a migrating river channel) and when they exist (e.g., seasonal ponds) often changes within a time frame that we can experience. Freshwater ecosystems are nearly always connected to and dependent upon one another, and as such they form drainage networks that constitute even larger ecological systems or ecological drainage units (EDUs) depicted in Maps 4 and 5. Freshwater ecosystems exist in many different forms depending upon the climate, geology, vegetation, and other features of the watersheds in which they occur. In very general terms, freshwater ecosystems can be defined by three major groups: standing-water ecosystems (e.g., lakes and ponds); flowing-water ecosystems (e.g., rivers and streams); and freshwater-dependent ecosystems that more closely interface with the terrestrial ecosystems (e.g., wetlands and riparian areas).

Freshwater ecosystems support an exceptional concentration of biodiversity. Species richness is greater relative to habitat extent in freshwater ecosystems than in either marine or terrestrial ecosystems. Freshwater ecosystems contain approximately 12% of all species and almost 25% of all vertebrate species (Stiassny 1996). Freshwater species include a wide variety of plants, fishes, mussels, crayfish, snails, reptiles, amphibians, insects, micro-organisms, birds, and mammals that live underwater or spend much of their time in or on the water. Many of these species depend upon the physical, chemical, and hydrological processes and biological interactions within freshwater ecosystems to trigger their various life cycle stages (e.g., spawning behaviour of a specific fish species might need to be triggered by adequate flooding at the right time of the year, for a sufficient duration, and within the right temperature range, etc.).

Almost all terrestrial animal species depend on freshwater ecosystems for water, food and various aspects of their life cycles. In addition, freshwater ecosystems provide food, drinking water, irrigation, electricity, waste removal, and transportation; recreation sites; and areas that provide a sense of place and spiritual observance, all of which form the basis of our economies and social values.

3.2.1.2 Methods [5]

The types and distributions of freshwater ecosystems are characterized based on abiotic factors that have been shown to influence the distribution of species and the spatial extent of freshwater community types. This method aims to capture the range of variability of freshwater system types by characterizing different combinations of physical habitat and environmental regimes that potentially result in unique freshwater ecosystem and community types. It is virtually impossible to build a freshwater ecosystem classification founded on biological data since freshwater communities have not been identified in most places, and there is generally a lack of adequate survey data for freshwater species. Given that freshwater ecosystems are themselves important targets for conservation, serving as a coarse-filter target and environmental context for species and communities, a classification

[5] Note: Puget Sound EDU methods and results are found in Appendix 10 as they were derived for a separate ecoregional assessment.

approach that identifies and maps the diversity and distribution of these systems is a critical tool for comprehensive conservation and resource management planning. An additional advantage of such an approach is that data on physical and geographic features (e.g., hydrography, land use and soil types, roads and dams, topographic relief, precipitation), which influence the formation and current condition of freshwater ecosystems, is widely and consistently available.

The freshwater ecosystem classification framework is based largely on The Nature Conservancy's classification framework for aquatic ecosystems (Higgins et al. 2003). The framework classifies environmental features of freshwater landscapes at two spatial scales, and loosely follows the hierarchical model of Tonn (1990) and Maxwell et al. (1995). It includes ecological drainage units that take into account factors associated with regional drainage patterns (e.g., zoogeography, climatic, and physiographic), as well as meso-scale units (coarse-scale freshwater systems) that take into account dominant environmental and ecological processes occurring within a watershed.

Nine abiotic variables were used to delineate freshwater ecosystem types that capture the major abiotic drivers of freshwater systems: accumulative precipitation yield, drainage area, lake and wetland influence, glacial influence, modeled water temperature, modeled hydrologic regime, geology, and mainstem and tributary stream gradient. Table 13 describes each variable and identifies its data source. These variables are widely accepted in the literature as being the dominant variables shaping coarse-scale freshwater systems and their associated communities; they also strongly co-vary with many other important physical processes (Vannote et al. 1980; Mathews 1998; Poff and Ward 1989; Poff and Alan 1995; Lyons 1989; Hart and Finelli 1999; Lewis and Magnuson 1999; Newall and Magnuson 1999; Brown et al. 2003).

Table 13. Summary of data types used in North Cascades freshwater ecosystem classification

VARIABLE	DESCRIPTION	SOURCE
Accumulative precipitation yield	Accumulative precipitation yield per upstream drainage	ClimateSource
Drainage Area	Accumulative drainage area per upstream drainage	BC Watershed Atlas; USGS HUC calculated watersheds
Percentage of lake area to watershed polygon area	Percentage of lake area in each watershed polygon	BC Watershed Atlas; NHD dataset
Percentage of wetland area to watershed polygon area	Percentage of wetland area in each watershed polygon	BC Watershed Atlas; NHD dataset
Percent glacial influence	Percentage of accumulative upstream drainage area that is currently glaciated	BC Watershed Atlas; NHD dataset
Water temperature	Modeled water temperature classes based on air temperature, glacial influence and lake influence	ClimateSource; BC Watershed Atlas
Hydrologic Regime	Modeled hydrologic regime classes based on temperature and precipitation data	ClimateSource; BC Watershed Atlas
Geology	Percentage of accumulative upstream drainage in each of the 5 geology classes	BC Ministry of Energy and Mines at 1:250,000; WA DNR 1:100,000
Mainstem and Tributary Stream Gradient	Percentage of mainstem and tributary reaches of each watershed polygon in each of 6 gradient classes	BC Watershed Atlas, and BC 25m DEM; USGS HUC

Defining Freshwater Ecosystems

Freshwater ecosystems are defined using a statistical cluster analysis. That is, watersheds are grouped together based on their relative similarity, and each group is defined as a unique ecosystem type. Descriptive statistics (mean, standard deviation, skewness, and variance) were calculated for each variable. Variables that were highly skewed (skewness values ≥2) were log 10 transformed to help meet the assumptions of normality for parametric statistics. Variability in categorical variables such as gradient classes, biogeoclimatic zones, and geology classes was reduced into two continuous axes using nonmetric multidimensional scaling. All variables were normalized for proportional comparisons between variables. Cluster analysis was performed on all normalized variables (agglomerative hierarchical clustering [Sorensen, flexible beta of –0.25], and 12 freshwater system types were selected (Map 9). Table 14 describes the variables and categories used in the classification of freshwater ecosystem types in the North Cascades ecoregion.

Table 14. Categories developed for quantitative data used in North Cascades freshwater ecosystem classification

Variable	Categories
Drainage Area (km^2)	Low =10-100; Moderate = 100-1,000, High = 1,000-10,000; Very High = 10,000-100,000, >100000
Accumulative Precipitation Yield	Low = >100,000,000; Moderate = 100,000,000-1,000,000,000; High = 1,000,000,000-10,000,000,000; Very High = >100,000,000,000
Mainstem Gradient	Shallow = <2%; Moderate = 2 - 16%; Steep = >16%
Tributary Gradient	Shallow = <2%; Moderate = 2 - 16%; Steep = >16%
Lake Influence	Low = <1% of watershed unit area; Moderate = 1 - 10%; High = 10 - 100%
Wetland Influence	Low = <1% of watershed unit area; Moderate = 1 - 10%; High = 10 - 100%
Glacial Influence	None; Low = <1.0 % of upstream drainage; Moderate = 1.0 - 5.0%; High = >5.0%

Freshwater Aquatic Assessment Units – BC Portion: Vertical Stacking

One of the components required when using automated optimized site selection programs such as MARXAN is a boundary file (*bound.dat*). The purpose of the boundary file is to allow the program to attempt to select contiguous assessment units in an effort to better represent or capture landscape scale priority conservation areas (Schindel, 2004). This method generally works well when dealing with terrestrial assessment units, but has the potential to work poorly when dealing with freshwater aquatic assessment units (AAUs) – such as third order watersheds, which were used as AAUs for the North Cascades and Pacific Ranges ecoregional assessment[6]. The potential problem in traditional horizontal grouping of adjacent assessment units, it that while watersheds may be adjacent, this does not necessarily indicate hydrological connectivity. For example, two neighbouring watersheds may meet at a ridgeline with each watershed draining into a separate drainage basin. So, while the two watersheds are adjacent, they do not have hydrological connectivity (Schindel, 2005).

Vertical Stacking is a method that was developed by Michael Schindel (TNC Oregon) designed to accommodate for these types of relationships, where adjacency between assessment units does not necessarily mean connectivity. Vertical stacking was used to generate the *bound.dat* input file for the freshwater MARXAN analysis portion of the North

[6] Only the British Columbia portion of the EDUs that fall wholly or partially within the North Cascades ecosection were analyzed as part of this ERA.

Cascades and Pacific Ranges ERA. In this case, the basic assessment units, third order watersheds, were nested within mainstem watersheds. A table containing all possible relationships between the third order watersheds and mainstems was generated by using a GIS to overlay the two layers. The resulting *bound.dat* file was used in MARXAN to ensure that the resulting portfolio would more accurately represent hydrological connectivity, than if a traditional horizontal boundary file was used. For more detailed information about Vertical Stacking, please refer to Schindel (2004), or Vander Schaaf et al. (2006).

3.2.1.3 Results and Discussion

Lower Fraser and Southern Coastal Streams ecological drainage units (EDUs) collectively consist of 829 freshwater systems that were classified into 17 freshwater system types. Table 15 summarizes the characteristics of each system type. The Lower Fraser EDU consisted of 251 watersheds that were grouped into 16 different aquatic ecological systems types. The Southern Coastal Streams EDU consisted of 578 watersheds that were grouped into 17 different aquatic ecological systems types. Map 9 spatially summarizes the abundance and distribution of these freshwater system types within each of the EDUs.

Based on the TNC/NatureServe recommendations (Comer 2001, 2003), a conservation goal of 30% was set for each freshwater coarse-filter system target type which was then stratified by EDU to ensure representation across EDUs. Freshwater ecosystem types derived from this assessment have value beyond supporting priority setting for biodiversity conservation. Freshwater ecosystem types can be used for evaluating and monitoring ecological potential and condition, predicting impacts from disturbance, and defining desirable future conditions. In addition, they can be used to inform sampling programs for biodiversity assessment and water quality monitoring, which requires an ecological framework in addition to a spatial framework to stratify sampling locations (Higgins et al. 2003).

We realize that this classification framework is a series of hypotheses that need to be tested and refined through additional data and expert review. We recommend that concurrently, data be gathered to refine/test the classification to bring the scientific rigor needed to further its development and use by conservation partners and agencies.

Table 15. Summary of coarse-filter freshwater ecosystem types in the North Cascades Ecoregion

Drain-age Area (km)	Accumu-lative Precipi-tation Yield	Hydrologic Regime	Water Temp.	Glacial Influence	Lake and Wetland Influence	Main-stem Gradient	Tributary Gradient	Under-lying Geology
very large	very high	rain on snow	cool	low	low	shallow	moderate	intrusive / metamor-phic
small	moderate	rain and glacial melt	cold	high	low	steep	moderate	intrusive / metamor-phic
small	high	rain and glacial melt	cold	high	low	moderate	steep	volcanic
small	moderate	rain and glacial melt	cold	high	low	steep	steep	intrusive / metamor-phic
small	high	rain on snow	warm	low	moderate	moderate	moderate	intrusive / metamor-phic

Drain-age Area (km)	Accumu-lative Precipi-tation Yield	Hydrologic Regime	Water Temp.	Glacial Influence	Lake and Wetland Influence	Main-stem Gradient	Tributary Gradient	Under-lying Geology
very small	moderate	rain and glacial melt	cold	high	low	steep	steep	intrusive / metamor-phic
small	high	rain	cool	moderate	low	steep	moderate	intrusive / metamor-phic
small	high	rain and glacial melt	cold	moderate	low	steep	moderate	intrusive / metamor-phic
very small	high	rain on snow	cool	low	low	steep	moderate	intrusive / metamor-phic
very small	high	snow melt	warm	none	moderate	shallow	shallow	hard sedimen-tary rock
very small	moderate	rain and glacial melt	cold	high	low	steep	moderate	intrusive / metamor-phic
very small	moderate	rain	cool	low	low	steep	steep	intrusive / metamor-phic
very small	moderate	snow melt	cool	none	low	moderate	moderate	intrusive / metamor-phic
very small	low	rain and glacial melt	cold	moderate	low	steep	steep	intrusive / metamor-phic
very small	moderate	rain	cool	low	low	steep	moderate	intrusive / metamor-phic
very small	moderate	rain on snow	cool	none	low	steep	steep	intrusive / metamor-phic
very small	moderate	rain on snow	cool	none	low	steep	moderate	intrusive / metamor-phic

3.2.2 Freshwater Fine-filter Animals

Technical Team

The freshwater fine-filter animals technical team was composed of experts from The Nature Conservancy (TNC), the Nature Conservancy of Canada (NCC), and Washington Department of Fish and Wildlife (WDFW):

Sairah Tyler	Veridia Consulting/Nature Conservancy of Canada
Kristy Ciruna	Nature Conservancy of Canada
Peter Skidmore	The Nature Conservancy, Washington Field Office
Joanne Schuett-Hames	Washington Department of Fish and Wildlife

3.2.2.1 *Freshwater Animal Target Selection*

The freshwater analysis used ecological drainage units (EDUs) as the ecological boundaries for target selection. Three EDUs intersect the North Cascades ecoregion and extend beyond its boundary (Southern Coastal Streams, Lower Fraser, and Puget Sound). As previously noted, the Puget Sound EDU was analyzed as part of the Willamette Valley- Puget Trough-Georgia Basin ecoregional assessment; therefore, it was not included in the freshwater fine-filter animals analysis (refer to Appendix 10 for details of the Puget Sound EDU methods and results). Two species (pink and chum salmon) were analyzed according to a different boundary than the EDUs; they were stratified by salmon ecoregion (XAN)[7] zones.

Methods used to identify fine-filter animal targets were based largely on Groves et al. (2000, 2002) and Higgins et al. (1998). Conservation targets were selected at multiple spatial scales and levels of biological organization. The freshwater animals team's objective was to develop a list of target species that require special attention, and their locational data were used to help prioritize freshwater areas for conservation. Freshwater fine-filter targets are generally defined as those species that are currently imperiled, threatened, endangered, or of special concern due to endemic, disjunct, vulnerable, keystone, or wide-ranging status, or are species aggregations or groups. Target selection criteria are shown in Table 16.

The draft target list was reviewed by regional and taxonomic experts, resulting in a final target list of 48 freshwater animal species: 27 fish (including 12 salmonids where different seasonal runs were treated as separate targets), 1 mammal, 5 amphibians, 1 bird, 8 dragonflies, and 6 stoneflies. Table 17 lists all of the freshwater fine-filter animal targets for the Southern Coastal Streams, Lower Fraser EDUs, and Fraser River and Puget Sound/Georgia Basin XAN Zones. Two of the forty-eight targets were assigned "retro status" because they were modeled habitat data and were not included in the MARXAN analyses. These targets were coastal tailed frog and steelhead habitats. We used these two datasets in a post hoc assessment of the portfolio results to evaluate the portfolio as defined by the goals and data of other targets.

Table 16. Target selection criteria

Status	Criteria
Imperiled, threatened, and endangered species	• Imperiled species have a global rank of G1-G3 or T1-T3 by NatureServe or the Conservation Data Centre in British Columbia (see www.natureserve.org for explanation of ranking system). National and Provincial Rankings were also included (N1-N3 and S1-S3). • For international programs, the IUCN Red List (www.iucnredlist.org) was used as a guide to select species in the critically endangered, endangered, or vulnerable categories. • Endangered and threatened species are those federally listed or proposed for listing as Threatened or Endangered under the ESA or COSEWIC. In British Columbia, "red-listed" species correspond to endangered or threatened. • Identified Wildlife refers to those Species at Risk and Regionally Important Wildlife that the Minister of Environment designates as requiring special management attention under the *Forest and Range Practices Act.*

[7] XANs are defined as watershed-coastal ecosystems of distinct physical characteristics, including the full sequence of riverine, estuarine, and near-shore marine habitats used by juvenile anadromous salmonids (Augerot et al. 2004).

Status	Criteria
Other species of special concern	• Declining species: Declining species exhibit significant, long-term declines in habitat and/or numbers, are subject to a high degree of threat, or may have unique habitat or behavioral requirements that expose them to great risk. • Endemic species: Endemic species are restricted to an ecoregion (or a small geographic area within an ecoregion), depend entirely on a single area for survival, and therefore are often more vulnerable. • Disjunct species have populations that are geographically isolated from populations in other ecoregions • Vulnerable species are usually abundant, may not be declining, but some aspect of their life history makes them especially vulnerable, such as habitats needed for migratory stopovers or winter range. • Keystone species are those whose impact on a community or ecological system is disproportionately large for their abundance. They contribute to ecosystem function in a unique and significant manner through their activities. Their removal causes major changes in community composition. • Wide-ranging species depend on vast areas. These species include top-level predators such as the gray wolf and northern goshawk. Wide-ranging species can be especially useful in examining linkages among conservation areas in a true conservation network.
Species aggregations, species ecological group, and hot spots	• Globally significant examples of species aggregations (i.e., critical migratory stopover sites that contain significant numbers of migratory individuals of many species). For example, significant migratory stopovers for shorebirds have been formally designated through the Western Hemi-sphere Shorebird Reserve Network. • Major groups of species share common ecological processes and patterns, and/or have similar conservation requirements and threats (e.g., freshwater mussels, forest-interior birds). It is often more practical in ecoregional plans to target such groups as opposed to each individual species of concern. • Biodiversity hotspots contain large numbers of endemic species and usually face significant threat.

Freshwater Animal Data Collection and Preparation

Occurrence data for each target were collected from seven sources; additional occurrence datasets were supplied by the terrestrial animals team. Refer to Appendix 4 for a full listing of the data sources used.

All of the freshwater fine-filter data went through the following preparation methods:

1. All non-target species were removed from the datasets
2. Data were filtered for currency and accuracy, and records were eliminated if
    a. they were collected prior to 1985;
    b. they were not from credible sources, the location was not accurate, or the sighting was not verified;
    c. they lacked basic information on species names; or
    d. the species was known to be extirpated.
3. Datasets were cross-walked to determine which attributes were similar across datasets despite different naming conventions.

4. Element Occurrences (EOs) were created through the following process:
    a. Riparian species were separated into their own files and then buffered with the appropriate species-specific separation distance. Any set of points that overlapped and represented one species were assigned the same occurrence identification (ID) and an amount of the occurrence they made up (1/2 or 1/3 of the total occurrence, etc.)
    b. Data from the BC CDC already had element occurrences assigned; therefore, buffers of any species that overlapped any BC CDC polygon occurrences of that species were assigned to the EO ID of the BC CDC data, and amounts were adjusted accordingly in both datasets to represent the full EO.
    c. BC CDC riparian polygon data were turned into point data so that they could be merged with the point data from other datasets. This resulted in one final riparian species point file.
5. All fish point datasets (from the Known Fish Observations and Royal BC Museum) were merged to create one fish point dataset. Fish arcs datasets (from the Washington Department of Fish and Wildlife, Mike Pearson's data, and the points that had been attributed to arcs) were merged and duplicate records were removed.

3.2.2.2 Setting Goals

Initial freshwater fine-filter animal conservation goals were developed using the TNC/NatureServe recommendations (Comer 2001, 2003; Appendix 19). To set final goals for the MARXAN analysis, it was necessary to first determine how many occurrences were located in each EDU. Target datasets were intersected with the freshwater assessment units (third order watersheds) in order to determine how much of each target was located in each EDU, and the TNC/NatureServe recommended goals were adjusted accordingly. Freshwater fine-filter goals are listed in Appendices 5 and 6.

Conservation goals for freshwater fine-filter data that consisted of distribution data in points and lines rather than populations were set according to percentages of distribution rather than number of populations. For all fish other than salmon, an initial distributional goal of 30% was used. Salmonid targets were defined differently from other freshwater species due to their complex and wide-ranging life history and their special consideration under COSEWIC and the Canadian *Species At Risk Act*. For the majority of salmon targets, a conservation goal was set at 50% of distribution. For two sockeye salmon populations (Cultus Lake and Sakinaw Lake), the conservation goal was set at 100% since those populations are specifically listed as endangered in Canada. Conservation goals for steelhead runs were also set at 100% because of the severe lack of distributional data for this target in the North Cascades EDUs.

3.2.2.3 Results and Discussion

Of the 24 targets that had occurrence data, only 20% (all of which were amphibians) met the TNC/NatureServe recommended conservation goals. The other 80% of the targets had too few occurrence data to meet the recommended goals. Refer to Appendices 5 and 6 for details of targets and goals results.

Table 17. Freshwater Fine-filter targets for the North Cascades Ecoregion

Common Name	Scientific Name	ELCODE	G RANK
Amphibians			
Cascades frog	*Rana cascadae*	AAABH01060	G3G4
Coastal tailed frog	*Ascaphus truei*	AAABA01010	G4
Coastal tailed frog (habitat)	*Ascaphus truei*	AAABA01010	G4
Pacific Giant Salamander	*Dicamptodon tenebrosus*	AAAAH01040	G5
Red-legged frog	*Rana aurora*	AAABH01020	G4
Western toad	*Bufo boreas*	AAABB01030	G4
Fishes			
Bull Trout	*Salvelinus confluentus*	AFCHA05020	G3
Chinook Salmon (no run info)	*Oncorhynchus tshawytscha*	AFCHA02050	G5
Chum Salmon (Fraser XAN Ecoregion)	*Oncorhynchus keta*	AFCHA02020	G5
Chum Salmon (Puget XAN Ecoregion)	*Oncorhynchus keta*	AFCHA02020	G5
Coastal Cutthroat Trout, Clarki Subspecies (anadromous)	*Oncorhynchus clarki clarki*	AFCHA0208A	G4
Coho Salmon	*Oncorhynchus kisutch*	AFCHA02030	G4
Cultus Lake Sculpin	*Cottus sp. 2*	AFC4E02270	G1
Cutthroat Trout, Clarkil Subspecies	*Oncorhynchus clarkiI clarkiI*	AFCHA0208A	G4
Dolly Varden	*Salvelinus malma*	AFCHA05040	G5
Dolly Varden (anadromous)	*Salvelinus malma*	AFCHA05040	G5
Eulachon	*Thaleichthys pacificus*	AFCHB04010	G5
Green Sturgeon	*Acipenser medirostris*	AFCAA01030	G3
Kokanee	*Oncorhynchus nerka*	AFCHA02040	G5
Mountain Sucker (ha)	*Catostomus platyrhynchus*	AFCJC02160	G5
Mountain Sucker (km)	*Catostomus platyrhynchus*	AFCJC02160	G5
Nooksack Dace	*Rhinichthys sp. 4*	AFCJB37110	G3
Pink Salmon, no run info (Fraser XAN Ecoregion)	*Oncorhynchus gorbuscha*	AFCHA02010	G5
Pink Salmon, no run info (Puget XAN Ecoregion)	*Oncorhynchus gorbuscha*	AFCHA02010	G5
Pygmy Longfin Smelt/Harrison/Pitt Lake Smelt	*Spirinchus sp. 1*	AFCHB03030	G1Q
Salish Sucker (ha)	*Catostomus sp. 4*	AFCJC02260	G1
Salish Sucker (km)	*Catostomus sp. 4*	AFCJC02260	G1
Sockeye Salmon	*Oncorhynchus nerka*	AFCHA02040	G5
Sockeye Salmon (Cultus Lake)	*Oncorhynchus nerka*	AFCHA02040	G5
Sockeye Salmon (Sakinaw Lake)	*Oncorhynchus nerka*	AFCHA02040	G5
Steelhead Salmon (modelled)	*Oncorhynchus mykiss*	AFCHA02090	G5

Common Name	Scientific Name	ELCODE	G RANK
Steelhead Salmon (no run info)	*Oncorhynchus mykiss*	AFCHA02090	G5
Steelhead Salmon (summer)	*Oncorhynchus mykiss*	AFCHA02090	G5
Steelhead Salmon (winter)	*Oncorhynchus mykiss*	AFCHA02090	G5
Threespine stickleback	*Gasterosteus aculeatus*	AFCPA03010	G5
Western Brook Lamprey	*Lampetra richardsoni*	AFBAA02090	G4G5
White Sturgeon	*Acipenser transmontanus*	AFCAA01050	G4
Birds			
Western grebe	*Aechmophorus occidentalis*	ABNCA04010	G5
Mammals			
Pacific water Shrew	*Sorex bendirii*	AMABA01170	G4
Insects			
Autumn Meadowhawk	*Sympetrum vicinum*	IIODO61140	G5
Beaverpond Baskettail	*Epitheca canis*	IIODO29030	G5
Black Petaltail	*Tanypteryx hageni*	IIODO02010	G4
Blue Dasher	*Pachydiplax longipennis*	IIODO53010	G5
Emma's Dancer (nez Perce)	*Argia emma*	IIODO68150	G5
Grappletail	*Octogomphus specularis*	IIODO89010	G4
Spring Stonefly trictura	*Cascadoperla trictura*	IIPLE22010	G3G4
Stonefly fraseri	*Isocapnia fraseri*	IIPLE05040	G1
Stonefly gregsoni	*Bolshecapnia gregsoni*	IIEPE02010	G2
Stonefly sasquatchi	*Bolshecapnia sasquatchi*	IIEPE02050	G3
Stonefly tibilalis	*Setvena tibilalis*	IIPLE2A020	G4
Stonefly vedderensis	*Isocapnia vedderensis*	IIPLE05110	G4
Vivid Dancer	*Argia vivida*	IIODO68290	G5
Western Pondhawk	*Erythemis collocata*	IIODO39020	G5

3.3 Summary of targets and goals

Table 18. Summary of targets used in the terrestrial and freshwater assessments by target groups

Ecoregion or EDU	Environ-mental Realm	Biological Level	Taxonomic Group	Target Count	Count of Targets with Data	Count of Targets with Data and Goals
North Cascades Ecoregion	Terrestrial	Ecological Systems		19	19	19
North Cascades Ecoregion	Terrestrial	Plant Communities		17	17	17
North Cascades Ecoregion	Terrestrial	Other Ecological Features		4	4	4
North Cascades Ecoregion	Terrestrial	Species	Amphibians	2	2	2
North Cascades Ecoregion	Terrestrial	Species	Birds	24	18	18

Ecoregion or EDU	Environ-mental Realm	Biological Level	Taxonomic Group	Target Count	Count of Targets with Data	Count of Targets with Data and Goals
North Cascades Ecoregion	Terrestrial	Species	Insects	6	6	6
North Cascades Ecoregion	Terrestrial	Species	Mammals	14	10	9
North Cascades Ecoregion	Terrestrial	Species	Molluscs	9	9	9
North Cascades Ecoregion	Terrestrial	Species	Nonvascular Plants	7	3	3
North Cascades Ecoregion	Terrestrial	Species	Vascular Plants	87	65	65
Lower Fraser EDU	Freshwater	Ecological Systems		17	17	17
Puget Sound EDU	Freshwater	Ecological Systems		7	7	7
Southern Coastal Streams EDU	Freshwater	Ecological Systems		16	16	16
Lower Fraser EDU	Freshwater	Species	Amphibians	5	4	4
Lower Fraser EDU	Freshwater	Species	Birds	1		0
Lower Fraser EDU	Freshwater	Species	Fishes	32	20	20
Lower Fraser EDU	Freshwater	Species	Insects	14	12	12
Lower Fraser EDU	Freshwater	Species	Mammals	1	1	1
Southern Coastal Streams EDU	Freshwater	Species	Amphibians	5	1	1
Southern Coastal Streams EDU	Freshwater	Species	Birds	1	1	1
Southern Coastal Streams EDU	Freshwater	Species	Fishes	29	13	13
Southern Coastal Streams EDU	Freshwater	Species	Insects	14	4	4
Southern Coastal Streams EDU	Freshwater	Species	Mammals	1	1	1

Chapter 4 – Suitability Index

Technical Team

The Suitability Index technical team was composed of the following people:

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4.1 Introduction

MARXAN was used to identify an efficient set of conservation areas. MARXAN searches for the lowest cost set of assessment units that will meet representation levels for all conservation targets. This set of assessment units is defined as an efficient or “optimal” solution. “Cost” corresponds to economic, socio-political, and environmental factors operating on the landscape that either support or impede management regimes for biodiversity conservation (Groves 2003); it is represented in MARXAN by the suitability index. Used in this context, cost refers not only to financial considerations but also refers to *likelihood of success,* especially in terms of species viability or persistence. In other words, conservation investment (whether financial or effort-based) has a higher return if it sustains biodiversity for the long-term.

Land use suitability is a well established concept among planners (Hopkins 1977; Collins et al. 2001), and there are many different methods for constructing an index (Banai-Kashini 1989; Carver 1991; Miller et al. 1998; Stoms et al. 2002). Suitability indices have been used to locate the best places for a wide range of land uses, from farms to nuclear waste sites. In this assessment, a suitability index was applied in an optimization algorithm in order to identify the best places for biodiversity conservation in the North Cascades ecoregion.

MARXAN requires that “cost” be represented as a single value for each assessment unit (AU). This value must represent the combination of all factors that may affect successful conservation at each AU and their relative importance. Our suitability index was a linear combination of several factors.

MARXAN will still select areas of high cost/low suitability if they are required to meet representation goals. For example, rare species or those with limited range will have fewer places for MARXAN to choose from, which may force the selection of “high cost” areas. The suitability index simply ensures that if there is a high suitability/low cost alternative, it will be preferentially selected.

4.1.1 Assumptions

The suitability index was developed using three assumptions:

1. Existing public land is more suitable for conservation than private land.
2. Rural areas are more suitable for conservation than urban areas.
3. Areas with low habitat fragmentation are more suitable for conservation than areas with high fragmentation.

The first assumption was based on the work of the Gap Analysis Program (Cassidy et al. 1997; Kagan et al. 1999). The Oregon and Washington GAP projects rated nearly all public lands as better managed for biodiversity than most private lands. Furthermore, conservation biologists have noted that existing public lands are the logical starting point for habitat protection programs (Dwyer et al. 1995). The team also reasoned that by focusing conservation on lands already set aside for public purposes, the impact on private or Aboriginal/tribal lands and the overall cost of conservation would be less than if public and private lands were treated equally. Therefore, existing public lands could form the core of large, multiple-use landscapes where biodiversity conservation is a major management goal.

The second assumption was based on the definition of urban area. In general, urban areas make intensive use of land for the location of buildings, structures, and impermeable surfaces to such a degree as to be incompatible with large-scale conservation of native biodiversity. However, this definition of urban does not preclude a need for natural areas or habitat restoration within the urban environment. The third assumption was based on the work of Diamond (1975) and Forman (1995), among others, and is a well-accepted principle of conservation biology. The third assumption is addressed indirectly in the index through two of the factors that are used: road density and percent of habitat in different land uses (i.e. urban, agriculture, etc.).

The validity of the first two assumptions is debatable. That is, other organizations or stakeholders may contend that biodiversity conservation on private lands is just as feasible as conservation on public lands, or that no distinction should be made between urban and rural areas with respect to biodiversity conservation. Certainly, there are situations where both these contentions are true. However for this assessment, it was assumed that public lands are the most sensible starting point for biodiversity conservation and that “urban area” is a land use designation that is mostly incompatible with maintaining a full suite of existing biodiversity.

Although the simple index used in this assessment cannot account for the many complex local situations that influence successful conservation, it is believed that some reasonable generalities are still quite useful for assessing conservation opportunities across an entire ecoregion. For a more detailed account of the suitability index, refer to Appendix 13.

4.2 Methods

The suitability index used in this project was based on the analytic hierarchy process (AHP) (Saaty 1980; Banai-Kashini 1989). AHP generates an equation that is a linear combination of factors that are thought to affect suitability. Each factor is represented by a separate term in the equation, and each term is multiplied by a weighting factor. AHP is unique because the weighting factors are obtained through a technique known as pair-wise comparisons (Saaty 1977) where expert opinion is solicited for the relative importance of each term in the equation. To simplify the elicitation process, the “abbreviated pair-wise comparisons” technique was used. That is, perfect internal consistency for each expert was assumed, which allowed the number of comparisons to be reduced. AHP has been used in other conservation assessments where expert judgments are used in lieu of empirical data (Store and Kangas 2001; Clevenger et al. 2002; Bojorquez-Tapia 2003).

Several experts - from the Nature Conservancy of Canada, The Nature Conservancy, Washington Department of Fish and Wildlife, NatureServe, and the Washington Natural Heritage Program - with knowledge of the ecoregion were sent a spreadsheet and asked for their opinion on the ranks and relative importance values of factors used in the suitability index. They were asked to do the same for sub-terms for management status and land use.

Responses were separated by jurisdiction, since inputs were slightly different between BC and Washington, and then were collated. Outliers were discarded. Weights for each factor were calculated by finding the dominant eigenvector of each comparisons matrix (Saaty 1977).

Two similar cost suitability indices were built—one for terrestrial areas and one for freshwater areas—by compiling spatial data related to the human use footprint (e.g., road density, urban growth, conversion of natural landscapes), current management, and aquatic factors such as the presence of dams. These data were incorporated into the AHP equation and a single suitability value or cost for each assessment unit was generated.

The use of suitability indices for assessing the likelihood of successful conservation has some potential drawbacks. For example, the index for this assessment was built using expert opinions about which factors to include and the relative importance of each factor. Also, few if any of these GIS data are ever ground-truthed for their accuracy. In most cases, these datasets would be greatly improved by field checking the accuracy of analytical results (Rumsey et al. 2003). To address these concerns, a sensitivity analysis on the suitability index was performed (Chapter 5).

4.2.1 Terrestrial Suitability Index

The terrestrial suitability index consists of four terms and is expressed as:

Terrestrial Suitability = A * management_status + B * land_use + C * road_density + D * future_urban_potential

A, B, C, and D are weighting factors calculated from expert input and pairwise comparison, which collectively sum to 100%. The individual index factors are shown in Map 11. Map 12 shows the combined terrestrial suitability index factors.

Two terms in the main equation were also linear combinations of other sub-factors. Weights, summing to 100 within each term, were also applied to sub-factors within management status and land use class. For example:

land_use = q * % urban + r * % agriculture + s * % mine + t * % timber harvest + u * % intensive recreation

Values for each factor (or sub-factor) were based on the percent area of that factor in the assessment unit. Values for each factor were normalized prior to applying the weights according to the following equation:

Normalized score = (score for that AU / highest score for all AU)*100

Appendix 14 provides details on how each factor was developed, including rationale for inclusion in the index, processing methods, factor weights and sub-weight values and data sources. The appendix also provides details on other factors that were considered for inclusion, including the rationale for not including the factors in the index.

4.2.2 Freshwater Suitability Index

The freshwater suitability index consisted of eight terms and is expressed as

Freshwater Suitability = A * management_status_score + B * land_use_score + C * dams_score + D * water_extraction_score + E * fish_stock_score + F * road_density_>50%_gradient_score + G * road_stream_crossing_score + H * riparian_disturbance_logging_score

A, B, C, D, E, F, G and H are weighting factors calculated from expert input and pairwise comparison, which collectively sum to 100. Map 13 shows the combined freshwater suitability index factors.

Two terms in the main equation were also linear combinations of other sub-factors. Weights, summing to 100 within each term, were applied to sub-factors within management status and land use class. For example

land_use = q * %_urban + r * % agriculture + s * % mine

Values for each factor (or sub-factor) were based on the percent area of that factor in the assessment unit. Values for each factor were normalized prior to applying the weights according to the following equation:

Normalized score = (score for that AU / highest score for all AU)*100

Weights were obtained from input received from two people—one member of the technical team and one outside expert. All of the respondents were from BC. Weights were assigned to the eight assessment units in the Lower Fraser EDU, which are located in Washington State. Data were lacking for many factors in Washington State; therefore, the weights were prorated and adjusted to sum to 1 for those factors for which there were data.

Appendix 13 provides details on how each of the factors were developed, including rationale for inclusion in the index, processing methods, factor weights and sub-weight values and data sources. The appendix also provides details on other factors that were considered for inclusion, in the index.

Chapter 5 – Prioritization of Assessment Units

5.1 Introduction

Organizations, agencies and landowners should be given the flexibility to pursue other options when portions of the portfolio are too difficult to protect. Assigning a relative priority to all AUs in the ecoregion will help planners explore options for conservation.

In this assessment, the optimal site selection algorithm MARXAN was used to assign a relative priority to each AU in the ecoregion. The relative priorities were expressed as two indices—irreplaceability and utility. Irreplaceability is an index that indicates the relative biodiversity value of a place (i.e., an assessment unit). Conservation utility is a function of both biodiversity value and the likelihood of successful conservation.

The prioritization results in this assessment should not be the only information used to direct conservation actions. Unforeseen opportunities have had and should continue to have a major influence on conservation decisions. Local attitudes toward conservation can hinder or enhance conservation actions. Considerations such as these are difficult to incorporate into long-range priority setting schemes but must be dealt with case by case.

5.1.1 Sensitivity Analysis

A sensitivity analysis is necessary whenever there is considerable uncertainty regarding modeling assumptions or parameter values. A sensitivity analysis determines what happens to model outputs in response to a systematic change of model inputs (Jorgensen and Bendoricchio 2001). Sensitivity analysis serves two main purposes: (1) to measure how much influence each parameter has on the model output; and (2) to evaluate the potential effects of poor parameter estimates or weak assumptions (Caswell 1989). A sensitivity analysis can be used to ascertain the robustness of the prioritization results and to judge the level of confidence in the conclusions.

Chapters 4 and 5 explain the inputs to MARXAN. The input with the greatest uncertainty was the suitability index. It was not a statistical model; rather, variable selection and parameter estimates for the index were based on professional judgment. For this reason, the sensitivity analysis focused on the suitability index. The methods for the sensitivity analysis are thoroughly explained in Appendix 18.

5.2 Methods

5.2.1 Irreplaceability

Irreplaceability is an index that indicates the relative conservation value of a place (i.e., an assessment unit). Irreplaceability has been defined a number of different ways (Ferrier et al. 2000; Noss et al. 2002; Leslie et al. 2003; Stewart et al. 2003); however, the original operational definition was created by Pressey at al. (1994). They defined irreplaceability of a site as the percentage of alternative reserve systems in which it occurs. Following this definition, Andelman and Willig (2002) and Leslie et al. (2003) each exploited the stochastic nature of the simulated annealing algorithm to calculate an irreplaceability index. Andelman and Willig's (2002) index is:

$$I_j = (1/n) \sum_{i=1}^{n} s_i \qquad (1)$$

where I is relative irreplaceability, n is the number of solutions, and s_i is a binary variable that equals 1 when AU_j is selected but 0 otherwise. I_j has values between 0 and 1, and is obtained from running the simulated annealing algorithm n times at a single representation level.

Irreplaceability is a function of the desired representation level (Pressey et al. 1994; Warman et al. 2004). Changing the representation level for target species often changes the number of AUs needed for the solution. For instance, low representation levels typically yield a small number of AUs with high irreplaceability and many AUs with zero irreplaceability, but as the representation level increases, some AUs attain higher irreplaceability values. The fact that some AUs go from zero irreplaceability to a positive irreplaceability demonstrates that Willig and Andelman's index is somewhat misleading; at low representation levels, some AUs are shown to have no value for biodiversity conservation when they actually do. For this assessment, an index for relative irreplaceability that addresses this shortcoming was created. This global irreplaceability index for AU_j was defined as:

$$G_j = (1/m) \sum_{k=1}^{m} I_{jk} \qquad (2)$$

where I_{jk} are relative irreplaceability values as defined in equation (2) and m is the number of representation levels used in the site selection algorithm. G_j has values between 0 and 1. Each I_{jk} is relative irreplaceability at a particular representation level. MARXAN was run at ten representation levels for coarse- and fine-filter targets. At the highest representation level, nearly all AUs attained a positive irreplaceability.

Many applications of irreplaceability have implicitly subsumed some type of conservation efficiency (e.g., Andelman and Willig 2002, Noss et al. 2002, Leslie et al. 2003, Stewart et al. 2003). Efficiency is usually achieved by minimizing the total area needed to satisfy the desired representation level. All AUs were 500 ha hexagons, and therefore, MARXAN minimized area by minimizing the total number of AUs.

5.2.2 Conservation Utility

The concept of irreplaceability was expanded upon by using conservation utility (Rumsey et al. 2004). Conservation utility is defined by equation (2), but the optimization algorithm is run with the AU costs incorporating a suitability index. To generate irreplaceability, AU cost equals the AU area. To create a map of conservation utility values, AU cost reflects practical aspects of conservation—current land uses, current management practices, habitat condition, etc. (see Chapter 4). In effect, conservation utility is a function of both biodiversity value and the likelihood (cost) of successful conservation.

5.2.3 Representation Levels

Coarse-filter

It was assumed that there is a logarithmic relationship between the risk of species extinction and the amount of habitat, based on the species-area curve. The species-area curve is one of the most thoroughly established quantitative relationships in all of ecology (Conner and McCoy 1979; Rosenzweig 1995). The curve is defined by the equation $S=cA^z$, where S is the number of species in a particular area, A is the given area, c and z are constants. The equation states that the number of species (S) found in a particular area increases as the habitat area (A) increases. The parameter z takes on a wide range of values depending on the taxa, region of the earth, and landscape setting included in the study.

Most values lie between 0.15 and 0.35 (Wilson 1992). A frequently cited rule-of-thumb for the z value is Darlington's Rule (MacArthur and Wilson 1967; Morrison et al. 1998). It states that a doubling of species occurs for every 10-fold increase in area, hence z = log (2) or 0.301. This relationship was used in this study to derive representation levels that roughly corresponded to equal increments of biodiversity—i.e., each increase in coarse-filter area captured an additional 10% of species.

Fine-filter

For fine-filter targets, each representation level corresponds to a different degree of risk for species extinction. Although the actual degree of risk cannot be estimated, it is understood that risk is not a linear function of representation. It is roughly logarithmic.

Fine-filter representation levels specify the number of species occurrences to be captured within a set of conservation areas. The relationship between species survival and number of isolated populations is also a power function:

$$\text{Species Persistence Probability} = \quad 1 - [1 - pr\,(P)]^{n}$$

where pr(P) is the persistence probability of each isolated population and n is the number of populations. This equation states that the probability of species persistence increases as the number of populations increases; however, there is a diminishing increase in persistence probability as the number of populations increases. According to this relationship, if the intent is to have representation levels correspond to equal degrees of risk, then fine-filter representation levels should not increase linearly but logarithmically. However, the above equation will not work in this study since pr (P) is unknown. Even if it were, it would not be equal across all populations.

Other relationships, however, were available. The Natural Heritage Programs/Conservation Data Centres use many criteria to determine global and subnational ranks (G- and S-Ranks). These criteria indicate the degree of imperilment—i.e., the risk of extinction according to the number of occurrences or the number of populations (Appendix 1 - Glossary) (Master et al., 2003). The relationship between the number of occurrences (or populations) and degree of imperilment follows a power function. The Natural Heritage Program/Conservation Data Centre G- and S-Rank criteria were used in this study to develop 10 representation levels.

5.2.4 Sensitivity Analysis

Sensitivity to the suitability index was examined by altering the index's parameter values, running the selection algorithm with the new index, and then quantifying the resulting changes in the conservation utility map. Recall that the suitability index equation is a weighted linear combination of factors:

Suitability = A • management status + B • %converted land + C • road density + D • %urban growth area

where A + B + C + D = 1; and management status, %converted land, road density, and %urban growth area were each normalized to a maximum value of 1. Also, recall that MARXAN tries to minimize the cost of AUs; therefore, the suitability index is actually formulated as an "unsuitability" index.

The values for parameters A, B, C, and D were determined by averaging expert opinion using the Analytic Hierarchy Process (AHP) (Saaty 1980). Each parameter was changed by +0.1 and parameters A and B were also changed by -0.1. After changing a parameter value, the other parameters were adjusted so that they all still summed to 1. Only the suitability index parameters were changed; none of the other inputs to the selection algorithm used to produce the original utility map were changed.

Resulting changes in the algorithms output were quantified several ways. First, three similarity measures were calculated to compare the conservation utility maps generated: mean absolute difference (also known as mean Manhattan metric), Bray-Curtis similarity measure, and Spearman rank correlation (Krebs 1999). The Bray-Curtis similarity measure normalizes the sum absolute difference to a scale from 0 to 1. Hence, mean absolute difference and the Bray-Curtis similarity measure give the same result but on different scales. Because utility will be used for prioritizing AUs, the rank correlation is particularly informative. Rank correlation indicates how the relative AU priorities change in response to changes in the suitability index. To prioritize AUs, the mean absolute difference in rank was also calculated.

5.3 Results

5.3.1 Terrestrial Analysis

The irreplaceability and utility maps for the terrestrial analysis are shown in Maps 14 and 15. The categories on these maps correspond to deciles. That is, the statistical distribution of utility and irreplaceability scores were each divided into 10% quantiles. The decile map indicates where the AUs with a selection frequency (or score) in the top 10 or 20% of all AUs are. Scores at the 90th percentile were 60 for both irreplaceability and utility. Additionally, the percentage of AUs with a score greater than 90% was 2.1% and 2.7% for irreplaceability and utility, respectively (see Appendix 15).

AUs with scores equal to 100 were those selected in every replicate at every representation level; 1.4% had irreplaceability equal to 100, 1.7% had utility equal to 100, and 1.3% had both scores equal to 100 (Table 19).

At the lowest representation level, the best solutions for irreplaceability and utility consisted of 2.2% and 2.3% of AUs, respectively. Scores of 100 were attained by 64% of AUs in the irreplaceability best solution and 75% of AUs in utility best solution, which demonstrates that few options existed for meeting the lowest representation level. That is, rare targets could only be captured at the high scoring AUs. This also shows how incorporating suitability into the analysis narrows the number of options.

Table 19. Percentage of Assessment Units (AUs) with high selection frequencies for both terrestrial and aquatic analyses of irreplaceability, conservation utility, and both combined

Realm	Number of AUs	Selection frequency	Irreplace-ability	Utility	Both
Terrestrial	9587	100 %	1.4	1.7	1.3
		≥ 95%	1.8	2.0	1.6
		≥ 90 %	2.1	2.7	2.0
Aquatic: Puget Sound EDU	442	100 %	1.4	1.6	1.4
		≥ 95%	3.6	3.8	3.2
		≥ 90 %	7.0	7.2	6.8
Aquatic: Lower Fraser River and Southern Coastal EDUs	909	100 %	1.9	2.9	1.4
		≥ 95%	3.0	4.7	2.3
		≥ 90 %	5.0	6.6	3.6

5.3.2 *Freshwater Analysis*

The irreplaceability and utility maps for the freshwater analysis are shown in Maps 16 and 17. A score greater than 90 was attained by 76 AUs for irreplaceability and 92 AUs for utility. Twenty-three AUs had an irreplaceability score of 100, 33 had a utility score of 100, and 19 had both scores equal to 100 (Table 19). The number AUs that attained perfect utility scores was greater than the number that attained perfect irreplaceability scores because when the optimization involved suitability, the higher suitability scores of some AUs caused them to be selected in every replicate.

5.3.3 *Sensitivity Analysis*

In general, changes to suitability index parameters result in changes in AU utility scores. Positive changes to all four parameters resulted in approximately the same values for mean absolute difference, Bray-Curtis similarity measure, and Spearman rank correlation (Table 20). However, among positive parameter changes, parameter C caused the greatest effect on similarity measures. Negative changes to parameters A and B resulted in larger values for mean absolute difference than those resulting from positive changes to A, B, C, and D (Table 20). For changes to all parameters, the null hypothesis was accepted for all similarity measures. That is, none of the changes to index parameters resulted in significant changes to the overall utility map. All values for weighted Spearman rank correlation were larger than those for unweighted Spearman rank correlation, which demonstrates even greater similarity among AUs with higher utility scores than lower scores.

Table 20. Similarity measures comparing original utility scores obtained after changing parameter values in the Suitability Index

	A		**B**		**C**	**D**
	-0.1	**+0.1**	**-0.1**	**+0.1**	**+0.1**	**+0.1**
Mean absolute difference	3.3	3.0	3.4	2.8	3.1	3.0
Bray-Curtis Measure	0.979	0.981	0.978	0.982	0.980	0.981
Spearman Rank Correlation	0.986	0.990	0.990	0.990	0.987	0.989
Weighted Rank Correlation	0.992	0.994	0.993	0.993	0.993	0.993

According to the similarity measures, there was little overall difference between the original and altered utility maps; however, many individual AUs did change, and some showed statistically significant changes in utility (Appendix 15). When each of the parameters was changed, about 50% of AUs changed utility score but only about 2–3.5% had a statistically significant change. Changes to parameter C, which modifies the relative influence of road density, caused the greatest number of significant changes.

Since utility will be used to prioritize AUs for conservation, the sensitivity of AU rank to changes in the suitability index is especially important. This analysis used only AUs that were highly ranked. For AUs with ranks from 1 to 100 (i.e., the top 11% of AUs), changes to A, which modifies the relative influence of management status, caused the greatest mean absolute difference in rank, followed by D, then B, and then C (Appendix 15). For AUs with the rank equal to 1 (i.e., utility=100; n=159), parameter B caused the greatest mean absolute change in rank followed by parameter A. Overall, few AUs with rank equal to 1 changed rank in response to parameters changes. Changes to B caused only 2.5% of them to change rank.

5.4 Discussion

How should the irreplaceability and conservation utility indices be interpreted? These indices were constructed by running MARXAN at ten representation levels. The first level captured a very small amount of each target, and the last level captured everything—i.e., all known occurrences of all targets. The first representation level should be thought of as the amount of biodiversity to be captured in an initial set of reserves, the second level as an additional amount to be captured by an enlarged set of reserves, the third level as an even greater additional amount, and so on. At each level, MARXAN's output indicates the relative necessity of each AU for efficiently capturing that particular amount of biodiversity. When the outputs from each level are summed, the result specifies the most efficient sequence of AU protection that will eventually represent all biodiversity. The sequence in which AUs should be protected is one way to gauge their relative importance. AUs that have the highest irreplaceability or utility scores should be protected first, and therefore, are the most important AUs for biodiversity conservation.

MARXAN generates a set of AUs corresponding to a local minimum of the objective function (see Appendix 8). AUs are included in a solution because they serve to minimize the objective function. Therefore, AUs with high irreplaceability or high utility scores are those that (1) contain one or more rare targets and/or (2) contain a large number of target occurrences. High utility scores are also attained by AUs with low unsuitability (i.e., high suitability). AUs with scores of 100 are those that were selected in every replicate at every representation level. To be chosen in every replicate the AU must contain target occurrences that were found in no other AU, contain a substantially larger number of occurrences than other AUs, or contain target occurrences and have a substantially lower unsuitability than other AUs.

Utility and irreplaceability scores are different ways to prioritize places for conservation. Irreplaceability has been the most commonly used index (e.g., Andelman and Willig 2002; Noss et al. 2002; Leslie et al. 2003; Stewart et al. 2003), and it assumes that the amount of land area where biodiversity values are found is the sole consideration for efficient conservation. Utility incorporates other factors, such as land management status and current condition, which can affect efficient conservation. In this analysis, many AUs attained scores of 100 for both utility and irreplaceability. These results demonstrate that for scores at or near 100, cost had little influence on selection frequency and that occurrence data drove the results. More importantly, it demonstrates that the results are robust. Under two different assumptions about efficiency (area versus unsuitability), the highest priority AUs were very similar.

Utility and irreplaceability scores were significantly different for many individual AUs at the middle and low end of the utility score range (see Appendix 15). This is useful information for prioritization. AUs at the low end of utility (or irreplaceability) typically are unremarkable in terms of biodiversity value. They contribute habitat or target occurrences, but they are interchangeable with other AUs. For these AUs, prioritizing on the basis of suitability rather than biodiversity value makes most sense. If a distinguishing feature of an AU is that conservation can be conducted there more successfully and inexpensively than in other AUs, then that AU should be a higher priority for action. For these AUs, the utility score should be used for prioritization.

The basic conclusion of the sensitivity analysis is that AU utility and rank change in response to changes in the suitability index. Similarity measures that compare "before" and "after" utility maps of the entire ecoregion indicate that the overall map is relatively insensitive to changes in suitability index parameters. That is, the average change over all AUs is small. However, the utility and rank of many AUs do change and some exhibit significant changes. The number of AUs that change significantly depends on which index parameter is changed and by how much.

The sensitivity of the utility map to changes in the suitability index was examined due to uncertainty about the index. The variable selection and parameter estimates for the index were based on best professional judgment. The sensitivity analysis considers how much utility scores would change if the subjective judgments were slightly different. The results of the sensitivity analysis had two implications for conservation planning. First, highest priority AUs (about ranks 1 through 10; the top 3% AUs) are rather robust to changes in the suitability index. Therefore, regardless of the uncertainties in the suitability index, confidence can be placed in the selection of the most highly ranked AUs. These AUs were selected mainly for their relative biological value, not relative suitability. For similar reasons, the lower ranked AUs (ranks >100), tend to be robust to changes in the suitability index—they maintain a low rank because they have relatively little biological value. Second, the utility of moderately ranked AUs (those ranked from 10^{th} to 100^{th}; about 12% of AUs), is sensitive to changes in the suitability index. When choosing among AUs of moderate rank, assumptions about how suitability affects rank must be examined.

Chapter 6 – Portfolio of Conservation Areas

This chapter presents the development of the mid-risk conservation portfolio and the results of the assessment. A conservation portfolio is a set of places where resources should be directed for the conservation of biodiversity. The conservation areas that make up the portfolio are summarized and how the overall portfolio captures fine- and coarse-filter targets is discussed. Alternative conservation portfolios reflecting different conservation goals for targets are reviewed.

6.1 Portfolio Development Process

Successful conservation will involve making choices about where limited resources should be expended (Ando et al. 1998; Pressey and Cowling, 2001). Portfolio creation is a major step toward making informed choices about where conservation areas or reserves should be located. Selecting a set of sites that efficiently capture multiple occurrences of hundreds of targets from thousands of potential sites is a task that cannot be accomplished by expert judgment alone. For this reason, MARXAN was used to help create the portfolio. Further explanation of MARXAN can be found in Appendix 8. Optimal reserve selection analyzes the trade-offs between conservation values and conservation costs to create an efficient set of conservation areas that satisfies conservation goals (Possingham et al. 2000; Cabeza and Moilanen 2001). The conservation value of a site is represented by the presence of target species, habitats, and ecological communities. The number, condition, and rarity of targets present at a particular site determine the conservation value of that place.

The portfolio design process for the North Cascades Ecoregion resulted in the creation of two portfolios: one for the terrestrial environment, the other for the freshwater environment (Maps 18 and 20). Portfolio creation was an iterative process that balanced the use of the optimal reserve selection algorithm with expert knowledge about important places for biodiversity conservation.

6.1.1 Terrestrial Assessment

The terrestrial portfolio identified a set of assessment units (AUs) that met conservation goals for all terrestrial conservation targets in a way that maximized portfolio suitability (Map 18). Terrestrial conservation targets included coarse-filter targets, such as terrestrial ecological systems, and fine-filter targets, such as rare plants, rare animals and rare communities (see Chapter 3).

Once the MARXAN analysis was complete, teams of experts were asked to examine the results and recommend additions and deletions to the selected areas based on their knowledge and experience of conservation target occurrences. Experts were also asked to identify potential habitat connectivity corridors between selected areas, since habitat connectivity is not targeted in the MARXAN analysis. Results of both the computer identified and expert selected areas were then used to create groups of AUs that would become terrestrial portfolio sites. The terrestrial portfolio refers to the complete set of these areas in the ecoregion.

6.1.2 Freshwater Assessment

The assessment of freshwater biodiversity was based on a different set of geographic boundaries than the ecoregion; it was based on ecological drainage units (EDUs) that overlap or connect with ecoregion boundaries (Map 5 and Chapter 3). The freshwater portfolio was developed independently from the terrestrial portfolio, reviewed by experts, and then overlaid with the terrestrial portfolio. Development of the preliminary freshwater portfolio relied on MARXAN spatial analysis to identify a set of watersheds that have both high biodiversity value and high suitability for conservation. The objective in creating the freshwater portfolio, like the terrestrial, was to select the most efficient set of areas that meet goals for all targets and to do it at the least cost, as defined by the suitability index (Chapter 4). The watersheds selected in this MARXAN analysis were then subjected to expert review. The watersheds selected by analysis and expert review were then combined into groups of watersheds to make up freshwater portfolio sites (Map 20).

6.2 Conservation Goals

Both the terrestrial and freshwater portfolios were created using conservation goals that specified a given number and distribution of populations (for species) and areas (for habitats) that were needed to sustain biodiversity in the ecoregion (for terrestrial) or ecological drainage unit (for freshwater) over the long term.

The intent of the analysis was to capture sufficient occurrences to meet conservation goals in the most efficient way possible, while also preferentially choosing occurrences with the least human impacts, according to the suitability index (Chapter 4). For this ecological assessment, conservation goals were set that reflected a high likelihood of target species survival and functioning ecological systems. However, there is much uncertainty, for example, regarding threats like future land conversion and climate change and little information regarding the number of occurrences or the area of an ecological system necessary to maintain all species within an ecoregion (Soule and Sanjayan 1998). In short, we had no scientifically established method for setting conservation goals for the vast majority of coarse- and fine-filter targets. Where we lacked better information, we adopted a set of generic conservation goals developed by ecologists from The Nature Conservancy and NatureServe (Marshall et al. 2000; Comer et al. 2001, 2003; Neely et al. 2001; Rumsey et al. 2003; Floberg et al. 2003; see also Appendix 19).

While the goals cannot be treated as conditions for ensuring long-term survival of species, they are an important device for assembling a portfolio of conservation areas that captures multiple examples of the ecoregion's biodiversity. These goals also provide a metric for gauging the contribution of different portions of the ecoregion to the conservation of its biodiversity and measuring the progress of conservation in the ecoregion over time.

6.3 Summary of Results

6.3.1 Terrestrial and Freshwater Portfolios

The terrestrial portfolio, shown in Map 18, covers 1,687,001 ha (4,168,665 ac) or 35% of the North Cascades ecoregion. The freshwater portfolio, shown in Map 20, covers 1,453,965 ha (3,592,821 ac) or 39% of the North Cascades Ecoregion.

The combined portfolio (Map 26) is the result of the overlay of the terrestrial and freshwater portfolios. Interestingly, little overlap occurs between the two realms (15%). This is probably because the freshwater portfolios often involved selection of whole systems from headwaters to mainstem rivers, while terrestrial selection was more focused on core areas representing the highest quality occurrences and important habitats. Since the lower elevation freshwater mainstem rivers tended to have higher human impacts, the terrestrial selection process tended to gravitate to upland or more pristine riparian sites to capture its targets, in areas removed from mainstem freshwater priorities.

While the conservation areas were designed with knowledge of the area requirements of conservation targets, they do not specifically describe the lands and waters needed to maintain each target at that location. Finer-scale conservation planning is needed to more precisely map the lands and waters that are necessary to ensure conservation of the targets in any particular area. Also, because of the way in which portfolio conservation areas were assembled, it may be appropriate to aggregate conservation areas at a later time. Conversely, it may be necessary to segregate individual conservation areas from larger ones. This refinement will be completed during later analyses that consider site-specific targets, threats, and goals. Thus, the current boundaries of the ecoregion are starting points for further analyses. The iterative nature of ecoregional assessments requires that results be interpreted carefully. The intent is to clarify and fill information gaps over time and to revisit and refine the portfolio as new information becomes available.

6.3.2 Terrestrial Portfolio

Of the total 155 portfolio sites resulting from the terrestrial analysis, 91 are entirely within British Columbia and 59 are entirely in Washington. Five portfolio sites are shared between British Columbia and Washington. They ranged in size from 500 ha (i.e., 1 hexagon; 1,236 ac) to landscapes of 204,000 ha (504,094 ac).

6.3.2.1 Protected Status and Land Ownership Patterns

Approximately 40% of the terrestrial portfolio is currently in designated protected areas. Assuming the biodiversity features in the portion of the portfolio within GAP 1 or GAP 2 lands are already protected, an additional 21% of the ecoregion requires some form of conservation action in order to conserve the full terrestrial portfolio (Map 23). A full breakdown of the protected status of the portfolio is shown in Table 21.

The patterns of land ownership and management within the terrestrial portfolio of conservation areas are shown in Table 22. Public lands, both federal and state/provincial, make up the majority of the ecoregional portfolio; 48% of the land in the BC portion of the portfolio is provincial Crown land while over 71% of the land in the WA portion of the portfolio is US federal land and more than 12% is state land. Private lands account for 5% of the portfolio in BC and 14% in WA. First Nations/tribal lands comprise less than 1% of the portfolio in both BC and WA.

Table 21. Protected areas within the terrestrial portfolio

	GAP 1	**GAP 2**	**GAP 3**	**GAP 4**
Area in Ecoregion (ha)	1,266,592	4,3681	2,945,583	172,754
% of Ecoregion	26%	1%	61%	4%
Terrestrial Portfolio (ha)	652,179	20,751	876,047	47,370
% of Portfolio	39%	1%	52%	3%
GAP Status in BC portion of Terrestrial Portfolio (ha)	349,613	5,686	621,674	46,393
% of BC portion	34%	1%	61%	5%
GAP Status in WA portion of Terrestrial Portfolio (ha)	302,566	15,065	254,373	977
% of WA portion	46%	2%	38%	<1%

Table 22. Land ownership within the terrestrial portfolio

Jurisdiction	% in Portfolio	Area in Portfolio (ha)	% in Ecoregion	Area in Ecoregion (ha)
Brtish Columbia				
Provincial Crown Land	48%	492,130	64%	1,982,360
Private Land	5%	53,402	5%	161,733
Provincial Park / Protected Area	34%	350,089	16%	511,827
Tree Farm License	12%	121,170	14%	444,641
Indian Reserve	<1%	5,433	1%	17,881
Conservation Trust Land	<1%	1,077	<1%	2,123
Federal Land	<1%	65	<1%	94
Washington – Federal Lands				
Forest Service: non-wilderness	32%	210,753	26%	430,305
Forest Service: Wilderness	24%	161,316	26%	431,423
National Park Service	15%	99,777	14%	233,544
Other Federal	<1%	1,222	<1%	1,706
Bureau of Land Management	<1%	98	<1%	263
Washington - State Lands				
Department of Natural Resources: Other	11%	7,0321	9%	147,114
Department of Fish and Wildlife	<1%	667	<1%	734
Department of Natural Resources: NRCA	1%	8,269	1%	15,321
Parks and Recreation	<1%	814	<1%	2270
Department of Natural Resources: NAP	<1%	734	<1%	946
Washington - Other Lands				
Private Land	14%	9,2471	22%	371,136
Tribal Land	<1%	19	<1%	19
County or Municipal	2%	14,027	2%	32,139
Conservation Land (TNC/Other)	<1%	3,288	<1%	7,955

6.3.3 Freshwater Portfolio

Of the total 121 portfolio sites resulting from the freshwater analysis, 59 are entirely within British Columbia and 59 are entirely in Washington. Three sites are shared between British Columbia and Washington. They range in size from single watersheds of 729 ha (1,802 ac) to combined watershed areas of 203,259 ha (502,263 ac).

A total of 258 watersheds were part of the freshwater conservation portfolio. Together they covered 3,475,256 ha (8,587,532 ac) and equalled 40% of the area contained in the three EDUs analysed (Map 5). The freshwater portfolio was aggregated and delineated as portfolio sites for watersheds that intersect the ecoregion. A number of watersheds were added to the portfolio to improve drainage network connectivity.

Sixty delineated freshwater Priority Conservation Areas (PCAs) are fully or partially in the North Cascades ecoregion[8]. They cover 2,008,055 ha (4,962,003 ac) or 39% of the ecoregion. Twenty-eight of them are entirely within British Columbia and 24 are entirely in Washington. One site is shared between British Columbia and Washington. They range in

[8] Including the full extent of the terrestrial assessment units.

size from partial watersheds of 828 ha (2,046 ac) to freshwater systems of 203,259 ha (502,262 ac).

6.3.3.1 Protected Status and Land Ownership Patterns

Approximately 26 % of the area of the freshwater portfolio (to the extent of the ecoregion[9], not EDUs) is currently in designated protected areas (GAP 1 or 2). Assuming the biodiversity values within the portion of the portfolio that coincides with parks (GAP 1 or 2) are already protected; an additional 13 % of the ecoregion requires some form of conservation action in order to conserve the full freshwater portfolio (Map 25). A full breakdown of the protected status of the portfolio is found in Table 23.

The patterns of land ownership and management within the freshwater portfolio of conservation areas are shown in Table 24. Public lands, both federal and state/provincial, make up most of the ecoregional freshwater portfolio; 53 % of the freshwater portfolio in BC is provincial Crown land, while just over 50% of the portfolio in WA is US federal land and over 15% is state land. Private lands encompass y 6 % of the freshwater portfolio in BC and and 33% in WA. First Nations/tribal lands comprise less than 1 % of the freshwater portfolio.

Table 23. Protected areas within the freshwater portfolio

	GAP 1	GAP 2	GAP 3	GAP 4
Area in Ecoregion (ha)	1,266,592	43,681	2,945,583	172,754
% Ecoregion	26%	1%	61%	4%
Freshwater Portfolio (ha)	443,060	11,062	1,046,005	79,602
% of Portfolio	25%	1%	59%	5%
GAP Status in BC portion of Freshwater Portfolio (ha)	247,592	5,151	868,802	79,548
% of BC portion	21%	<1%	72%	7%
GAP Status in WA portion of Freshwater Portfolio (ha)	195,468	5,911	177,203	54
% of WA portion	35%	1%	32%	<1%

Table 24. Land ownership within the freshwater portfolio

Jurisdiction	% in Portfolio	Area in Portfolio (ha)	% in Ecoregion	Area in Ecoregion (ha)
British Columbia				
Provincial Crown Land	53%	635,298	64%	1,982,360
Private Land	6%	70,884	5%	161,733
Provincial Park or Protected Area	21%	249,971	16%	511,827
Tree Farm License	19%	231,656	14%	444,641
Indian Reserve	1%	12,254	1%	17,881
Conservation Trust Land	<1%	964	<1%	2,123
Federal Land	<1%	65	<1%	94
Washington - Federal Lands				
Forest Service: non-wilderness	20%	111,926	26%	430,305
Forest Service: Wilderness	14%	81,046	26%	431,423
Other Federal	<1%	1,651	<1%	1,706
Bureau of Land Management	<1%	95	<1%	263
National Park Service	16%	90,842	14%	233,544

[9] Including the full extent of the terrestrial assessment units.

Jurisdiction	% in Portfolio	Area in Portfolio (ha)	% in Ecoregion	Area in Ecoregion (ha)
Washington - State Lands				
Department of Natural Resources: Other	14%	79,582	9%	147,114
Department of Fish and Wildlife	<1%	610	<1%	734
Department of Natural Resources: NRCA	1%	3,366	1%	15,321
Parks and Recreation	<1%	1,243	<1%	2,270
Department of Natural Resources: NAP	<1%	746	<1%	946
Washington - Other Lands				
Private Land	33%	183,615	22%	371,136
Tribal Land	<1%	19	<1%	19
Conservation Land (TNC/Other)	1%	5,335	<1%	7,955
County or Municipal	<1%	1,456	2%	32,139

6.4 Target Representation and Conservation Goals

Major ecological gradients and variability are well represented across the portfolio of conservation areas as evidenced by the high degree of representation of ecological systems and the ecological variables used to represent them (vegetation, elevation, landform, geologic substrate, etc.). For the terrestrial systems targets 100% of the conservation goals were achieved in 3 of the 4 ecosections. Overall, 100% of terrestrial systems conservation goals were achieved for the ecoregion. Refer to Table 25 for a summary of goal performance for terrestrial ecological systems.

Table 25. Summary of goal performance for terrestrial ecological systems

Ecosection	Number of Systems Targets	Targets with Goals	Targets Meeting Goals for Ecosection	% Targets Meeting Goals for Ecosection
Northeastern Pacific Ranges	19	14	13	93
Northwestern Cascade Ranges	19	15	15	100
Southeastern Pacific Ranges	19	16	16	100
Southern Pacific Ranges	19	11	11	100
Ecoregion	19	19	19	100

For the terrestrial fine filter animals analysis, there were 43 of 81 targets (53%) with spatial data that were used in the MARXAN analyses: 2 of 2 amphibian targets, 15 of 26 bird targets, 11 of 16 mammal targets, 6 of 13 butterfly targets, and 9 of 24 mollusc targets. Of those targets with spatial data, only 13 of 43 (30%) met the conservation goals that were set for them (Table 26). The success of meeting nearly all conservation goals for terrestrial systems contrasted with only meeting 30% of terrestrial fine filter animals goals provides insights into the performance of the MARXAN model. The terrestrial systems dataset provided complete coverage of the ecoregion, therefore MARXAN had enough information and choice to balance portfolio costs with meeting conservation goals for all targets. Whereas for the terrestrial fine filter animals targets data, those targets that were represented as occurrence data generally had too few occurrences to meet conservation goals, and those targets that were represented using habitat data generally met conservation goals. This also applies to the freshwater coarse- and fine-filter targets and goals.

Table 26. Summary of the number of terrestrial animal targets with spatial data, and targets with sufficient spatial data to meet conservation goals, by taxon

Terrestrial Animal Taxa Group	# of Targets in Taxa Group	# of Targets with Spatial Data (%)	# of Targets Meeting Conservation Goals (% of targets with data)
Amphibians	2	2 (100%)	1 (50%)
Reptiles	0	---	---
Birds	26	15 (58%)	5 (33%)
Mammals	16	11 (69%)	6 (55%)
Butterflies	13	6 (46%)	0 (0%)
Molluscs	24	9 (38%)	1 (11%)
Total	81	43 (53%)	13 (30%)

As with the terrestrial portfolio, the freshwater portfolio well represented major ecological gradients and variability across the portfolio of conservation areas as evidenced by the high degree of representation of the ecological systems and ecological variables used to represent them.Goals were met for 16 of the 17 freshwater system types in the Lower Fraser EDU, 5 of the 7 freshwater system types in the Puget Sound EDU, and 16 of the 16 freshwater system types in the Southern Coastal Streams EDU (Table 27).

Table 27. Summary of goal performance for freshwater ecological systems

EDU	Number of Targets	Systems Targets with Goals	Targets Meeting Goals for EDU	% Targets Meeting Goals for EDU
Lower Fraser EDU	17	17	16	94%
Puget Sound EDU	7	7	5	71%
Southern Coastal Streams EDU	16	16	16	100%

For the freshwater fine-filter animals analysis, goals and targets were stratified by EDU and each EDU was treated as its own study area for the purposes of running the MARXAN analysis. Therefore, each EDU had its own set of targets and goals. For the Lower Fraser EDU: 2 of 4 amphibian targets met the stated conservation goals, 12 of 12 insects, and 1 of 1 mammal targets, while no fish targets met stated conservation goals. For the Southern Coastal Streams EDU: 1 of 1 amphibian targets, 3 of 4 insect targets, and 1 of 1 mammal targets met the stated conservation goals, while 0 of 1 bird targets, and 0 of 14 fish targets met stated conservation goals. Refer to Table 28 for a summary of targets and conservation goals. As previously noted, the Puget Sound EDU was assessed as part of another ecoregional assessment process and the resultant information was included as part of the North Cascades freshwater analysis. Refer to Appendix 10 for details of the Puget Sound EDU methods and results.

Table 28. Summary of freshwater fine-filter animals targets

EDU	Freshwater Fine Filter Taxa	Number of Targets	# of Targets with Goals	# of Targets Meeting Goals for EDU	% of Targets with Data Meeting Goals for EDU
Lower Fraser EDU	Amphibians	5	4	2	50%
Lower Fraser EDU	Birds	1	0	---	---
Lower Fraser EDU	Fishes	32	20	0	0%

EDU	Freshwater Fine Filter Taxa	Number of Targets	# of Targets with Goals	# of Targets Meeting Goals for EDU	% of Targets with Data Meeting Goals for EDU
Lower Fraser EDU	Insects	14	12	12	100%
Lower Fraser EDU	Mammals	1	1	1	100%
Southern Coastal Streams EDU	Amphibians	5	1	1	100%
Southern Coastal Streams EDU	Birds	1	1	0	0%
Southern Coastal Streams EDU	Fishes	29	13	0	0%
Southern Coastal Streams EDU	Insects	14	4	3	75%
Southern Coastal Streams EDU	Mammals	1	1	1	100%

6.5 Alternative Portfolios

The size of the conservation portfolio is mainly determined by the goals – the larger the goals for representing targets, the larger the area of the portfolio. For this reason, goal setting is possibly the most critical step in creating a portfolio. Hence, we created additional portfolios with higher and lower goals to demonstrate how changing goals changes the total size and configuration of the portfolio.

6.5.1 Methods

The methods used to develop the alternative terrestrial and freshwater portfolios were essentially the same.

Risk is related to the amount of habitat or the number of target occurrences that are protected in the portfolio. More habitat area and number of occurrences correlates with a lower level of risk. The goals for the lower risk and higher risk portfolios were based on the goals of the mid-risk portfolio. For higher risk, the goals were reduced. All mid-risk coarse-filter goals were multiplied by 0.6 and fine-filter goals by 0.5, but the goals could not be less than 1 for targets with occurrence goals. For the lower risk, the goals were increased. The mid-risk coarse-filter goals were multiplied by 1.6 and fine-filter goals by 1.5, but the goals could not exceed the maximum available.

Higher and lower risk alternative portfolios that were derived from the mid-risk portfolios were created. All of the AUs in the higher risk portfolio belong to the mid-risk portfolio and all AUs in the mid-risk portfolio belong to the lower risk portfolio. MARXAN has a feature for locking AUs into or out of the optimal solution. To create a nested higher risk portfolio, all AUs that were not in the mid-risk portfolio were locked out. This limited the algorithm's selection space to only the mid-risk portfolio. To create a nested lower risk portfolio, all AUs that were in the mid-risk portfolio were locked in. Hence, the low-risk portfolio started with these locked-in AUs so the algorithm added more AUs to the mid-risk portfolio.

The site selection algorithm for both the lower risk and higher risk portfolios was run with the same targets and with the same boundary modifier and target penalty factors as those used for the mid-risk portfolio.

6.5.2 *Results*

The alternative portfolios for terrestrial and freshwater biodiversity are depicted on Maps 19 and 21. The terrestrial mid-risk portfolio included 30 % of the hexagonal assessment units (Table 29). However, the assessment units in the freshwater portfolio tended to be among the largest watersheds, and consequently, the freshwater portfolio captured about 39 % of the land area (Table 30).

The number of AUs in the terrestrial higher risk portfolio was roughly 0.54 times the mid-risk portfolio (Table 29) and the number of AUs in the terrestrial lower risk portfolio was about 1.56 times the mid-risk portfolio. These ratios were roughly the same that were used to alter the mid-risk goals. The same ratios for the Puget Sound EDU alternatives were 0.50 and 1.56, which was about the same as those used to alter the mid-risk goals.

Table 29. Percent of all Assessment Units (AUs) in ecoregion or Ecological Drainage Unit (EDU) that was captured by each of the alternative portfolios

Analysis	Percent of AUs selected			Total number of AUs available
	higher risk	mid-risk	lower risk	
Terrestrial	16.2	29.8	46.6	9,587
Freshwater: Puget Sound EDU	13.1	26.2	41.0	442
Freshwater: Lower Fraser River and Southern Coastal EDUs	8.5	15.3	30.5	909

Table 30. Percent of land area in ecoregion or Ecological Drainage Unit (EDU) that was captured by each of the alternative portfolios

Analysis	Percent of area selected			Total area available (ha)
	higher risk	mid-risk	lower risk	
Terrestrial	16.2	29.8	46.6	4,793,500
Freshwater: Puget Sound EDU	24.4	39.0	57.1	3,603,000
Freshwater: Lower Fraser River and Southern Coastal EDUs	27.6	39.7	57.0	5,272,000

6.5.3 *Discussion*

The three alternative portfolios represent different tolerances of risk to biodiversity loss. The low risk portfolio covers the largest geographic area; the high risk covers the smallest. The three portfolios are also an acknowledgment of the uncertainty involved in determining how much area is enough to conserve biodiversity. However, any portfolio's absolute risk to the loss of biodiversity over the long-term is unknown.

6.6 Portfolio Integration Efforts and Overlay Results

There is an underlying assumption in ecoregional assessment methodology, as described in *Geography of Hope* (TNC 2001): we want efficiency in selecting sites to reduce the cost of conservation, and minimizing portfolio area is one way of increasing efficiency. This assumption also applies to the integration of the terrestrial and the freshwater biodiversity values. Ideally, we would address common ecological functions, processes and biological elements that operate between terrestrial and freshwater systems in our conservation plan. However, no claims are made, even implicitly, that this was achieved through this project. Post-assessment analysis at the sub-ecoregional scale is needed to determine the extent to which such things as ecological functions are shared.

In this assessment, an attempt was made to create an integrated portfolio by combining terrestrial and freshwater targets into one MARXAN run as described in Appendix 17. However, several challenges presented themselves. While the initial results did provide a portfolio that was efficient with respect to size of the ecoregional footprint, the sacrifices made to achieve this efficiency were not satisfactory.

Specifically, the goal of integration is to select areas of the highest quality for terrestrial and freshwater biodiversity in order to achieve a smaller spatial footprint. In this study, the integration process exchanged too many high quality sites for marginal quality areas for the sake of creating a smaller footprint. During integration, it was also difficult to combine priority freshwater watersheds meaningfully within selected terrestrial hexagons, since watersheds and stream reaches would sometimes be selected in fragments. This attempted integration required more compromise (too little area chosen, too many goals met in areas of marginal quality and too much fragmentation of freshwater priorities) than was considered acceptable by the Core Team. Future iterations of this assessment will produce a fully integrated portfolio.

6.6.1 Combined Portfolios

The mid-risk terrestrial and freshwater portfolios were combined by overlaying one portfolio over the other. Map 26 shows both portfolios, and the areas of overlap. Given the ecological and technical challenges discussed above, a simple overlay of the terrestrial and freshwater portfolios was considered appropriate because:

1. it is easy to identify why an area is selected
2. the footprint of the expert-reviewed terrestrial and freshwater portfolios is maintained
3. neither the terrestrial or freshwater portfolio is compromised
4. areas where biodiversity values from each portfolio coincide are depicted

The overlapping portfolio area is also a relatively small portion of the ecoregion (15%). These areas may be further evaluated by using the prioritization analyses of the freshwater and terrestrial portfolios (Chapter 7). However, because freshwater conservation must occur at the watershed scale and terrestrial conservation must take place in areas large enough for natural disturbances to be maintained, those referencing the areas of overlap are advised to also consult the underlying freshwater and terrestrial sites.

The portfolios include a suite of sites that collectively represent the biodiversity of the ecoregion. In addition to showing areas that are most important for terrestrial or freshwater species and natural systems, Map 26 depicts areas of overlap where terrestrial and freshwater priorities co-occur. The overlapping areas do not include many areas identified by experts, generally do not meet goals, and frequently contain only partial target occurrences. However, they have utility for those interested in conserving both priority freshwater and terrestrial targets in the same area, by directing practitioners to areas where the potential exists to incorporate both terrestrial and freshwater targets in their conservation strategies.

6.7 Retrospective Analysis

For most target species, data are used to define the portfolio of sites by incorporating it into the analysis and defining the goals for capturing that target in the site selection process. However for a few species, we do not include their data and goals in the site selection process that defines the portfolio, but rather we evaluate the portfolio by how well it captures the data that represent these species. We refer to these species as retrospective targets. If the goal of the species is not met, modifications to the site selection process can be made such as including the species data in the site selection analysis.

A species may be represented by so much data and such large goals that its inclusion results in a portfolio that mimics that species' data (i.e. weighted too much for that species), and consequently the portfolio does not include areas that are important to a large number of other targets. This was the case for two wide-ranging carnivores that were selected as targets for the North Cascades assessment: the grizzly bear and the fisher. For example, the grizzly bear recovery zone coincides with >75% of the Washington portion of the ecoregion and the default goal for grizzly bears is 30% of that area. This amount of data and the 30% goal would significantly influence the result of the site selection analysis, in effect driving the solution to mimic the recovery zone within the Washington portion of the ecoregion.

6.7.1 Grizzly Bear

In BC, data was obtained from a spatial modeling project on grizzly bear habitat capability, suitability, and effectiveness in southwestern British Columbia (Apps and Hamilton 2002). Based on advice from the authors (C. Apps and A. Hamilton, pers. comm.), the team used the habitat effectiveness data in the retrospective comparison. Effectiveness was based on habitat suitability values and a habitat security sub-model (Apps and Hamilton 2002). Habitat effectiveness classes and corresponding bear densities are listed in Table 31.

Table 31. Grizzly bear Habitat Effectiveness Ratings (Apps and Hamilton, 2002)

BC Grizzly Bear Habitat Effectiveness Class Rating	
Habitat Class	**Bears/1000 km2**
1	76 – 100
2	51 –75
3	26 – 50
4	6 – 25
5	0 – 5

In Washington, grizzly bear habitat was identified as those areas within the ecoregion that overlapped with the grizzly bear recovery area (USFWS 1993). This area was further delineated to define core grizzly habitats by excluding (buffering and removing) areas near roads, trails and developed areas.

6.7.2 Fisher

The fisher was considered a target in the Washington portion of the ecoregion but was not included among the targets listed for British Columbia as the ecoregion is largely outside the species range within the province (Weir 2003). While the fisher is presumed extirpated from Washington, habitat modeling has been undertaken within the fisher's historical range in the North Cascades to identify suitable areas for fisher reintroductions (Lewis and Hayes 2004). The fisher was used as a retrospective target because a large amount of suitable habitat was identified within the Washington portion of the ecoregion and a relatively large goal (30%) was used.

6.7.2.1 Results

The terrestrial portfolio captured 42% of core habitat in Washington for grizzly bears and 35% of habitat effectiveness classes 1–5 in British Columbia (Table 32, Maps 30a,b). The goals for grizzly bear habitat (30%) were exceeded in British Columbia (35%) and in Washington (42%). As expected, the goals for grizzly bears in British Columbia were met largely through the selection of areas in habitat classes 4 and 5 (i.e., habitats that support lower grizzly densities), as they made up >98% of the grizzly habitat in the British Columbia portion of the ecoregion (Table 33). Despite the small amount of area in habitat classes 2 and 3 (i.e., habitats that support greater grizzly densities), large percentages of these areas (55 and 42%, respectively) were captured by the portfolio (Table 33).

There was a remarkable overlap between the portfolio and suitable fisher habitat (Map 29). The portfolio captured 54% of fisher habitat in Washington, greatly exceeding the goal of 30% (Table 32, Map 29).

Table 32. Summary of the retrospective analysis for Fisher and Grizzly bear

Terrestrial Retro Target Analyses	Hectares (ha)	Acres (ac)	Percent captured
Fisher Habitat (within 5km buffer) (WA only)	255,799	632,092	
Fisher Habitat Captured (within 5km buffer) (WA only)	138,603	342,495	54%
Grizzly Bear Core Habitat Total Area (WA only)	807,686	1,995,832	
Grizzly Bear Core Habitat Area (WA only) Captured	336,921	832,550	42%
Grizzly Bear Effectiveness Habitat Area (BC only: classes 1 - 5)**	1,484,514	3,668,308	
Grizzly Bear Effectiveness Habitat Area Captured (BC only: classes 1 - 5)**	514,076	1,270,308	35%

Table 33. The availability of Grizzly bear habitat and the amount captured by the portfolio, by habitat class, in the British Columbia portion of the ecoregion

BC Grizzly Bear Habitat Capability, Suitability and Effectiveness Class Rating		Amount of habitat available and captured, by class	
Habitat Class	**Bears/1000 km^2**	**Amount available (km^2) (% of available)**	**Amount captured (% of available)**
1	76 – 100	0.25 (<0.1%)	0.0 (0%)
2	51 –75	21 (0.14%)	12 (55%)
3	26 – 50	133 (0.89%)	55 (42%)
4	6 – 25	1744 (11.7%)	569 (33%)
5	0 – 5	12947 (87.2%)	4505 (35%)

6.7.3 Northern Spotted Owl

Northern Spotted owls are listed as federally threatened in the United States and as endangered (listed by COSEWIC in 2000) in Canada. At the onset of the North Cascades

ERA team members debated whether or not to use the Northern Spotted owl as a focal species and create a habitat-based model for inclusion into the MARXAN analysis. However, a habitat model was not available to us at that time, so we used point locations of spotted owl nests and observations to represent the species. Given the importance of conserving Northern Spotted owls and the fact that the ecoregion contains all of Canada's remaining spotted owls and spotted owl habitat, we conducted a post hoc assessment of how well the portfolios captured northern spotted owl habitat.

In Washington, the team used spotted owl occupancy data, which included point locations for spotted owl nests and locations where resident pairs were observed. In BC we also used point locations for documented nests and locations of spotted owl detections. These data were part of the fine-filter animals analysis. Goals were set for Northern Spotted owl based on expert input. The goals were to capture all of the 169 nests (in BC and Washington) and resident pair sites (Washington only), and 25 of the 34 owl detection sites (other than nests) in BC.

Although not treated as a focal species, Northern Spotted owl habitat and occurrences were captured directly in the fine-filter analysis and indirectly in the terrestrial systems analysis where old-growth forests were mapped and given special emphasis (Chapter 3 and Appendix 9). Northern Spotted owls are largely dependent on landscapes dominated by low-elevation old-growth forests for habitat.

Northern Spotted owl habitat and corridors were also directly captured in the assessment through expert input. Experts in Washington and British Columbia identified connectivity corridors for wide-ranging species including the Northern Spotted owl, with considerable attention focused on areas where the ecoregion narrows, north of the international boundary. All expert recommended areas were added in to the assessment as expert identified areas (Map 22).

For a post hoc assessment of how well the portfolios captured Northern Spotted owl habitat, we obtained Northern Spotted owl habitat data from the Western Canada Wilderness Committee (WCWC) and overlaid it with the North Cascades assessment portfolios. This data provided by the WCWC is based on the following datasets:

- Chilliwack Forest District forest cover data, 1:20,000 scale. MoF, BC, 2001.
- Squamish (excluding TFL38) Forest District forest cover data, 1:20,000 scale. MoF, BC, 2001.
- Former Lillooet Forest District (now amalgamated with the Merritt Forest District to form the larger Cascades Forest District) forest cover data, 1:20,000 scale. MoF, BC, 1999.
- Chilliwack and Cascades Forest Districts, Consolidated Forest Development Plans, 1:20,000 scale. MoF, BC, 2005.
- GVRD Watersheds forest cover data, 1:20,000 scale. GVRD, BC, 1991.
- TFL#38 forest cover data, 1:20,000 scale. Interfor, 1996.
- Baseline Thematic Mapping, 1:250,000 scale. MoE, BC, 1996.
- Digital Elevation Model, 1:20,000 scale. MoE, BC, 1996.

- Biogeoclimatic ecosystem classification (BEC) mapping data, 1:250,000 scale. MoF, BC, 2001.

6.7.3.1 Results

In general, the terrestrial, freshwater, and combined portfolios captured from 54% to 76% of identified northern spotted owl habitat in British Columbia (Table 34 and Map 31). This high level of data capture is important for this species of concern. However, emphasis placed on identifying important areas for spotted owl and old growth protection have not hindered our ability to efficiently identify areas of importance for the many other conservation targets encompassed in this assessment.

Table 34. Amount of Northern Spotted owl habitat captured in terrestrial, freshwater, and combined portfolios

	Hectares	Acres	Percent
Spotted Owl Habitat (within Terrestrial AUs)	308,654	762,700	
Spotted Owl Habitat Captured by Terrestrial Solution	165,997	410,186	54%
Spotted Owl Habitat Captured by Freshwater Solution	152,162	376,000	49%
Spotted Owl Habitat Captured by Union of Terrestrial and Freshwater Solutions	233,752	577,613	76%

Chapter 7 – Prioritization of Portfolios

7.1 Introduction

Limited resources and other social or economic considerations may make protection of the entire portfolio impractical. Ecoregional assessments typically identify a large number of conservation areas (Rumsey et al. 2003; Floberg et al. 2004). By virtue of its selection, each conservation area is worthy of conservation action; however, not all areas are of equal conservation value or in need of attention with the same degree of urgency. The challenge of conserving all of the identified areas in an ecoregional assessment is overwhelming if not impossible for any single organization or agency. By using a practical approach to priority setting, this challenge can be focused on an ambitious set of objectives, which if undertaken by the conservation community as a whole, is within our collective reach (Groves 2003).

The portfolio delineation phase of the North Cascades Ecoregional Assessment identified a very large proportion of the ecoregion as priority areas for conservation. With 54% of the ecoregion included within both the terrestrial and freshwater results, it was necessary to apply a prioritization scheme to help distinguish which conservation areas require conservation action more immediately than others.

7.2 Methods

The method described below can provide conservation strategists who are working in the North Cascades Ecoregion with a means of evaluating priorities based on quantitative measures that emerged from this assessment. This work was based on criteria established in TNC's *Geography of Hope* (Groves et al. 2000) and methods applied by Noss et al. (2002) in the Utah-Wyoming Rocky Mountains ecoregional plan. A more thorough evaluation of priorities is required and planners/decision-makers will need to build on the quantitative summary presented here with more subjective qualitative measures related to conservation feasibility, opportunity and leverage.

7.2.1 Irreplaceability versus Vulnerability Scatter plot

One approach for prioritization is to plot biodiversity value of a site against the degree of threat to that site. The irreplaceability versus vulnerability scatter plot was first used by Pressey et al. (1996, as described by Margules and Pressey 2000) and was more recently used by Noss et al. (2002) and Lawler et al. (2003). In this study, irreplaceability versus vulnerability was plotted for the sites in the conservation portfolio. Irreplaceability has been defined a number of different ways (Pressey et al. 1994; Ferrier et al. 2000; Noss et al. 2002; Leslie et al. 2003; and Stewart et al. 2003). The definition of irreplaceability used in this study (see Section 6.2.1) was similar to that of Andelman and Willig (2002) and Leslie et al. (2003). Irreplaceability was normalized by dividing all values by the maximum value and multiplying by 100.

Margules and Pressey (2000) defined vulnerability as the risk of an area being transformed by extractive uses, but it could be defined more broadly as the risk of an area being transformed by degradative processes. The broader definition encompasses adverse impacts from invasive species and fire suppression. Vulnerability could also be defined from the perspective of target species—the relative likelihood that target species will be lost from an area. Since target persistence depends on habitat, a vulnerability index would be a function of current and likely future habitat conditions. Future habitat conditions are generally determined by the management practices and policies associated with an area. The suitability index used in this study incorporated factors that reflected both current habitat conditions and management; therefore, for the purposes of prioritization, it was assumed that the suitability index could also be used as a vulnerability index. The "integrated" vulnerability index was calculated by averaging the terrestrial and freshwater suitability indices for each AU. Like the suitability index, vulnerability was normalized by dividing all values by the maximum value and multiplying by 100.

Margules and Pressey (2000) and Noss et al. (2002) divided their scatter plots into four quadrants which corresponded to priority categories: high irreplaceability, high vulnerability (Q1); high irreplaceability, low vulnerability (Q2); low irreplaceability, low vulnerability (Q3); and low irreplaceability, high vulnerability (Q4) (Figure 5). Potential conservation areas in Q1 were considered the highest priority; in Q3 they were the lowest priority. Quadrants Q2 and Q3 included conservation areas of moderate priority. However, the importance of each quadrant is debatable (Pyke 2005). Some have argued that the highest priorities should be potential conservation areas in Q2 because such places have high biological value and a high likelihood of successful conservation.

The purpose of dividing the scatter plot into quadrants is to assign conservation areas to priority categories. The scatter plot quadrant divisions used by Margules and Pressey (2000) and Noss et al (2002) implied that irreplaceability and vulnerability are equally important. Lacking a strong rationale for favouring either axis, the same convention was used in this study.

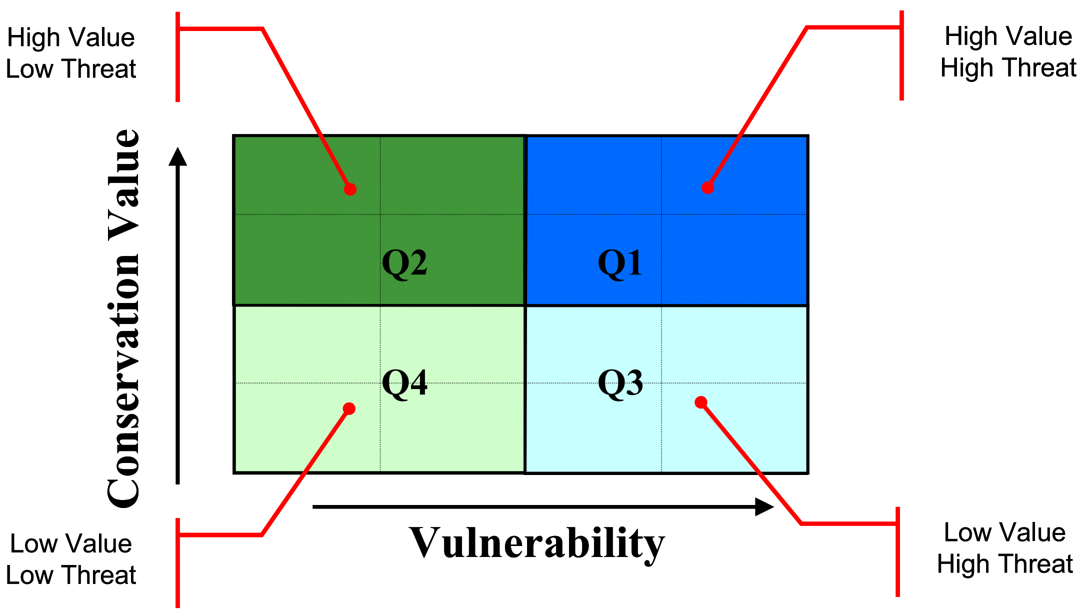

Figure 5. Graphing Relative Conservation Value and Vulnerability Scores

7.2.2 Prioritizing Terrestrial and Freshwater Portfolios in the North Cascades

Terrestrial and freshwater portfolios were prioritized separately using identical methodology. The first step was to define measures of conservation value and vulnerability. For this analysis, the measures were a function of readily available GIS data that were compiled through the ecoregional assessment process. Conservation value was based on irreplaceability measures, an output from running the MARXAN model; for vulnerability, the suitability index that was an input to the model was used (for specific detail see Appendix 17). These data were populated into a custom Microsoft Excel spreadsheet, which allowed interactive weightings for each independent factor. Weightings included two different factors: certainty and importance. Certainty can be considered as a measure of how much confidence can be placed in the data, and how well the data reflect what is intended. Importance represents the user's assumptions of which factors best reflect conservation value, or alternatively which factors best reflect an organization's mandate. Weightings for certainty and importance were input as a range from zero to one (with 1 being greatest), then multiplied for a final cumulative weighting for each factor. The core team came to consensus on one set of weightings, which resulted in the preliminary site prioritization (Appendix 17).

7.3 Results

The following three products resulted from the prioritization process:

1. Scatter plots that show the relative position of portfolio sites for conservation value and vulnerability (Figures 6 and 7). Each of the factors that comprised value and vulnerability were given weights reflecting the importance and confidence of each factor;
2. A table of portfolio sites organized by quartile position in the scatter plot (Maps 27a and 28a); and
3. A color-coded map that combined the conservation value quartiles with the vulnerability quartiles results in 16 possible bins, represented by a 16-color scatter plot grid and map (Maps 27 and 28).

For planners working at an ecoregional scale, the prioritization process allows potential conservation sites to be clearly sorted according to factors that are important for biodiversity value as well as those that pose threats. Relative positioning of sites on the scatter plot complements relative priority positioning of sites on the ecoregional map.

The measures of value and vulnerability are composed of the relative importance and confidence weightings applied to the various factors. Through quantification of practical differences between factors, this prioritization method allows alternative prioritization perspectives to be easily applied and compared. These alternatives, whether they involve a subset of factors used in this exercise or an entirely new set of factors, are accommodated and examined by changing the values or value weights in an EXCEL spreadsheet. Future analysis could allow interested parties to experiment with different prioritization scenarios. The ability to quantify the relative relationship of conservation value and vulnerability provides a basis for strategic planning and fosters debate on conservation needs.

The scatter plots created by using the methods described in Section 8.2 are shown below. The terrestrial priority conservation area results for individual sites are shown on Map 27; the scatter plot of terrestrial priority conservation areas is shown in Figure 6. The scatter plot of weighted freshwater conservation areas is shown in Figure 7. Individual site results for freshwater priority conservation areas are shown on Map 28.

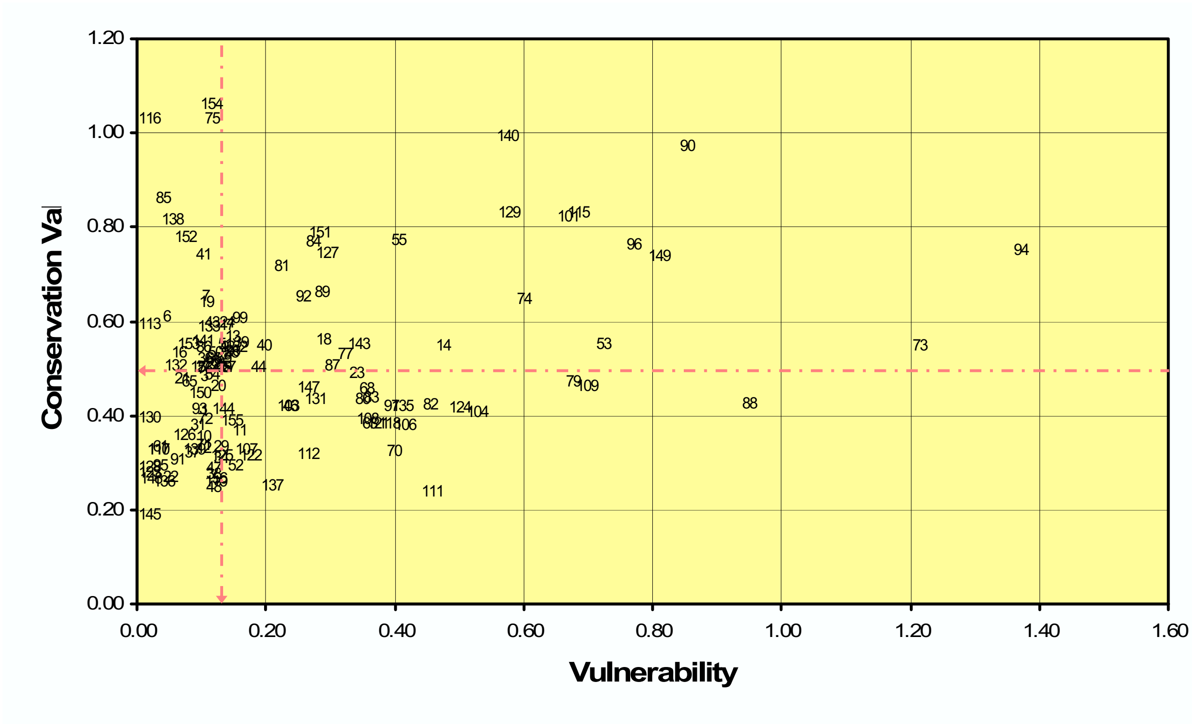

Figure 6. Terrestrial Priority Conservation Areas Scatter plot

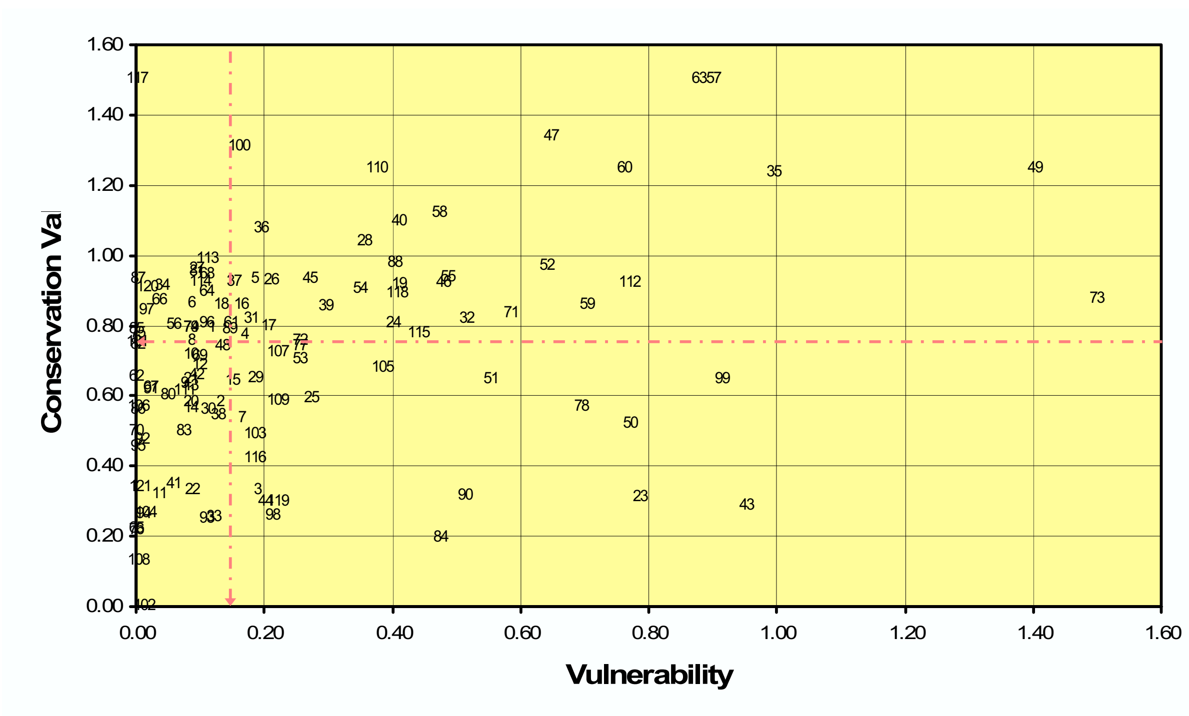

Figure 7. Freshwater Priority Conservation Areas Scatter plot

Chapter 8 – Recommendations for Future Iterations

Ecoregional assessments represent the current state of knowledge for identifying the most important places for biodiversity conservation in an ecoregion and establishing conservation priorities. It is expected that future iterations of assessments will be produced as new needs are recognized, methods are improved and new data become available. What follows is a list of suggestions to address in future iterations of these assessments.

8.1 Data

There were a number of species, communities and natural systems for which the desired occurrence data did not exist, including many invertebrate species, non-vascular plants, and imperiled and rare species and plant communities. As a result, most of the ecoregion's biodiversity must be represented through the surrogate of coarse-filter habitat types or ecological systems. New survey efforts should focus on finding additional occurrences of these species and communities and documenting the condition of known occurrences. Up-to-date survey data would add considerably to the overall quality of the analysis.

A low cost method for overcoming the lack of occurrence data is to use species-habitat models to predict species occurrences (Scott et al. 2002). However, there were a number of reasons why predictive models were not used in this assessment. First, reasonably accurate species-specific habitat models were not available. Those that were (e.g., Cassidy et al. 1997) had low spatial precision and untested accuracy. Second, resources were not available for developing models for a large number of species. Third, species-specific habitat models have both false negatives and false positives (areas where species exist or do not exist that are incorrectly represented in model results). Scientific literature indicates that false negatives inherent in survey data are likely to be less damaging than the false positives of habitat models. Freitag and Van Jaarsveld (1996) and Araujo and Williams (2000) recommended using only occurrence data because of the potential for false positives in habitat models. Loiselle (2003) recommended that species-specific habitat models be used cautiously. Given the lack of readily available models of proven accuracy, and without the resources needed to develop models for this assessment, it was deemed that the most prudent approach was to use primarily occurrence data (except where models were used for five large mammals: grizzly bear, lynx, fisher, bighorn sheep and mountain goat).

There are also data gaps for several terrestrial ecological systems. For example, non-forest ecological systems are relatively poorly represented compared with forest systems *(discussed in 3.1.1.4. Alpine and Montane Composite Targets)*. In addition, the best available spatial data were not adequate to map the four wetland systems accurately and consistently across the ecoregion. It is assumed, however, that many were captured as part of the mapped area of matrix and large patch ecological systems, especially as low-lying landforms. The unmapped wetland system types are Temperate Pacific Subalpine-Montane Wet Meadow (small patch), Temperate Pacific Tidal Salt and Brackish Marsh (small patch), North Pacific Bog and Fen (small patch), and North Pacific Hardwood-Conifer Swamp (large patch). Development of a comprehensive data source for terrestrial ecological systems would enhance future iterations.

Finally, gathering freshwater data was more challenging than gathering terrestrial data. The freshwater analysis was somewhat limited in precision, comprehensiveness, and reliability due to a number of data gaps: (1) No occurrence or satisfactory habitat data were available for 95 of the 143 (66%) target freshwater animal species (see Table 23). Over 90% of these species were invertebrates. This reflects our extremely poor understanding of invertebrate species diversity, geographic distribution, and habitat requirements. Eighteen of the species for which there were data had fewer than 10 known occurrences in the ecoregion. Lack of data is likely a function of low survey effort or inconsistent data collection methods; (2) Freshwater plants were not included in this iteration; and (3) the target list should be reevaluated for each EDU to determine if there are any species that should be targets for only one EDU rather than both EDUs. These data gaps should be addressed in subsequent assessment iterations. Additionally, we realize that the freshwater classification framework is a series of hypotheses that need to be tested and refined through additional data and expert review. We recommend that concurrently, data be gathered to refine/test the classification to bring the scientific rigor needed to further its development and use by conservation partners and agencies.

8.2 Conservation goals

Establishing conservation goals is among the most difficult scientific endeavors in biodiversity conservation. There is much uncertainty regarding threats such as future land conversion and climate change and little information regarding the number of species occurrences or the area of an ecological system necessary to maintain all species within an ecoregion (Soule and Sanjayan 1998).

Hence, the goals cannot be treated as conditions that ensure long-term survival of species and ecological systems; however, they are useful tools for assembling a portfolio of conservation areas that includes multiple examples of the ecoregion's biodiversity. These goals also provide a metric for gauging the contribution of different portions of the ecoregion to the conservation of its biodiversity, and the progress of conservation in the ecoregion over time.

8.3 Expert opinion

All judgments are made with imperfect knowledge, and expert opinion may be affected by motivational biases (e.g., judgments influenced by political philosophy) and cognitive biases (e.g., poor problem solving abilities; Tversky and Kahneman 1974). A group of experts working together may be adversely affected by "groupthink", personality conflicts, and power imbalances (Coughlan and Armour 1992). Nevertheless, the reliance on expert opinion in the assessment process was decidedly advantageous since experts were able to fill in data gaps and address shortcomings in the methodology, such as adding locations of target occurrences that were not yet recorded in standard datasets. Future assessments should use more elicitation techniques that reduce subjectivity and error in expert opinion (e.g., Saaty 1980).

8.4 Integration of terrestrial and freshwater portfolios

Integration of the terrestrial and freshwater portfolios posed many challenges. Perhaps most importantly, the freshwater and terrestrial analyses were based on different types of planning units. The terrestrial analysis used hexagons, and the freshwater analysis used watersheds. While each type of assessment unit may be appropriate to its respective realm, combining terrestrial and freshwater data into one planning unit (required by MARXAN) created too great a compromise. Attributing freshwater data to terrestrial hexagons unacceptably fragmented freshwater stream reaches and created slivers of watersheds that were less useful to planners than the stand-alone freshwater and terrestrial portfolios.

The terrestrial suitability index was intended to guide AU selection towards places that are far from human development; the freshwater portfolio must include main stem reaches, which typically are places heavily impacted by development. Since lands along many of the main stem reaches are in poor condition, they do not contribute to terrestrial goals. The overall effects of integrating terrestrial and freshwater realms was that the portfolio became less efficient, there was little overlap between portfolios, and the size of the total portfolio increased. In fact, the there was only 15% overlap between the terrestrial and freshwater portfolios.

Although integration of terrestrial and freshwater values was attempted, a satisfactory analytical method for integration was lacking in the final analysis. Developing a system in which terrestrial, marine and freshwater information can be assigned to a common AU would greatly benefit integration efforts. Additionally, integration might be improved by incorporating the ecological processes, threats, or targets that explicitly link terrestrial and freshwater into the selection algorithm.

8.5 Connectivity

The draft terrestrial portfolio used the solution provided by MARXAN that offered the set of assessment units meeting conservation goals with the maximum suitability (least human impact). This approach does not adequately deal with habitat connectivity because it only selects places where populations are located, and it lacks the capacity to select areas that populations might use for migration. Consequently, the MARXAN solution may exclude some assessment units that are essential for habitat connectivity. Expert review was used to address this deficiency by explicitly adding corridors to maintain habitat connectivity. In the future, a more sophisticated algorithm could possibly be used to specifically address corridor needs.

8.6 Vegetation mapping

A vegetation map was constructed by piecing together land cover data from a number of sources. The accuracy of the source data was variable or in some cases unknown, and the accuracy of the resulting vegetation map was not fully tested across the ecoregion. However, a number of positive responses from reviewers led to increased confidence that the map accurately reflected existing vegetation at a scale that was suitable for the assessment. In addition, because the analysis was stratified by ecological sections, and the vegetation data were generally uniform across a section, the effects of the data gaps were generally restricted by sectional boundaries.

Weaknesses in the vegetation map could be improved by quantitatively evaluating its accuracy for all system types and seral stages, particularly where the map was developed with restricted plot data.

8.7 Update of assessments

Updates or new iterations of ecoregional assessments are driven by the needs of specific conservation projects within an ecoregion or the availability of new methods and data. Since ecoregional assessments are large, expensive, and complex undertakings that typically take a number of years to complete, the decision to do a new iteration is not trivial. At the same time, conservation biologists have become increasingly aware that in order to respond to rapid changes, more frequent and consistent updates are critical. This is because habitat, ownership, and land use patterns across the ecoregion will change, abundance and spatial distribution of some species will change, understanding of ecosystems will increase, analytical methods will improve, and occurrence data will become more comprehensive. Additionally, as further research on climate change is conducted, future iterations will have the opportunity to incorporate the predicted effect on portfolio boundaries, accommodating potential shifts in the ranges of species, communities and systems.

Conservation biologists have recently realized that information is needed that will enable effective response to dynamic landscapes (Poiani et al., 2000). Depending on the magnitude of change, actions may need to be re-prioritized using up-to-date information about the status of the landscape and alterations that are likely to occur in the near future. Developing a formal process for updating ecoregional assessments will ensure that planners and decision makers have recent, applicable information on which to base strategies and decisions.

8.8 Involvement of decision makers

The assessment process was largely a scientific endeavor that did not involve the general public or policy makers. While certain aspects of the assessment must remain purely scientific, the usefulness, and hence effectiveness, of the assessment may be enhanced by involving the public and decision makers. For example, Rumsey et al. (2004) worked with stakeholders and decision makers on an ecoregional assessment in British Columbia that resulted in a decision by the provincial government to designate a network of parks and protected areas.

MARXAN and other such algorithms used for this analysis are expected to become fully interactive in the next several years and will for allow real-time scenario building. This should help public decision makers who become involved in the assessment process. In Australia, an interactive computer program was used by stakeholder negotiators to prioritize potential reserves and make land use designations (Finkel 1998). By using the computer interactively, negotiations took place in an objective and transparent environment.

One of the original motivations for using site selection algorithms was the limitation of funds for conservation (Pressey et al. 1993; Justus and Sarkar 2002); therefore, developing cost-efficient reserve networks is essential for maximizing biodiversity conservation. The cost index deals with the economic cost of conservation in a superficial way. To fully inform decision makers, the social and economic costs of conservation must be examined more closely (Shogren et al. 1999; Hughey et al. 2003).

The next iteration of this assessment should include both socio-economic factors and conservation targets in the target list. These may include high value farm or forest land or lands for recreation and urban development, rendering the assessment more inclusive in terms of supporting human needs.

8.9 Climate change

Much more attention needs to be given to the effects of climate change on the ecoregion. In the ecoregional assessment process, climate change was taken into account only superficially by selecting examples of conservation targets along a variety of physical gradients. However, global climate models for the next 100 years can be used to predict temperature and precipitation changes for large areas in the ecoregion. The spatial information from these models can show areas that are expected to be most and least affected by climate changes. This information could be used in computer vegetation models to predict the vulnerability of basic vegetation types to change. It could also be used to predict which areas and groups of species might need special attention now to prepare for coming changes. For example, some areas could serve as species refugia, while others would be areas of change that could perhaps be managed for future conditions. As additional research concerning impacts of climate change on ecological systems and biological diversity becomes available, it must be discretely incorporated into future iterations of ecoregional assessments.

Chapter 9 – Assessment Products and Their Uses

Three principal products emerged from this effort: conservation portfolios, irreplaceability maps, and a comprehensive compilation of conservation data for the ecoregion. A number of important ancillary products were also produced. These should be useful to groups who need answers to specific questions about threats, freshwater conservation, and conservation site priorities in the North Cascades ecoregion. Products include:

- **a portfolio** of conservation areas that contribute collectively and significantly toward the conservation of biological diversity in the North Cascades Ecoregion
- **a map of conservation priorities** that shows the relative importance of all parts of the ecoregion in terms of conserving biodiversity
- **a compilation of biodiversity information and data** that were used to develop the ecoregional assessment
- **a thorough documentation of the assessment process**, portfolio identification and site prioritization methods, and data management so that future iterations can be created efficiently based upon past work
- **a description of the lessons learned** during the assessment process and any innovative analytical techniques or data management practices that were developed
- **an explanation of major limitations** and important data gaps that, if addressed, would improve the next iteration of the assessment

The data that have been compiled and developed for this assessment are useful to anyone involved in conservation planning, priority setting, and decision making. In addition, they can be used for other analyses that address different conservation-related questions. These data are especially useful because they are in a GIS format and have undergone extensive review to correct data errors.

The conservation portfolios depict a set of conservation areas that most efficiently meet a specific set of conservation goals defined for the ecoregion. The conservation areas identified in each portfolio are important for a number of reasons. First, some are the only places where one or more species or plant community targets are known to occur. This is particularly true for those associated with low-elevation, old-growth coniferous forests. Second, some areas, such as parks and wilderness areas comprise the last large, relatively undisturbed landscapes in the ecoregion, which are especially important to wide-ranging species such as grizzly and black bears, wolves, wolverines, northern spotted owls, northern goshawks, and fishers. These places are vital to conserving ecoregional biodiversity and maintaining landscape-scale ecological processes. Third, wherever possible, the portfolios identify areas where conservation is most likely to be successful.

The irreplaceability maps depict a prioritization of all assessment units (AUs) (Maps 14 and 16). One type of irreplaceability map, conservation utility, is based on the both relative irreplaceability and relative suitability of AUs (Maps 15 and 17, Chapter 6). This map can be used to compare AUs with one another when making ecoregion-level conservation decisions, and it can inform smaller scale conservation decision making as well. The alternative portfolios are intended as an illustration of how the conservation areas change based on different goal levels for species and ecosystems. These particular alternatives were selected to bracket the scientific uncertainty in the relationship between successful biodiversity conservation and different amounts of habitat conservation.

9.1 Caveats for users

This assessment has no regulatory authority. Rather, it is a guide to help inform conservation decision making across the North Cascades ecoregion. The sites described are approximate and often large and complex enough to allow (or require) a wide range of resource management approaches. Ultimately, the boundaries and management of any priority conservation area will be based on the policies, values, and decisions of the affected landowners, conservation organizations, governments, and other community members.

Many of the high priority conservation areas described in this assessment may accommodate multiple uses as determined by landowners, local communities and appropriate agencies. Rather than creating protected areas in the usual sense, we speak of the need for portfolio sites to be conserved. While effective conservation can necessitate restricted use, it does not necessarily exclude all human activities.

A reliable assessment of restoration priorities would require a different approach than the one presented in this report. Assessment units and portfolio sites were selected for the habitats and species that exist there now, not for their restoration potential. However, many high priority areas will contain lower-quality habitats in need of restoration, and this restoration could greatly enhance the viability of these areas and the conservation targets they contain.

Users must be mindful of the large scale at which this assessment was prepared. Many places deemed low priority at the ecoregional scale are, nevertheless, locally important for their natural beauty, educational value, ecosystem services, and conservation of local biodiversity. These include many small wetlands, small patches of natural habitat, and other important parts of the natural landscape. They should be managed to maintain their own special values. Furthermore, due to their large size, high priority assessment units and conservation portfolio sites may include areas unsuitable for conservation. It is expect that local planners who are equipped with more complete information and higher resolution data will develop refined boundaries for these sites. Users should remember that the intended geographic scale of use of the analysis and much of its data is 1:100,000. Finally, the scale and concept of matrix-forming terrestrial systems, by definition, contain considerable environmental, ecological and genetic variation. Spatial data developed for this assessment are accurate only at a coarse scale.

Some factors in the suitability index require consideration of what are traditionally policy questions. For example, setting the index to favour the selection of public over private land presumes a policy of using existing public lands to meet goals wherever possible, thereby minimizing the involvement of private or tribal lands.

This assessment is one of many science-based tools that will assist conservation efforts undertaken by government agencies, non-governmental organizations, and individuals. It cannot replace recovery plans for endangered species or the detailed planning required in designing a local conservation project. It also does not address the special considerations of salmon or game management, and consequently the plan cannot be used to ensure adequate populations for harvest.

Chapter 10 – Summary and Conclusions

Although degraded in some areas, the North Cascades still provides an opportunity for conservation of wildlife and natural systems in the ecoregion (CBI 2003). Based on the results of this assessment, the following conclusions can be made:

10.1 Ecoregional goals

Establishing conservation goals is one of the most crucial steps in the ecoregional conservation assessment process as it forms the basis from which to gauge the success of how well the North Cascades portfolio of conservation areas performs in conserving the ecoregion's biodiversity. Conservation goals set the context for planning and implementation, and measuring progress towards meeting established goals and objectives. These goals also provide a clear purpose for decisions and lend accountability and defensibility to the assessment (Pressey, Cowling, and Rouget, 2003).

Setting conservation goals is also one of the most difficult steps in the assessment process. As a result, setting goals for conservation targets in the assessment primarily involves reliance on expert opinion and informed guesswork and is likely to have a high degree of uncertainty (Groves *et al*., 2000). However, given the global "biodiversity crisis", there are irreparable consequences in delaying conservation efforts until new procedures or better estimates become available. As human populations continue to grow, many large habitat blocks will face development pressure to meet human needs.

Although goals established for terrestrial and freshwater ecological systems (having to do with how much area of habitat is selected in the portfolio) were largely met in this assessment, goals established for fine filter targets were largely unmet. While it is arguably relatively more important that we met goals for terrestrial and freshwater ecological systems, since by protecting these systems we also protect the vast majority of species that are unknown or poorly understood, it is still a potential concern to fall short of the majority of the species goals. However, while not meeting goals for species targets may be an indication of too few actual species occurrences in the ecoregion, it could also indicate poor survey data. Given the relatively good condition of the North Cascades ecoregion, we suspect the more probable reason for not meeting many species goals is that the ecoregion is still poorly studied and documented. Moreover, where goals are met for species and habitats in the ecoregion, it only means that there are adequate target occurrences that exist within the ecoregion. If all these occurrences and the areas that contain them are conserved, the intent is that biodiversity would be maintained, subject to many uncertainties associated with our knowledge of species, natural communities and future conditions. Of course, we have no way of knowing how well our goals will reflect the actual needs of biodiversity, and future iterations will no doubt improve on these estimates. In the meantime, organizations can use the stated goals as starting place to address gaps in biodiversity protection and track progress. It is important to realize however that meeting goals only means that a number of occurrences of species and habitats have been identified in the ecoregion, not that they are necessarily protected in any way.

10.2 Sensitivity analysis results

High irreplaceability values, i.e., greater than about 85 to 90, are mostly insensitive to the suitability index. AUs achieve high scores because of their biological contents not because of suitability. In contrast, moderate scores, about 50 to 80, tend to be much more sensitive to the suitability index. Since the suitability index relies on the subjective judgments of individuals, AUs with moderate irreplaceability scores should be examined more closely.

Software programs like MARXAN are often referred to as "decision support tools." Such tools can best support decisions by enabling us to explore the effect of various assumptions and differing perspectives. Both Davis et al. (1996) and Stoms et al. (1998) did the equivalent of a sensitivity analysis for their suitability indices. However, they referred to their different indices as "model variations" or "alternatives"; an implicit recognition that different sets of assumptions may have equal validity. To address uncertainties in suitability indices, AU priorities, especially for moderately ranked AUs, should be derived from several different analyses using different indices. This will enhance the robustness of analytical results and lead to more confident decision making.

10.3 Alternative portfolios

The alternative portfolios are intended to illustrate how conservation areas change based on different goal levels for species and ecosystems. Deciding which goal level alternative is most appropriate is ultimately a decision for the user and society to make based on the best available science, value-based policy decisions, and results of tracking biodiversity persistence over time. These particular alternatives were selected to bracket the scientific uncertainty in the relationship between changes in biodiversity and different amounts of habitat loss.

The alternative portfolios were referred to as "higher" and "lower" risk. The higher risk portfolio appears to be pessimistically small. As "higher risk" implies, if this portfolio were implemented, some species would very likely vanish from the ecoregion. On the other hand, the lower risk portfolio appears to be impractically large. The land area captured is enormous, but even under this alternative not all land would be set aside for preservation. Undoubtedly, much habitat must be conserved in multiple-use landscapes where land uses, such as forestry, can be compatible with biodiversity conservation. The mid-risk portfolio strikes a balance between the risk of species loss and the impracticality of conserving extremely large areas. This portfolio is also based on the stated conservation goals regarding the number, area, and distribution of species and habitats that might be required to maintain biodiversity.

The higher risk portfolio imposes a higher degree of risk than the mid-risk portfolio and the lower risk portfolio a lower degree of risk, but it is not known how much higher and lower the risk is. In fact, the "mid-risk" portfolio could actually be high risk. That is, it might result in a high probability of ecoregional extinction or extirpation for some species. For a small number of species, we may have the scientific capacity to determine the level of risk imposed by each portfolio, but given the enormous human changes to the ecoregion that have occurred and are expected to occur, certainty of the persistence of biodiversity cannot be *guaranteed* by meeting ecoregional goals. As much as possible, future ecoregional assessments should attempt to overcome this shortcoming.

10.4 Use of Assessment

Biodiversity conservation in the ecoregion will attain its fullest potential if all conservation organizations, government agencies and private landowners coordinate their conservation strategies according to the priorities identified through this assessment. The North Cascades Ecoregional Assessment puts forth a baseline to be built upon and refined by site-scale planning efforts. It is intended to guide users to areas with high biodiversity value and suitability. The specifics of conservation site delineation, planning and management will rely on more localized expertise.

Priority Conservation Areas (portfolio sites) span lands and waters that fall under various ownerships and within various jurisdictions and we recognize that some organizations and agencies will be better suited to work in specific areas than others may be. The ultimate vision of the ecoregional assessment process is to facilitate the thoughtful coordination of current and future conservation efforts by the growing number of federal, provincial, state, local, private and non-governmental organizations engaged in this field. To that end, we encourage wide use of the data and products developed and welcome comments on how future iterations may be improved.

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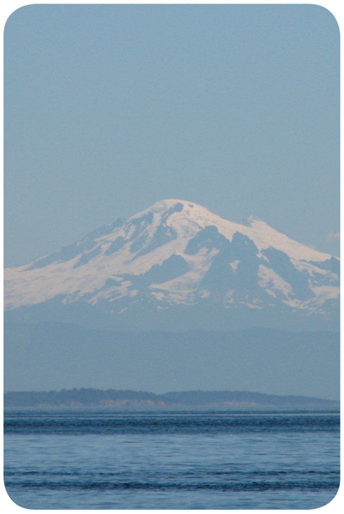

VOLUME

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APPENDICES

North Cascades and Pacific Ranges Ecoregional Assessment

November 2006

Nature Conservancy Canada

Conservation de la Nature Canada

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

Washington Department of FISH and WILDLIFE

North Cascades and Pacific Ranges Ecoregional Assessment

Volume 2 - Appendices

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APPENDIX 1 – GLOSSARY

Appendix 1 – Glossary

Aquatic/freshwater ecological systems: dynamic spatial assemblages of biological communities that occur together in a freshwaterlandscape with similar geomorphological patterns, are tied together by similar ecological processes (e.g. hydrologic and nutrient regimes, access to floodplains) or environmental gradients (e.g. temperature, chemical, habitat volume), and form a robust, cohesive, and distinguishable unit on a hydrography map.

Assessment unit: the area-based polygon units used in the optimal site-selection algorithm and attributed with the amount and quality of all targets located within them. These units are non-overlapping and cover the entire ecoregion. The terrestrial assessment unit chosen for the North Cascades is a 500-hectare hexagon; watersheds were used as freshwater assessment units.

Automated portfolio: a data-driven portfolio created by the MARXAN site-selection algorithm operating on hexagonal assessment units (terrestrial) or watersheds (freshwater).
Base layer: a data layer in a GIS that all other layers are referenced to geometrically.
Biodiversity: the full range of natural variety and variability within and among organisms, and the ecological complexes in which they occur. This term encompasses multiple levels of organization, including genes, subspecies, species, communities, and ecological systems or ecosystems.
Cadastral: relating to landed property, usually including the dimensions and value of land parcels, used to record ownership.
Candidate species: plants and animals that the U.S. Fish and Wildlife Service or Canadian Species At Risk Act/Committee On the Status of Endangered Wildlife In Canada believe should be considered for status review. A status review may conclude that the species should be added to the federal list of threatened and endangered species.
Circumboreal: living in the region around the high latitudes of the northern hemisphere.

Coarse filter: refers to the biological communities or ecological systems, which if protected in sufficient quantity should conserve the vast majority of species in the ecoregion.

Conservation target: (see Target)
Core team: the interdisciplinary group that is accountable for the completion of the ecoregional assessment project.
Cost: a component of the MARXAN algorithm that encourages MARXAN to minimize the area of the portfolio by assigning a penalty to factors that negatively affect biodiversity, such as proximity to roads and development. In the North Cascades assessment, a cost was assigned to each assessment unit in the ecoregion. Used synonymously with “suitability.”
Crosswalk: a comparison of two different vegetation classification systems and resolving the differences between them to form a common standard.

Declining: species that have exhibited significant, long-term reduction in habitat/and or numbers, and are subject to continuing threats in the ecoregion.
Disjunct: (see Distribution).
Distribution: in ecoregional assessments, we think of distribution *relative to the ecoregion* and use it as a guide to establish numeric differentials in goal setting (higher with endemic, to lower with peripheral)

Endemic	>90% of global distribution in ecoregion
Limited	<90% of global distribution is with in the ecoregion, and distribution is limited to 2-3 ecoregions
Disjunct	distribution in ecoregion quite likely reflects significant genetic differentiation from main range due to historic isolation; roughly >2 ecoregions separate this ecoregion from other more central parts of its range
Widespread	global distribution >3 ecoregions
Peripheral	<10% of global distribution in ecoregion

Ecological drainage unit (EDU): aggregates of watersheds that share ecological characteristics. These watersheds have similar climate, hydrologic regime, physiography, and zoogeographic history.

Ecological integrity: the probability of an ecological community or ecological system to persist at a given site is partially a function of its integrity. The ecological integrity or viability of a community is governed primarily by three factors: demography of component species populations; internal processes and structures among these components; and intactness of landscape-level processes which sustain the community or system.

Ecological land unit (ELU): mapping units used in large-scale conservation assessment projects that are typically defined by two or more environmental variables such as elevation, geological type, and landform (e.g., cliff, valley bottom, summit). Biophysical or environmental analyses based on ELUs combined with land cover types and satellite imagery can be useful tools for predicting locations of communities or systems when field surveys are lacking.

Ecological system: (see Terrestrial ecological system or Freshwater ecological system)

Ecoregion: a relatively large area of land and water that contains geographically distinct assemblages of natural communities, with boundaries that are approximate. These communities share a large majority of their species, dynamics, and environmental conditions, and function together effectively as a conservation unit at global and continental scales.

Element occurrence (EO): a term originating from the methodology of the Natural Heritage Network that refers to a unit of land or water on which a population of a species or example of an ecological community occurs. For communities, these EOs represent a defined area that contains a characteristic species composition and structure.

Endangered species: any species which is in danger of extinction throughout all of its range; a species that is federally listed as Endangered by the U.S. Fish and Wildlife Service under the Endangered Species Act or the Canadian Species At Risk Act/Committee On the Status of Endangered Wildlife In Canada

Endemic: (see Distribution)

ESU: Evolutionarily Significant Unit used to identify "distinct population segments" of Pacific salmon (*Oncorhynchus* spp.) stocks under the US Endangered Species Act. The basic spatial unit used to help describe a species' diversity within its range and aid in the recovery of a listed species.

Extirpation: the extinction of a species or a group of organisms in a particular local area.
Fine filter: species of concern or aggregations that complement the coarse filter, helping to ensure that the coarse filter strategy adequately captures the range of viable, native species and biological communities. Endangered or threatened, declining, vulnerable, wide-ranging, very rare, endemic, and keystone species are some potential fine filter targets.

Focal group: a collection of organisms related by taxonomic or functional similarities.
Fragmentation: the process by which habitats are increasingly subdivided into smaller units, resulting in increased insularity as well as losses of total habitat area.
Functional landscapes: large areas (usually greater than 1,000 acres [405 hectares]) where the natural ecological processes needed to conserve biodiversity can be maintained or potentially restored.
Functional network: a well-connected set of functional landscapes within an ecoregion or across multiple

GAP (National Gap Analysis Program): Gap analysis is a scientific method for identifying the degree to which native animal species and natural communities are represented in our present-day mix of conservation lands. Those species and communities not adequately represented in the existing network of conservation lands constitute conservation "gaps." The purpose of the Gap Analysis Program (GAP) is to provide broad geographic information on the status of ordinary species (those not threatened with extinction or naturally rare) and their habitats in order to provide land managers, planners, scientists, and policy makers with the information they need to make better-informed decisions. URL: http://gapanalysis.nbii.gov/portal/server.pt

GAP status: the classification scheme or category that describes the relative degree of management or protection of specific geographic areas for the purpose of maintaining biodiversity. The goal is to assign each mapped land unit with categories of management or protection status, ranging from 1 (highest protection for maintenance of biodiversity) to 4 (no or unknown amount of protection).

Biodiversity Management Status Categories of the GAP Analysis Program	
Category	**Description**
Status 1	An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a natural state within which disturbance events (of natural type, frequency, intensity, and legacy) are allowed to proceed without interference or are mimicked through management.
Status 2	An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a primarily natural state, but which may receive uses or management practices that degrade the quality of existing natural communities, including suppression of natural disturbance.
Status 3	An area having permanent protection from conversion of natural land cover for the majority of the area, but subject to extractive uses of either a broad, low-intensity type (e.g., logging) or localized intense types (e.g., mining). It also confers protection to federally

	listed endangered and threatened species throughout the area.
Status 4	There are no known public or private institutional mandates or legally recognized easements or deed restrictions held by the managing entity to prevent conversion of natural habitat types to anthropogenic habitat types. The area generally allows conversion to unnatural land cover throughout.

GIS (Geographic Information System): a computerized system of organizing and analyzing spatially-explicit data and information.
Global rank: an assessment of a biological element's (species or plant association) relative imperilment and conservation status across its geographic distribution. The ranks range from GX (presumed extinct) to G5 (secure). These ranks are assigned by the Natural Heritage Network and are determined by the number of occurrences or total area of coverage (plant associations only), modified by other factors such as condition, historic trend in distribution or condition, vulnerability, and impacts. The definitions of these ranks, which are not to be interpreted as legal designations, are as follows:

GX	**Presumed Extinct**: Not located despite intensive searches and virtually no likelihood of rediscovery
GH	**Possibly Extinct**: Missing; known only from historical occurrences but still some hope of rediscovery
G1	**Critically Imperiled**: At high risk of extinction due to extreme rarity (often 5 or fewer occurrences), very steep declines, or other factors.
G2	**Imperiled**: At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.
G3	**Vulnerable**: At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.
G4	**Apparently Secure**: Uncommon but not rare; some cause for long-term concern due to declines or other factors.
G5	**Secure**: Common; widespread and abundant.

G(#)**T**(#): Trinomial (T) rank applies to subspecies or varieties; these taxa are T-ranked using the same definitions as the G-ranks above.

Variant Global Ranks

G#G#	**Range Rank**: A numeric range rank (e.g., G2G3) is used to indicate uncertainty about the exact status of a species or community. Ranges cannot skip more than one rank (e.g., GU should be used rather than G1G4).
GU	**Unrankable**: Currently unrankable due to lack of information or due to substantially conflicting information about status or trends. NOTE: Whenever possible, the most likely rank is assigned and the question mark qualifier is added (e.g., G2?) to express uncertainty, or a range rank (e.g., G2G3) is used to delineate the limits (range) of uncertainty.
GNR	**Not ranked**: Global rank not assessed.

Rank Qualifiers

?	**Inexact Numeric Rank**: Denotes inexact numeric rank.

Q	**Questionable taxonomy that may reduce conservation priority**: Distinctiveness of this entity as a taxon at the current level is questionable; resolution of this uncertainty may result in change from a species to a subspecies or hybrid, or inclusion of this taxon in another taxon, with the resulting taxon having a lower-priority (numerically higher) conservation status rank.

Goal: in ecoregional assessments, a numerical value associated with a species or system that describes how many populations (for species targets) or how much area (for systems targets) the portfolio should include to represent each target, and how those target occurrences should be distributed across the ecoregion to better represent genetic diversity and hedge against local extirpations.

Ground-truthing: assessing the accuracy of GIS data through field verification.

Historic species: species that were known to occupy an area, but most likely no longer exist in that area.
Impact: the combined concept of ecological stresses to a target and the sources of that stress to the target. Impacts are described in terms of severity and urgency. Sometimes used synonymously with "threat."
Imperiled species: species that have a global rank of G1-G2 by Natural Heritage Programs/Conservation Data Centers. Regularly reviewed and updated by experts, these ranks take into account number of occurrences, quality and condition of occurrences, population size, range of distribution, impacts and protection status.

Linear communities or systems: occur as linear strips and are often ecotonal between terrestrial and freshwatersystems. Similar to small patch communities, linear communities occur in specific conditions, and the aggregate of all linear communities comprises only a small percentage of the natural vegetation of the ecoregion.

Limited: (see Distribution)

Macrohabitats: units of streams and lakes that are similar with respect to their size, thermal, chemical, and hydrological regimes. Each macrohabitat type represents a different physical setting that correlates with patterns in freshwater biodiversity.
MARXAN: **Ma**rine **R**eserve Design using Spatially **Ex**plicit **An**nealing. Software consisting of computerized optimal site selection algorithms that select conservation sites based on their biological value and suitability for conservation.
URL: www.ecology.uq.edu.au/MARXAN.htm

Matrix-forming systems or matrix communities: communities that form extensive and contiguous cover, occur on the most extensive landforms, and typically have wide ecological tolerances.
Minimum dynamic area (MDA): MDA has been defined as the smallest area that is needed to maintain a natural habitat, community, or population based on natural disturbance regimes and the ability of the biota to recolonize or restabilize component species. In this context, identification of a minimum dynamic area for a particular conservation target is based on the size of patches created by various disturbances, the frequency of those disturbances, the longevity of the resulting patches, and the ability of the component species to disperse through the greater mosaic. More recent work in landscape ecology has expanded this definition to include not only issues related to species viability, but also the maintenance of the disturbance regime itself (Groves et al., 2000).

National and Subnational Conservation Status Definitions: Listed below are definitions for interpreting NatureServe conservation status ranks at the national (N-rank) and subnational (S-rank) levels. The term "subnational" refers to province or state-level jurisdictions (e.g., British Columbia, Washington). Assigning national and subnational conservation status ranks for species and ecological communities follows the same general principles as used in assigning global status ranks. A subnational rank, however, cannot imply that the species or community is more secure at the state/province level than it is nationally or globally (i.e., a rank of G1S3 cannot occur), and similarly, a national rank cannot exceed the global rank. Subnational ranks are assigned and maintained by state or provincial natural heritage programs and conservation data centers.

National (N) and Subnational (S) Conservation Status Ranks

Status	Definition
NX **SX**	**Presumed Extirpated**—Species or community is believed to be extirpated from the nation or state/province. Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered.
NH **SH**	**Possibly Extirpated** (Historical)—Species or community occurred historically in the nation or state/province, and there is some possibility that it may be rediscovered. Its presence may not have been verified in the past 20-40 years. A species or community could become NH or SH without such a 20-40 year delay if the only known occurrences in a nation or state/province were destroyed or if it had been extensively and unsuccessfully looked for. The NH or SH rank is reserved for species or communities for which some effort has been made to relocate occurrences, rather than simply using this status for all elements not known from verified extant occurrences.
N1 **S1**	**Critically Imperiled**—Critically imperiled in the nation or state/province because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state/province.
N2 **S2**	**Imperiled**—Imperiled in the nation or state/province because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the nation or state/province.
N3 **S3**	**Vulnerable**—Vulnerable in the nation or state/province due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.
N4 **S4**	**Apparently Secure**—Uncommon but not rare; some cause for long-term concern due to declines or other factors.
N5 **S5**	**Secure**—Common, widespread, and abundant in the nation or state/province.
NNR **SNR**	**Unranked**—Nation or state/province conservation status not yet assessed.
NU **SU**	**Unrankable**—Currently unrankable due to lack of information or due to substantially conflicting information about status or trends.

NNA SNA	**Not Applicable** —A conservation status rank is not applicable because the species is not a suitable target for conservation activities.
N#N# S#S#	**Range Rank** —A numeric range rank (e.g., S2S3) is used to indicate any range of uncertainty about the status of the species or community. Ranges cannot skip more than one rank (e.g., SU is used rather than S1S4).
Not Provided	Species is known to occur in this nation or state/province. Contact the relevant natural heritage program for assigned conservation status.

NatureServe: NatureServe is a non-profit conservation organization that provides the scientific information and tools needed to help guide effective conservation action. NatureServe and its network of natural heritage programs are the leading source for information about rare and endangered species and threatened ecosystems. NatureServe represents an international network of biological inventories—known as natural heritage programs or conservation data centers—operating in all 50 U.S. states, Canada, Latin America and the Caribbean. URL: www.natureserve.org

Non-vascular plant: in the North Cascades assessment, this term refers to lichens, mosses, and fungi.
Ocean Ecoregional Units: OEU are defined as watershed-coastal ecosystems of distinct physical characteristics, including the full sequence of riverine, estuarine, and near-shore marine habitats used by juvenile anadromous salmonids. Augerot (2005) developed a four-stage hierarchical classification to divide the North Pacific Rim into ecoregions.

Occurrence: spatially referenced locations of species, plant associations, or ecological systems. May be equivalent to Natural Heritage Program element occurrences, or may be more loosely defined locations delineated through the identification of areas by experts.
Peripheral: (see Distribution)

Partners in Flight (PIF): a cooperative program among U.S. federal, state, and local governments, philanthropic foundations, professional organizations, conservation groups, industry, the academic community, and private individuals, to foster conservation of migratory bird populations and their habitats in the Western hemisphere.
URL: http://www.pwrc.usgs.gov/pif/

Plant association: a recurring plant community with a characteristic range in species composition, specific diagnostic species, and a defined range in habitat conditions and physiognomy or structure. Ex: red-osier dogwood/sedges; Idaho fescue-bluebunch wheatgrass.

Population: a group of individuals of a species living in a certain area that maintain some degree of reproductive isolation.
Portfolio: (see Portfolio of Sites)
Portfolio of sites: in the North Cascades assessment, the identified suite of priority conservation areas that are considered the highest priorities for conservation in the ecoregion.

Priority conservation area: areas of biodiversity concentration that contain target species, plant associations, and ecological systems. Boundaries need to be refined during site conservation planning for adequate protection and to ensure supporting ecological processes are maintained for the targets within.

RBI: Relative Biodiversity Index. Abundance in query domain/abundance in area of interest) * 100.

Reach: the length of a stream channel that is uniform with respect to discharge, depth, area and slope.

Retrospective ("retro") target: A large amount of habitat or modeled data can significantly influence the result of the site selection analysis. Rather than let one species dominate the result, we use some datasets retrospectively to evaluate the portfolio as defined by the goals and data of other targets. Retrospective evaluation has the benefit of simplifying the analysis by reducing the amount of data being input, and by reducing the influence of a large quantity of data or the influence of a species with a very high goal associated with its data. If the goals met from other targets do not capture enough of these retro targets in the portfolio, then the goals will be adjusted appropriately to incorporate more of that species.

Small patch systems: communities or systems that form small discrete areas of vegetation cover and that are dependent upon specific local environmental conditions, such as hydric soil.

Species aggregate: where multiple species are represented by a single target, as in the case of a multi-species shorebird colony target or a single species such as the American widgeon used, for example, in representing multiple species of dabbling ducks. Species aggregates were used most extensively in the marine analysis.

Stenohaline: limited to or able to live only within a narrow range of saltwater concentrations.

Suitability: the likelihood of successful conservation at a particular place relative to other places in the ecoregion. The lower the suitability "value" the more suitable an assessment unit is for conservation. For the North Cascades assessment, four GIS layers were used to determine each terrestrial assessment unit's suitability for conservation: management status, land use, road density, and future urban potential. For the freshwater assessment the GIS layers used were management status, land use, dams, water extraction, fish stocking, road density on slopes > 50% gradient, road-stream crossing and riparian disturbance.

T Ranks: Infraspecific Taxon Conservation Status Ranks. Infraspecific taxa refer to subspecies, varieties and other designations below the level of the species. Infraspecific taxon status ranks (T-ranks) apply to plants and animal species only; these T-ranks do not apply to ecological communities. The status of infraspecific taxa (subspecies or varieties) are indicated by a "T-rank" following the species' global rank. Rules for assigning T-ranks follow the same principles outlined above for global conservation status ranks. For example, the global rank of a critically imperiled subspecies of an otherwise widespread and common species would be G5T1. A T-rank cannot imply the subspecies or variety is more abundant than the species as a whole-for example, a G1T2 cannot occur. A vertebrate animal population, such as those listed as distinct population segments under the U.S. Endangered Species Act, may be considered an infraspecific taxon and assigned a T-rank; in such cases a Q is used after the T-rank to denote the taxon's informal taxonomic status. At this time, the T rank is not used for ecological communities.

Target: also called conservation target. An element of biodiversity selected as a focus for the conservation assessment. The three principle types of targets are species, plant associations, and ecological systems.

Terrestrial ecological systems/ecosystems: dynamic spatial assemblages of plant associations that 1) occur together on the landscape; 2) are tied together by similar ecological processes (e.g. fire, hydrology), underlying environmental features (e.g. soils, geology) or environmental gradients (e.g. elevation, hydrologically-related zones); and 3) form a robust, cohesive, and distinguishable unit on the ground. Ecological systems are characterized by both biotic and abiotic components. Ex: North Pacific Western Hemlock-Silver Fir Forest.

Threatened species: any species that is likely to become an endangered species throughout all or a significant portion of its range; a species federally listed as Threatened by the U.S. Fish and Wildlife Service under the Endangered Species Act or the Canadian Species At Risk Act/Committee On the Status of Endangered Wildlife In Canada.

Umbrella species: species that, by being protected, may also protect the habitat and populations of other species.

Urban Growth Area (UGA): a designated area, within which urban growth will be encouraged and outside of which growth can only occur if it is not urban in nature. In the USA urban growth areas around cities are designated by the county in consultation with the cities; urban growth areas not associated with cities are designated by the county.

Viability: the ability of a species to persist for many generations or an ecological community or system to persist over some time period. Primarily used to refer to species in this document.

Vulnerable: vulnerable species are usually abundant, may or may not be declining, but some aspect of their life history makes them especially vulnerable (e.g., migratory concentration or rare/endemic habitat).

Widespread: (see Distribution)

XAN: (See Ocean Ecoregional Units)

APPENDIX 2 – NORTH CASCADES CORE TEAM, ADVISORS, ASSESSMENT SUPPORT AND TECHNICAL TEAMS

Appendix 2 – North Cascades Core Team, Advisors, Assessment Support and Technical Teams

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APPENDIX 3 – EXPERT REVIEW

Appendix 3 -- Expert Review

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British Columbia

Squamish, BC, September 20-23, 2005

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Joe Foy, Western Canada Wilderness Committee, Vancouver, BC
Carl Halvorson, North Vancouver Outdoors School, Brackendale, BC
Wendy Horan, Association of Whistler Area Residents/Squamish-Lillooet Regional District, Pemberton, BC
Laurie Kremsater, University of British Columbia -Centre for Applied Biology, Vancouver, BC
Randall Lewis, Environment, Lands and Resources, Squamish Nation, Squamish, BC
Graham Seagel, Capilano College, North Vancouver, BC
David Tudhope, Sustainable Resource Management Officer, BC Ministry of Agriculture and Lands, Surrey, BC
Edith Tobe, Freshwater biologist, Squamish River Watershed Society, Squamish, BC
Sarah Weber, Biologist, Squamish, BC

Washington

Olympia, WA, September 29, 2005

Ruth Milner, Washington Department of Fish & Wildlife, Arlington, WA
Mike Davison, Washington Department of Fish & Wildlife, La Conner, WA
Phyllis Reed, US Forest Service, Darrington, WA
Don Gay, US Forest Service, Sedro Woolley, WA
Bob Kuntz, North Cascades National Park, Sedro Woolley, WA
Roger Christopherson, North Cascades National Park, Sedro Woolley, WA
Ronald Holmes, North Cascades National Park, Sedro Woolley, WA
Jen Sevigny, Stillaquamish-Arlington Tribes
Mike Sevigny, Tulalip-Tulalip Tribes
Chris Danilson, Sauk-Suiattle-Darrington Tribes

Mill Creek, WA, October 03, 2005

Lee Kantar, Washington Department of Fish & Wildlife, King County, WA
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Chris Chappell, Washington Natural Heritage Program, Olympia, WA
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Jan Henderson, US Forest Service, Mountlake Terrace

Portfolio review:

British Columbia

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Matt Austin, BC Ministry of Water, Land & Air Protection, BC
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Geoff Scudder, University of British Columbia, BC
Leah Ramsay, BC Conservation Data Centre, BC
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Dave Hays, Washington Department of Fish and Wildlife, WA
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Lisa Hallock, WA Natural Heritage Program, WA
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Terrestrial Coarse Filter

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Terrestrial Fine Filter Plants

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Frank Lomer, Botanist, New Westminster, BC

Dr. Adolf Ceska, Botanist, Victoria, BC
Dr. Hans Roemer, Botanist, Victoria, BC
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Terrestrial Fine Filter Animals

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Freshwater Coarse Filter

BC Freshwater Systems Classification

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Sam Brenkman, Olympic National Park
Jerry Gorsline, Washington Environmental Council

Freshwater Fine Filter Animals

Target List Review

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APPENDIX 4 – DATA SOURCES

Appendix 4 – Data Sources

The following summarizes data sources used in the North Cascades Ecoregional Assessment.

Category/Jurisdiction	Layer Name/Description	Source	Date	Scale
Terrestrial Assessment Units				
	Hexagons	Generated using ArcView Sites Extension	2005	500 ha
Freshwater Assessment Units				
British Columbia	BC Watershed Atlas	ftp://ftp.env.gov.bc.ca/dist/arcwhse/watershed_atlas/	2000	1:50,000
Washington State	Hydrologic Unit Boundary (HUC) calculated watersheds	US Geological Service	2002	1:24,000
Ecological Boundaries				
	TNC Ecoregions	http://conserveonline.org/workspaces/ecoregional.shapefile	2003	1:250,000
	Ecoregion Ecosystem Classification Units	BC Ministry of Environment (formerly Ministry of Sustainable Resource Management [MSRM] ftp://ftp.env.gov.bc.ca/dist/arcwhse/wildlife (QES_BC)	2003	1:250,000
	Regional and Zonal Ecosystems of the Shining Mountains	BC Ministry of Sustainable Resource Management (MSRM) http://srmwww.gov.bc.ca/ecology/bei/shiningmtns.html	2000	1:250,000
Land Ownership and Management Status				
British Columbia	BC Provincial Parks and Protected Areas (with IUCN rank assigned)	BC Government ftp://ftp.env.gov.bc.ca/dist/arcwhse/parks/	2005	1:20,000-1:250,000
	Goal 2 Protected Areas Lillooet LRMP Central Coast LRMP Goal 2 candidates	 BC Government BC Government	 2004 July 2005	 1:20,000 1:20,000
	Regional Park Greater Vancouver, Fraser Valley, Sunshine Coast, Powell River Regional Districts	Various	2005	~ 1:20,000

Category/Jurisdiction	Layer Name/Description	Source	Date	Scale
	BC Conservation Mapping Project (Includes some regional district parks)	Nature Trust et al.	April 2005	1:20,000
	Provincial tenures with conservation value	BC Government	1999-2003	1:20,000
	Conservation Trust Land BC Conservation Mapping Project (Includes lands owned by the Nature Conservancy of Canada, The Nature Trust and Ducks Unlimited)	Nature Trust et al.	April 2005	1:20,000
	Wildlife Management Areas BC Conservation Mapping Project (Includes National Wildlife Areas / Migratory Bird Sanctuaries) DFO MPA and fishery closures	Nature Trust et al. http://www.pac.dfo-mpo.gc.ca/oceans/closure/sites.pdf	April 2005 Current to 1997. Mapped in 2003	1:20,000 various
	Indian Reserve	BC Government	2002	1:20,000
	Private Land Southern Interior forest cover private ownership BC Provincial private land overview	ftp://kamftp.env.gov.bc.ca/pub/outgoing/dist/sir_overview/arc_data/arcinfo_e00/ BC Government	1997-2001 Circa 1990s	1:20,000 1:250,000
	Tree Farm Licenses	BC Government	2002	1:20,000
	Regional Districts	ftp://ftp.env.gov.bc.ca/dist/arcwhse/boundaries (BRGD_BC)	2002	1:250,000
	Municipalities	BC Government	2001	1:20,000
	Forest Districts	ftp://ftp.env.gov.bc.ca/dist/arcwhse/forest_boundaries (TTFD_BC)	2005	1:20,000
	Community Watersheds	BC Ministry of Environment ftp://ftp.env.gov.bc.ca/dist/arcwhse/water/	June 2005	1:20,000
Washington State	Washington Department of Natural Resources Public land survey, Ownership, County, and Administration (POCA) Note – Includes Tribal Reserves	http://www3.wadnr.gov/dnrapp5/website/cadastre/links/other_dnr_gis_data/POCA.htm	2002	1:100,000

Category/Jurisdiction	Layer Name/Description	Source	Date	Scale
	Washington Department of Natural Resources Major Public Lands (MPL) – includes public lands for all local, state, and federal agencies in WA	http://www3.wadnr.gov/dnrapp5/website/cadastre/links/other_dnr_gis_data/NonDNR_Major_%20Public_Lands.htm	2000	1:100,000
	TNC, Land Trust, and more specific forest information such as LSR	Various via TNC GIS staff	2005	various
	County Boundary – created from Dept. of Natural Resources (POCA) dataset	Derived from Washington Dept. of Ecology county dataset	1998	1:24,000
Terrestrial Ecological Systems				
British Columbia	Existing Vegetation Biogeoclimatic Ecosystem Classification (BEC)	BC Ministry of Forests & Range http://www.for.gov.bc.ca/HRE/becweb/index.html	2003	1:250,000
	Climatic Zones, Potential Natural Vegetation Broad Ecosystem Inventory and Mapping (BEU)	BC Ministry of Agriculture and Lands (formerly MSRM) http://srmwww.gov.bc.ca/ecology/bei/index.html	1998	1:250,000
	Tree Size data Baseline Thematic Mapping (BTM)	BC Ministry of Agriculture and Lands (formerly MSRM) http://ilmbwww.gov.bc.ca/cis/initiatives/ias/btm/index.html	Imagery from 1990-97 & 1998 Spatial: 2001	1:250 000 (10-15 ha polygon size)
	Existing Vegetation, Tree size data Forest Cover Maps	BC Ministry of Forests and Range	Inventoried 1997 - 2001	1:20,000
	Elevation, topography for modeling Gridded Elevation Model (TDEM)	BC Ministry of Agriculture and Lands (formerly MSRM) – TRIM/TRIMII Program http://ilmbwww.gov.bc.ca/bmgs/trim/trim	1997/2002	25 m grid resolution
British Columbia and Washington State	Existing Vegetation GeoCover Orthorectified Landsat Thematic Mapper Mosaics	Earth Satellite Corporation	1990	30m resolution

Category/Jurisdiction	Layer Name/Description	Source	Date	Scale
	Climate Zones and Potential Natural Vegetation Regional and Zonal Ecosystems of the Shining Mountains	BC Ministry of Sustainable Resource Management (MSRM) http://srmwww.gov.bc.ca/ecology/bei/shiningmtns.html	2000	1:250,000
	Comer, P., D. Faber-Langendoen, R. Evans, S. Gawler, C. Josse, G. Kittel, S. Menard, M. Pyne, M. Reid, K. Schulz, K. Snow, and J. Teague. 2003. *Ecological Systems of the United States: A Working Classification of US Terrestrial Systems*. NatureServe, Arlington, Virginia.		2003	n/a
Washington State	Existing Vegetation Henderson, J.A., D.A. Peter, and R. Lesher. 1992. *Field Guide to the Forested Plant Associations of the Mt. Baker-Snoqualmie National Forest*. USDA USFS PNW Region. R6 ECOL Tech Paper 028-91. 196p.		1992	n/a
	Existing Vegetation Almack, J.A., W.L. Gaines, P.H. Morrison, J.R. Eby, G.F. Wooten, M.C. Snyder, S.H. Fitkin, and E.R. Garcia. 1993. *North Cascades Grizzly Bear Ecosystem Evaluation (NCGBE) - Final Report. Interagency Grizzly Bear Committee*. Denver, Colorado. 156 pp.		1993	n/a
	Modeled Existing Vegetation Henderson, J.A. 2001 revised draft. *The PNV Model - A gradient model for predicting environmental variables and units of Potential Natural Vegetation across a landscape.* USFS Mt. Baker Snoqualime NF. Mountlake Terrace, WA		2001	n/a
	Tree Size data Quadratic mean diameter, Interagency Vegetation Mapping Project (IVMP)	BLM Oregon, Forest Service Region 6	1996	30m grid resolution.
	Urban and Agricultural Land USGS Land Use and Land Cover (LULC) layer	US Geological Service http://edc.usgs.gov/products/landcover/lulc.html	1980s	1:250,000
	Urban and Agricultural Land USGS National Land Cover Dataset (NLCD) layer	US Geological Service http://landcover.usgs.gov/mapping_proc.php#explain	1999, 1996	30m grid resolution
	Elevation, topography for modeling National Elevation Dataset (NED), USGS EROS	US Geological Service	1999	30m grid resolution
Riparian Ecosystems (model / for reviewing results)				
	Digital Elevation Model (DEM) / DEM-derived hillshade grid	Derived from elevation data (see terrestrial ecological systems)		
	Satellite Imagery – NASA Geocover	https://zulu.ssc.nasa.gov/mrsid/mrsid.pl	2000/	

Category/Jurisdiction	Layer Name/Description	Source	Date	Scale
			2001/ 2002	
	LULC, NLCD and BTM – see terrestrial systems above			
Terrestrial Plant Species Targets and Plant Associations				
	International Vegetation Classification (IVC) Grossman D.H., Faber-Langendoen D., Weakley A.S., Anderson M., Bourgeron P., Crawford R., Goodin K., Landaal S., Metzler K., Patterson K.D., Pyne M., Reid M., and Sneddon L. 1998. *International classification of ecological communities: terrestrial vegetation of the United States. Volume I, The National Vegetation Classification System: development, status, and applications.* The Nature Conservancy: Arlington, VA.		1998	n/a
	British Columbia Conservation Data Centre	http://www.env.gov.bc.ca/cdc/index.html	2005	1:20,000
	Washington Natural Heritage Program		2005	
Terrestrial Animals Species Targets				
British Columbia	Element occurrence data for 12 target species	British Columbia Conservation Data Centre http://www.env.gov.bc.ca/cdc/index.html	2005	1:20,000
	Point occurrence data for 7 target species. Polygon data for 3 species: wildlife habitat areas for grizzly bears, winter range polygons for mountain goats, suitable nesting habitat for marbled murrelets	British Columbia Ministry of Environment (Formerly BC Ministry of Water, Land and Air Protection)	2005	
Washington State	Point occurrence data for 19 target species. Polygon data for 4 species: recovery zones for grizzly bears and lynx, population centers for mountain goats, modeled habitat for fishers	Washington Department of Fish and Wildlife	2005	
	Point occurrence data for 5 birds, 3 mammals	Mt. Baker-Snoqualmie National Forests	2005	
	Element occurrence data for western toads and Cascades frogs	Washington Department of Natural Resources Heritage Program	2005	
Inter-jurisdiction	Point occurrence data for 8 mollusks	R. Forsyth- Independent mollusk researcher	2005	
	Point occurrence data for tailed frogs and coastal giant salamanders	Independent researchers: G. Sutherland, J. Richardson, L. Dupuis, T. Wabe	2005	
Freshwater Ecological Systems				

Category/Jurisdiction	Layer Name/Description	Source	Date	Scale
British Columbia	Drainage Area BC Watershed Atlas	BC Ministry of Environment http://www.bcfisheries.gov.bc.ca/fishinv/basemaps-technotes.html ftp://ftp.env.gov.bc.ca/dist/arcwhse/watershed_atlas/	2000	1:50,000
	Percentage of lake area to watershed polygon area BC Watershed Atlas	See above for watershed atlas	2000	1:50,000
	Percentage of wetland area to watershed polygon area BC Watershed Atlas	See above for watershed atlas	2000	1:50,000
	Percent glacial influence BC Watershed Atlas Glaciers from BC TRIM mapping	See above for watershed atlas BC Ministry of Agriculture and Lands (formerly MSRM) – TRIM/TRIMII Program	2000 1997/2002	1:50,000 1:20,000
	Biogeoclimatic Zone Biogeoclimatic Ecosystem Classification (BEC)	BC Ministry of Forests & Range http://www.for.gov.bc.ca/HRE/becweb/index.html	2003	1:250,000
	Geology Digital Geology Map of British Columbia	BC Ministry of Energy and Mines http://www.em.gov.bc.ca/Mining/Geolsurv/Publications/catalog/bcgeolmap.htm	2003	1:250,000
	Mainstem and Tributary Stream Gradient BC Watershed Atlas BC TRIM DEM	See above for watershed atlas BC Ministry of Agriculture and Lands (formerly MSRM) – TRIM/TRIMII Program	2000 1997/2002	1:50,000 1:20,000 (25 meter)
British Columbia and Washington State	Accumulative precipitation yield	ClimateSource http://www.climatesource.com	2005	n/a
Washington State	Drainage Area Hydrologic Unit Boundary (HUC) calculated watersheds	US Geological Service	2002	1:24,000
	Percentage of lake area to watershed polygon area National Hydrography Dataset (NHD)	US Geological Service http://nhd.usgs.gov/data.html	2004	1:100,000
	Percentage of wetland area to watershed polygon area National Hydrography Dataset (NHD)	US Geological Service http://nhd.usgs.gov/data.html	2004	1:100,000
	Percent glacial influence National Hydrography Dataset (NHD)	US Geological Service http://nhd.usgs.gov/data.html	2004	1:100,000

Category/Jurisdiction	Layer Name/Description	Source	Date	Scale
	Biogeoclimatic Zones Regional and Zonal Ecosystems of the Shining Mountains	BC Ministry of Sustainable Resource Management http://srmwww.gov.bc.ca/ecology/bei/shiningmtns.html	November 2000	1:250,000
	Geology Surface Geology	Washington Department of Natural Resources http://www.dnr.wa.gov/geology/dig100k.htm	2003	1:100,000
	Mainstem and Tributary Stream Gradient HUC calculated watersheds National Hydrography Dataset (NHD)	US Geological Service http://nhd.usgs.gov/data.html	2002 2004	1:24,000 1:100,000
Freshwater Species Targets – See Appendix 4.1 for further details				
British Columbia	Fisheries Information Summary System (FISS)	British Columbia Fisheries/Canadian Department of Fisheries and Oceans http://www.bcfisheries.gov.bc.ca/fishinv/fiss.html	2005	1:50,000
	Occurrences: fish and dragonflies	BC Conservation Data Centre http://www.env.gov.bc.ca/cdc/index.html	2005	1:20,000
	Fish observations	British Columbia Ministry of Environment	2005	
	Observations/points: Plecoptera and Tricoptera	University of British Columbia	2005	
	Observations/points: Fish, Dragonflies, Ephemeroptera, Tricoptera, Plecoptera	Royal British Columbia Museum (various researchers)	2005	
	Observations/points: Salish Sucker and Nooksack Dace	Pearson Ecological	2005	
Washington State	Amphibians, Birds, Mammals	Washington Department of Fish and Wildlife	2005	1:24,000
	Attributing freshwater species BC Macroreach stream network (BCMCRH1A)	BC Ministry of Environment (formerly MSRM)	2004	1:50,000
Suitability Indices				
British Columbia	Management Status See Land Ownership and Management Status			

Category/Jurisdiction	Layer Name/Description	Source	Date	Scale
	Land Use Baseline Thematic Mapping (BTM) – Version 2 for most of Ecoregion	BC Ministry of Agriculture and Lands (formerly MSRM) http://ilmbwww.gov.bc.ca/cis/initiatives/ias/btm/index.html	Imagery from 1990-97 & 1998 Spatial: 2001-2005	1:250 000 (10-15 ha polygon size)
	Future Urban Potential Statistics Canada Urban Growth Core areas	2001 Census	2001	1:250,000
	Road Density	BC Ministry of Agriculture and Lands TRIM/TRIMII Program http://ilmbwww.gov.bc.ca/bmgs/trim/trim	1997-2005	1:20,000
	Dams	Dam Safety Group Additional dam locations from BC Hydro	2001 2001	latitude and longitude coordinates (DMS)
	Water Extraction Points of diversion Water licenses Extraction Query (by water district)	BC Ministry of Environment ftp://ftp.env.gov.bc.ca/dist/arcwhse/water_licenses http://www.elp.gov.bc.ca:8000/pls/wtrwhse/water_licences.input.	2005 2005	1:20,000
	Fish Stock Enhancement (lake)	BC Ministry of Environment http://srmapps.gov.bc.ca/apps/fidq/	2005	1:20,000
	Road Stream Crossing Road Density (slopes > 50%) Riparian Disturbance	BC Ministry of Environment Watershed Statistics/Watersheds BC	2000	1:20,000
Washington State	Management Status See Land Ownership and Management Status			
	Land Use USGS National Land Cover Dataset (NLCD) layer	US Geological Service http://landcover.usgs.gov/mapping_proc.php#explain	1999, 1996	30m grid resolution
	Land Use USFS land-use allocation tracts that contain the ski resorts and hills	Via TNC GIS staff	2004	

Category/Jurisdiction	Layer Name/Description	Source	Date	Scale
	Future Urban Potential Delineated urban areas	Washington Dept of Community, Trade, and Economic Development (CTED) ftp://ftp.wsdot.wa.gov/public/Cartography/UrbanAreas/UrbanAreaShapeFiles	Circa 2001	
	Dams	Streamnet http://www.streamnet.org	1995 to 2001	1:100,000
	Road Density Bureau of Land Management Geographic Data Technology Inc. Tiger 2002 Skagit County Street Centerlines Washington Department of Natural Resources	 http://www.blm.gov/or/gis/index.htm Dynamap/1000 downloaded from NRCS Gateway http://www.skagitcounty.net http://www3.wadnr.gov/dnrapp6/dataweb/dmmatrix.html (download by county)	 Aug. 2004 1999 2002 July 2004 June 2005	 1:24,000 1:24,000 1:100,000 1:24,000 1:24,000
Retrospective Analysis – Grizzly				
British Columbia	Grizzly Bear Habitat Effectiveness and Connectivity in Southwestern British Columbia Grizzly Bear Population Units (GBPU)	(Apps and Hamilton, 2002) British Columbia Ministry of Environment ftp://ftp.env.gov.bc.ca/dist/arcwhse/wildlife	2002 2003	1:20,000 – 1:250,000 1:250,000
Washington State	North Cascades Grizzly bear recovery plan	US Fish and Wildlife Service	1993	1:250,000
Retrospective Analysis – Fisher habitat				
Washington State		USDI Bureau of Land Management and USDA Forest Service. 1996. Interagency Vegetation Mapping Project. USDI Bureau of Land Management, Portland, OR. www.or.blm.gov/gis/projects/ivmp.asp	1996	30m grid resolution
Retrospective Analysis – Modeled Steelhead habitat				
British Columbia	Modeled distribution of steelhead stocks (work in progress)	British Columbia Ministry of Environment	2005	
Retrospective Analysis – Coastal tailed frog habitat				

Category/Jurisdiction	Layer Name/Description	Source	Date	Scale
British Columbia		British Columbia Integrated Land Management Bureau - ILMBSURCS - Client Services (Surrey) Mr. Gurdeep Singh – Manger, Land Information Managemnt http://ilmbwww.gov.bc.ca/ilmb/lup/lrmp/coast/s2s/index.html	2001	1:20,000

APPENDIX 5 – TARGETS AND GOALS SUMMARY

Appendix 5 – Targets and Goals Summary

Targets List

Habitat Type / Level of Biological Organization / Taxon / Common Name	Scientific Name	ELCODE	G Rank	Mapped Data?

North Cascades Ecoregion

Terrestrial

Terrestrial Ecological Systems

Common Name	Scientific Name	ELCODE	G Rank	Mapped Data?
Aggregate higher elevation				✔
Aggregate lower elevation				✔
Alpine composite				✔
East Cascades Mesic Montane Mixed Conifer Forest				✔
Montane composite				✔
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest				✔
North Pacific Lowland Riparian Forest and Shrubland				✔
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest				✔
North Pacific Maritime Mesic Subalpine Parkland				✔
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest				✔
North Pacific Mesic Western Hemlock - Silver fir Forest				✔
North Pacific Montane Massive Bedrock, Cliff and Talus				✔
North Pacific Montane Riparian Woodland and Shrubland				✔
North Pacific Mountain Hemlock Forest				✔
Northern Interior Spruce-Fir woodland and forest				✔
Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest				✔
Northern Rocky Mountain Subalpine Dry Parkland				✔
Old Growth Forest				✔
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland				✔

Species

Amphibians

Common Name	Scientific Name	ELCODE	G Rank	Mapped Data?
Cascades frog	Rana cascadae	AAABH01060	G3G4	✔
Western toad ts	Bufo boreas	AAABB01030	G4	✔

Birds

Habitat Type

Level of Biological Organization

Taxon

Common Name	Scientific Name	ELCODE	G Rank	Mapped Data?
American dipper	Cinclus mexicanus	ABPBH01010	G5	☐
Bald eagle	Haliaeetus leucocephalus	ABNKC10010	G5	☐
Bald eagle nests	Haliaeetus leucocephalus	ABNKC10010	G5	☑
Bald eagle roosts	Haliaeetus leucocephalus	ABNKC10010	G5	☑
Band-tailed pigeon	Columba fasciata	ABNPB01080	G4	☑
Barrow's goldeneye	Bucephala islandica	ABNJB18020	G5	☑
Common Loon	Gavia immer	ABNBA01030	G5	☑
Double-crested cormorant	Phalacrocorax auritus	BNFD01020	G5	☐
Golden Eagle	Aquila chrysaetos	ABNKC22010	G5	☑
Great blue heron	Ardia herodius fannini	ABNGA04010	G5T4	☑
Harlequin duck	Histrionicus histrionicus	ABNJB15010	G4	☑
Marbled murrelet	Brachyramphus marmoratus	ABNNN06010	G3G4	☑
Marbled murrelet habitat	Brachyramphus marmoratus	ABNNN06010	G3G4	☑
Northern goshawk	Accipiter gentilis laingi	ABNKC12061	G5	☑
Northern spotted owl	Strix occidentalis caurina	ABNSB12011	G3T3	☑
Northern spotted owl Nests	Strix occidentalis caurina	ABNSB12011	G3T3	☑
Peregrine falcon	Falco peregrinus anatum	ABNKD06071	G4T3	☑
Red breasted sapsucker	Sphyrapicus ruber	ABNYF05020	G5	☑
Sandhill Crane	Grus canadensis	ABNMK01010	G5	☑
Vaux's swift	Chaetura vauxi	ABNUA03020	G5	☑
White-tailed ptarmigan	Lagopus leucurus	ABNLC10030	G5	☑
Insects				
Arctic blue	Plebejus glandon	IILEPH0050	G5	☑
Astarte fritillary	Boloria astarte	IILEPJ7120	G5	☑
common branded skipper	Hesperia comma	IILEP65034	G5	☑
lustrous copper	Lycaena cuprea henryae	IILEPC1020	G5	☑
Melissa arctic	Oeneis melissa	IILEPP1100	G5	☑
Vidler's alpine	Erebia vidleri	IILEPN8010	G4G5	☑
Mammals				
Fisher	Martes pennanti	AMAJF01020	G5	☑
Gray wolf	Canis lupus	AMAJA01030	G4	☑
Grizzly bear	Ursus arctos horribilis	AMAJB01020	G4	☐

Habitat Type Level of Biological Organization Taxon Common Name	Scientific Name	ELCODE	G Rank	Mapped Data?
Grizzly bear a	Ursus arctos horribilis	AMAJB01021	G4T3T4	☐
Grizzly bear b	Ursus arctos horribilis	AMAJB01021	G4T3T4	☐
Lynx	Lynx canadensis	AMAJH03010	G5	☑
Mountain goat	Oreamos americanus	AMALE02010	G5	☑
Mtn beaver rainieri	Aplodontia rufa rainieri	AMAFA01014	G5T4	☑
Mtn beaver rufa	Aplodontia rufa rufa	AMAFA01015	G5T4?	☑
Northern bog lemming	SynaptomYs borealis	AMAFF17020	G4	☐
Roosevelt elk	Cervus canadensis	AMALC01010	G5T4	☑
Townsend's big-eared bat	Coryhorhinus townsendii	AMACC08010	G4	☑
Trowbridge's shrew	Sorex trowbridgii	AMABA01220	G5	☑
Wolverine	Gulo gulo	AMAJF03012	G4	☑
<u>Mollusks</u>				
Conical Spot	Punctum randolphii	IMGAS47050	G4	☑
Northern Tightcoil	Pristiloma arcticum	IMGAS80120	G3G4	☑
Oregon Forestsnail	Allogona townsendiana	IMGAS07060	G3G4	☑
Pacific Sideband	Monadenia fidelis	IMGAS21020	G4G5	☑
Pygmy Oregonian	Cryptomastix germana	IMGAS36120	G3G4	☑
Robust Lancetooth	Haplotrema vancouverens	IMGASC7030	G5	☑
Striated Tightcoil	Pristiloma stearnsii	IMGAS47050	G3	☑
Western Flat whorl	Planogyra clappi	IMGAS80010	G3G4	☑
Western thorn	Carychium occidentale	IMGAS93020	G3G4	☑
<u>Nonvascular Plants</u>				
Cryptic Paw	Nephroma occultum	NLLEC1C050	G3	☐
Lescur's Bartramiopsis Moss	Bartramiopsis lescurii	NBMUS0T010	G3G5	☑
Luminous Moss	Schistostega pennata	NBMUS6P010	G3G5	☑
Navel Lichen	Umbilicaria decussata	NLLEC5N240	G3?	☐
Oldgrowth Specklebelly	Pseudocyphellaria rainierensis	NLLEC3B060	G3	☑
Poor Pocket Moss	Fissidens pauperculus	NBMUS2W0U0	G3	☐
Witch's Hair Lichen	Alectoria nigricans	NLTEST7860	G5	☐
<u>Vascular Plants</u>				
Alaska Harebell	Campanula lasiocarpa	PDCAM020F0	G5	☑
Alpine Anemone	Anemone drummondii var. drummondii	PDRAN04061	G4T4	☑

Habitat Type Level of Biological Organization Taxon Common Name	Scientific Name	ELCODE	G Rank	Mapped Data?
Arctic Aster	Aster sibiricus var. meritus	PDASTEB030	G5T5	☑
Bearded Sedge	Carex comosa	PMCYP032Y0	G5	☑
Black Lily	Fritillaria camschatcensis	PMLIL0V050	G5	☑
Blue Vervain	Verbena hastata var. scabra	PDVER0N0E2	G5T5	☐
Blunt-sepaled Starwort	Stellaria obtusa	PDCAR0X0U0	G5	☑
Bog Clubmoss	Lycopodiella inundata	PPLYC03060	G5	☑
Brandegee's Lomatium	Lomatium brandegeei	PDAPI1B040	G3?	☐
Brewer's Monkey-flower	Mimulus breweri	PDSCR1B0N0	G5	☐
Canyon Bog-orchid	Platanthera sparsiflora	PMORC1Y0N0	G4G5	☑
Cascade Parsley Fern	Cryptogramma cascadensis	PPADI0B040	G5	☑
Choris' Bog-orchid	Platanthera chorisiana	PMORC1Y030	G3G4	☑
Cliff Paintbrush	Castilleja rupicola	PDSCR0D2U0	G2G3	☑
Clubmoss Cassiope	Cassiope lycopodioides	PDERI07020	G4	☑
Cooley's Buttercup	Ranunculus cooleyae	PDRAN0S010	G4	☑
Corrupt Spleenwort	Asplenium adulterinum	PPASP02230	G3?	☐
Creeping Snowberry	Gaultheria hispidula	PDERI0F010	G5	☑
Curved Woodrush	Luzula arcuata	PMJUN02030	G5	☐
Dwarf Groundsmoke	Gayophytum humile	PDONA09050	G5	☑
Elegant Jacob's-ladder	Polemonium elegans	PDPLM0E090	G4	☑
Elmera	Elmera racemosa var. racemosa	PDSAX0B012	G4G5T4	☑
Enander's Sedge	Carex lenticularis var. dolia	PMCYP037A3	G5T3Q	☑
Few-flowered Sedge	Carex pauciflora	PMCYP03A50	G5	☑
Field Dodder	Cuscuta pentagona	PDCUS01140	G5	☐
Flat-leaved Bladderwort	Utricularia intermedia	PDLNT020A0	G5	☑
Flowering Quillwort	Lilaea scilloides	PMJCG01010	G5?	☐
Geyer's Onion	Allium geyeri var. tenerum	PMLIL02102	G4G5TNR	☑
Giant Helleborine	Epipactis gigantea	PMORC11010	G3G4	☑
Golden Draba	Draba aurea	PDBRA110E0	G5	☐
Gray's Bluegrass	Poa arctica ssp. arctica	PMPOA4Z085	G5T3T5	☑
Green-fruited Sedge	Carex interrupta	PMCYP036L0	G3G4	☑
Kruckeberg's Holly Fern	Polystichum kruckebergii	PPDRY0R0C0	G4	☑
Lace Fern	Cheilanthes gracillima	PPADI090B0	G4G5	☑

Habitat Type Level of Biological Organization Taxon Common Name	Scientific Name	ELCODE	G Rank	Mapped Data?
Lance-fruited Draba	Draba lonchocarpa var. thompsonii	PDBRA111F2	G5T3T4	☐
Lance-leaved Figwort	Scrophularia lanceolata	PDSCR1S050	G5	☑
Large Canadian St. John's-wort	Hypericum majus	PDCLU03120	G5	☐
Large-awn Sedge	Carex macrochaeta	PMCYP03820	G5	☑
Leafy Mitrewort	Mitella caulescens	PDSAX0N020	G5	☑
Least Moonwort	Botrychium simplex	PPOPH010E0	G5	☐
Lesser Bladderwort	Utricularia minor	PDLNT020D0	G5	☑
Long-styled Sedge	Carex stylosa	PMCYP03D50	G5	☑
Marginal Wood Fern	Dryopteris marginalis	PPDRY0A0K0	G5	☑
Menzies' Burnet	Sanguisorba menziesii	PDROS1L030	G3G4	☑
Mountain Sneezeweed	Helenium autumnale var. grandiflorum	PDAST4L031	G5TNR	☐
Nodding Saxifrage	Saxifraga cernua	PDSAX0U0B0	G4	☐
Nodding Semaphoregrass	Pleuropogon refractus	PMPOA4Y080	G4	☑
Olney's Bulrush	Schoenoplectus americanus	PMCYP0Q020	G5	☑
Oniongrass	Melica bulbosa var. bulbosa	PMPOA3X031	G5TNRQ	☑
Pacific Waterleaf	Hydrophyllum tenuipes	PDHYD08070	G4G5	☑
Phantom Orchid	Cephalanthera austiniae	PMORC0F010	G4	☑
Pointed Broom Sedge	Carex scoparia	PMCYP03C90	G5	☑
Poor Sedge	Carex magellanica ssp. irrigua	PMCYP03G31	G5T5	☑
Pull-up Muhly	Muhlenbergia filiformis	PMPOA480N0	G5	☐
Purple-marked Yellow Violet	Viola purpurea var. venosa	PDVIO041S1	G5T4T5	☑
Regel's Rush	Juncus regelii	PMJUN012D0	G4?	☑
Scalepod	Idahoa scapigera	PDBRA1G010	G5	☐
Several-flowered Sedge	Carex pluriflora	PMCYP03AT0	G4	☑
Short-fruited Smelowskia	Smelowskia ovalis	PDBRA2D040	G5	☑
Skunk Polemonium	Polemonium viscosum	PDPLM0E0M0	G5	☑
Slender Gentian	Gentianella tenella ssp. tenella	PDGEN07072	G4G5T4	☑
Slender Spike-rush	Eleocharis nitida	PMCYP09180	G3G4	☑
Small Northern Bog-orchid	Platanthera obtusata	PMORC1Y0J0	G5	☑
Small-fruited Willowherb	Epilobium leptocarpum	PDONA060F0	G5	☑
Smoky Mountain Sedge	Carex proposita	PMCYP03B60	G4	☑
Smooth Willowherb	Epilobium glaberrimum ssp. fastigiatum	PDONA06091	G5TNR	☐

Habitat Type Level of Biological Organization Taxon Common Name	Scientific Name	ELCODE	G Rank	Mapped Data?
Snow Bramble	Rubus nivalis	PDROS1K4S0	G4?	✔
Soft-leaved Willow	Salix sessilifolia	PDSAL022Q0	G4	✔
Spleenwort-leaved Goldthread	Coptis aspleniifolia	PDRAN0A010	G5	✔
Stalked Moonwort	Botrychium pedunculosum	PPOPH010T0	G2G3	✔
Steer's Head	Dicentra uniflora	PDFUM040A0	G4?	☐
Stiff-leaved Pondweed	Potamogeton strictifolius	PMPOT03110	G5	✔
Tall Bugbane	Cimicifuga elata	PDRAN07030	G2	✔
Thompson's Chaenactis	Chaenactis thompsonii	PDAST200J0	G2G3	✔
Three-leaved Lewisia	Lewisia triphylla	PDPOR040H0	G4?	☐
Treelike Clubmoss	Lycopodium dendroideum	PPLYC010B0	G5	✔
Triangular-lobed Moonwort	Botrychium ascendens	PPOPH010S0	G2G3	✔
Umbellate Starwort	Stellaria umbellata	PDCAR0X120	G5	☐
Ussurian Water-milfoil	Myriophyllum ussuriense	PDHAL040E0	G3	✔
Vancouver Island Beggarticks	Bidens amplissima	PDAST18020	G3	☐
Washington Springbeauty	Claytonia washingtoniana	PDPOR030U0	G2G4	✔
Water Lobelia	Lobelia dortmanna	PDCAM0E0C0	G4G5	✔
Water-pepper	Polygonum hydropiperoides	PDPGN0L170	G5	✔
Western Mannagrass	Glyceria occidentalis	PMPOA2Y0D0	G5	✔
White Wintergreen	Pyrola elliptica	PDPYR04040	G5	☐
Woodland Penstemon	Nothochelone nemorosa	PDSCR1F010	G5	✔
Woody-branched Rockcress	Arabis lignifera	PDBRA06120	G5	☐
Other Ecological Features				
Hot Spring				✔
Karst PH				✔
Karst SM				✔
Karst TM				✔
Communities				
Carex (livida, utriculata) / Sphagnum spp. Herbaceous Vegetation Community	Carex (livida, utriculata) / Sphagnum spp. Herbaceous Vegetation	CEGL003423	G1G2	✔

Habitat Type Level of Biological Organization Taxon Common Name	Scientific Name	ELCODE	G Rank	Mapped Data?
Carex aquatilis var. dives - Carex utriculata Herbaceous Vegetation Community	Carex aquatilis var. dives - Carex utriculata Herbaceous Vegetation			✔
Carex cusickii - (Carex aquatilis var. dives) / Sphagnum spp. Herbaceous Vegetation Community	Carex cusickii - (Carex aquatilis var. dives) / Sphagnum spp. Herbaceous Vegetation			✔
Carex interior - Hypericum anagalloides Herbaceous Vegetation Community	Carex interior - Hypericum anagalloides Herbaceous Vegetation	CEGL001857	G2?Q	✔
Carex pellita (=C. lanuginosa) Herbaceous Vegetation Community	Carex pellita (=C. lanuginosa) Herbaceous Vegetation	CEGL001809	G3	✔
Deschampsia caespitosa Herbaceous Vegetation Community	Deschampsia caespitosa Herbaceous Vegetation	CEGL001599	G4	✔
Eriophorum chamissonis / Sphagnum spp. Herbaceous Vegetation Community	Eriophorum chamissonis / Sphagnum spp.			✔
Ledum groenlandicum - Myrica gale / Sphagnum spp. Shrubland Community	Ledum groenlandicum - Myrica gale / Sphagnum spp.	CEGL003335	G2	✔
Picea sitchensis / Polystichum munitum Forest Community	Picea sitchensis / Polystichum munitum	CEGL000059	G4?	✔
Picea sitchensis / Rubus spectabilis Dry Community	Picea sitchensis / Rubus spectabilis			✔
Populus balsamifera ssp. trichocarpa / Salix sitchensis - Rubus parviflorus Community	Populus balsamifera ssp. trichocarpa / Salix sitchensis - Rubus parviflorus			✔
Quercus garryana - Acer macrophyllum - Prunus spp. Community	Quercus garryana - Acer macrophyllum - Prunus spp.			✔
Rhynchospora alba - (Vaccinium oxycoccus) / Sphagnum tenellum Herbaceous Vegetation Community	Rhynchospora alba - (Vaccinium oxycoccus) / Sphagnum tenellum	CEGL003338	G3	✔
Spiraea douglasii / Carex aquatilis var. dives Shrubland Community	Spiraea douglasii / Carex aquatilis var. dives	CEGL003415	G4	✔
Thuja plicata - Tsuga heterophylla / Lysichiton americanus Forest Community	Thuja plicata - Tsuga heterophylla / Lysichiton americanus	CEGL002670	G2	✔
Tsuga heterophylla - (Thuja plicata) / Ledum groenlandicum / Sphagnum spp. Woodland Community	Tsuga heterophylla - (Thuja plicata) / Ledum groenlandicum / Sphagnum spp.			✔
Tsuga mertensiana - Abies amabilis / Elliottia pyroliflorus Woodland Community	Tsuga mertensiana - Abies amabilis / Elliottia pyroliflorus	CEGL000503	G3G4	✔

Puget Sound EDU

Freshwater

Species

Fishes

Common Name	Scientific Name	ELCODE	G Rank	Mapped Data?
Bull Trout - Coastal and Puget Sound habitat	Salvelinus confluentus pop. 3	AFCHA05024	G3T2Q	✔
Chinook - Puget Sound habitat	Oncorhynchus tshawytscha pop. 15	AFCHA0205Q	G5T2Q	✔
Chum Salmon - Pacific Coast habitat	Onchorhynchus keta pop. 5	AFCHA02025	G5T3Q	✔
Coastal Cutthroat Trout - Puget Sound habitat	Oncorhynchus clarki clarki pop. 7	AFCHA0208N	G4T3Q	✔
Coho Salmon - Puget Sound/Straight of Georgia habitat	Onchorhynchus kisutch pop. 5	AFCHA02035	G4T3Q	✔
Olympic Mudminnow habitat	Novumbra hubbsi	AFCHD03010	G3	✔

Habitat Type

Level of Biological Organization

Taxon

Common Name	Scientific Name	ELCODE	G Rank	Mapped Data?
Pacific Lamprey habitat	Lampetra tridentata	AFBAA02100	G5	☑
Pink Salmon - Even-year habitat	Onchorhynchus gorbuscha	AFCHA0201E	GQ	☑
Pink Salmon - Odd-year habitat	Onchorhynchus gorbuscha	AFCHA02010	G5	☑
River Lamprey habitat	Lampetra ayresi	AFBAA02030	G4	☑
Salish Sucker	Catostomus Sp 4	AFCJC02260	GQ	☑
Sockeye Salmon - Baker River habitat	Onchorhynchus nerka pop. 5	AFCHA02046	G5T3Q	☑
Steelhead - Puget Sound habitat	Onchorhynchus mykiss	AFCHA02090	G5	☑
Western Brook Lamprey habitat	Lamptera richardsoni	AFBAA02090	G5	☑
<u>Vascular Plants</u>				
Leafy Pondweed habitat	Potamogeton foliosus	PMPOT030B0	G5	☑
Water Lobelia	Lobelia dortmanna	PDCAM0E0C0	G4G5	☑

<u>Freshwater Ecological Systems</u>

Common Name	Scientific Name	ELCODE	G Rank	Mapped Data?
Cascade foothills headwaters - glacial drift and alluvium , low to mid elevation, mixed gradient		FSPT1.14D		☑
Cascade foothills headwaters - glacial drift, mid elevations, mixed gradient		FSPT1.14C		☑
Cascades headwaters, sedimentary, mid elevation		FSPT1.113		☑
Cascades tributary headwaters - granitic, low to mid elevation		FSPT1.17		☑
Fraser/Nooksack coastal plain - sandstone, low elevation, low gradient		FSPT1.21		☑
intermediate,geology_hard_sediments,elevation_low,gradient_mainstem shallow - tributary shallow				☑
Nooksack coastal plain headwaters - glacial drift and outwash, low elevation, low to moderate gradient		FSPT1.375E		☑
North Cascades - mafic , mid elevation, mixed gradient		FSPT1.32C		☑
North Cascades headwaters - granitic , mid to high elevation, moderate to high gradient		FSPT1.2B		☑
North Cascades headwaters - mostly volcanic, mid to high elevation, moderate to high gradient		FSPT1.330B		☑
Northern Cascades headwaters - sandstone, moderate to high elevation, moderate to high gradient		FSPT1.73B		☑
Puget lowland headwaters north - glacial drift, low elevation, low to moderate gradient		FSPT1.375A		☑
Puget lowland headwaters west - glacial drift, low elevation, low to moderate gradient		FSPT1.375B		☑
Puget uplands and islands headwaters - glacial drift, low to mid elevation, low to moderate gradient		FSPT1.375D		☑

Habitat Type Level of Biological Organization Taxon Common Name	Scientific Name	ELCODE	G Rank	Mapped Data?
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem moderate - tributary moderate b				☑
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary moderate b				☑
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow a				☑
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow b				☑
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow d				☑
small,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem shallow - tributary shallow				☑
<u>Communities</u>				
North Pacific Bog and Fen Community	North Pacific Bog and Fen	CES204.063	GQ	☑
North Pacific Shrub Swamp Community	North Pacific Shrub Swamp	CES204.865	GQ	☑

Lower Fraser EDU

<u>Freshwater</u>				
<u>Species</u>				
<u>Amphibians</u>				
Coastal tailed frog	Ascaphus truei	AAABA01010	G4	☑
Coastal tailed frog (habitat)	Ascaphus truei	AAABA01010	G4	☐
Pacific Giant Salamander	Dicamptodon tenebrosus	AAAAH01040	G5	☑
Red-legged frog	Rana aurora	AAABH01020	G4	☑
Western toad	Bufo boreas	AAABB01030	G4	☑
<u>Birds</u>				
Western grebe	Aechmophorus occidentalis	ABNCA04010	G5	☐
<u>Fishes</u>				
Bull Trout	Salvelinus confluentus	AFCHA05020	G3	☑
Chinook Salmon (no run info)	Oncorhynchus tshawytscha	AFCHA02050	G5	☑
Chum Salmon (Fraser XAN Ecoregion)	Oncorhynchus keta	AFCHA02020	G5	☑
Coastal Cutthroat Trout, Clarki Subspecies (anadromous)	Oncorhynchus clarki clarki	AFCHA0208A	G4	☑

Habitat Type

Level of Biological Organization

Taxon Common Name	Scientific Name	ELCODE	G Rank	Mapped Data?
Coho Salmon	Oncorhynchus kisutch	AFCHA02030	G4	✔
Cultus Lake Sculpin	Cottus sp. 2	AFC4E02270	G1	✔
Cutthroat Trout, Clarkil Subspecies	Oncorhynchus clarkiI clarkiI	AFCHA0208A	G4	✔
Dolly Varden	Salvelinus malma	AFCHA05040	G5	✔
Dolly Varden (anadromous)	Salvelinus malma	AFCHA05040	G5	☐
Eulachon	Thaleichthys pacificus	AFCHB04010	G5	✔
Green Sturgeon	Acipenser medirostris	AFCAA01030	G3	✔
Kokanee	Oncorhynchus nerka	AFCHA02040	G5	✔
Mountain Sucker (ha)	Catostomus platyrhynchus	AFCJC02160	G5	✔
Mountain Sucker (km)	Catostomus platyrhynchus	AFCJC02160	G5	✔
Nooksack Dace	Rhinichthys sp. 4	AFCJB37110	G3	✔
Pink Salmon, no run info (Fraser XAN Ecoregion)	Oncorhynchus gorbuscha	AFCHA02010	G5	✔
Pygmy Longfin Smelt/Harrison/Pitt Lake Smelt	Spirinchus sp. 1	AFCHB03030	G1Q	✔
Salish Sucker (ha)	Catostomus sp. 4	AFCJC02260	G1	✔
Salish Sucker (km)	Catostomus sp. 4	AFCJC02260	G1	✔
Sockeye Salmon	Oncorhynchus nerka	AFCHA02040	G5	✔
Sockeye Salmon (Cultus Lake)	Oncorhynchus nerka	AFCHA02040	G5	✔
Sockeye Salmon (Sakinaw Lake)	Oncorhynchus nerka	AFCHA02040	G5	☐
Steelhead Salmon (modelled)	Oncorhynchus mykiss	AFCHA02090	G5	☐
Steelhead Salmon (no run info)	Oncorhynchus mykiss	AFCHA02090	G5	✔
Steelhead Salmon (summer)	Oncorhynchus mykiss	AFCHA02090	G5	✔
Steelhead Salmon (winter)	Oncorhynchus mykiss	AFCHA02090	G5	✔
Threespine stickleback	Gasterosteus aculeatus	AFCPA03010	G5	✔
Western Brook Lamprey	Lampetra richardsoni	AFBAA02090	G4G5	✔
White Sturgeon	Acipenser transmontanus	AFCAA01050	G4	✔
White Sturgeon	Acipenser transmontanus	AFCAA01050	G4	✔
Insects				
Autumn Meadowhawk	Sympetrum vicinum	IIODO61140	G5	✔
Beaverpond Baskettail	Epitheca canis	IIODO29030	G5	✔
Black Petaltail	Tanypteryx hageni	IIODO02010	G4	☐
Blue Dasher	Pachydiplax longipennis	IIODO53010	G5	✔
Emma's Dancer (nez Perce)	Argia emma	IIODO68150	G5	✔

Habitat Type Level of Biological Organization Taxon Common Name	Scientific Name	ELCODE	G Rank	Mapped Data?
Grappletail	Octogomphus specularis	IIODO89010	G4	☑
Spring Stonefly trictura	Cascadoperla trictura	IIPLE22010	G3G4	☑
Stonefly fraseri	Isocapnia fraseri	IIPLE05040	G1	☑
Stonefly gregsoni	Bolshecapnia gregsoni	IIEPE02010	G2	☐
Stonefly sasquatchi	Bolshecapnia sasquatchi	IIEPE02050	G3	☑
Stonefly tibilalis	Setvena tibilalis	IIPLE2A020	G4	☑
Stonefly vedderensis	Isocapnia vedderensis	IIPLE05110	G4	☑
Vivid Dancer	Argia vivida	IIODO68290	G5	☑
Western Pondhawk	Erythemis collocata	IIODO39020	G5	☑
Mammals				
Pacific water Shrew	Sorex bendirii	AMABA01170	G4	☑
Freshwater Ecological Systems				
intermediate,geology_hard_sediments,elevation_low,gradient_mainstem shallow - tributary shallow				☑
intermediate,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem shallow - tributary shallow a				☑
intermediate,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem shallow - tributary shallow b				☑
intermediate,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem steep - tributary steep				☑
intermediate,geology_intrusive - metamorphic,elevation_low,gradient_mainstem shallow - tributary shallow				☑
large,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem shallow - tributary shallow				☑
large,geology_intrusive-metamorphic,elevation_low,gradient_mainstem steep_tributary moderate				☑
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem moderate - tributary moderate a				☑
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem moderate - tributary moderate b				☑
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary moderate a				☑
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary moderate b				☑

Habitat Type Level of Biological Organization Taxon Common Name	Scientific Name	ELCODE	G Rank	Mapped Data?
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary moderate c				✔
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow a				✔
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow b				✔
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow c				✔
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow d				✔
small,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem shallow - tributary shallow				✔

Southern Coastal Streams EDU

Freshwater

Species

Amphibians				
Coastal tailed frog	Ascaphus truei	AAABA01010	G4	✔
Coastal tailed frog (habitat)	Ascaphus truei	AAABA01010	G4	☐
Pacific Giant Salamander	Dicamptodon tenebrosus	AAAAH01040	G5	☐
Red-legged frog	Rana aurora	AAABH01020	G4	☐
Western toad	Bufo boreas	AAABB01030	G4	☐
Birds				
Western grebe	Aechmophorus occidentalis	ABNCA04010	G5	✔
Fishes				
Bull Trout	Salvelinus confluentus	AFCHA05020	G3	✔
Chinook Salmon (no run info)	Oncorhynchus tshawytscha	AFCHA02050	G5	✔
Chum Salmon (Puget XAN Ecoregion)	Oncorhynchus keta	AFCHA02020	G5	✔
Coastal Cutthroat Trout, Clarki Subspecies (anadromous)	Oncorhynchus clarki clarki	AFCHA0208A	G4	✔
Coho Salmon	Oncorhynchus kisutch	AFCHA02030	G4	✔
Cultus Lake Sculpin	Cottus sp. 2	AFC4E02270	G1	☐
Cutthroat Trout, Clarkil Subspecies	Oncorhynchus clarkil clarkil	AFCHA0208A	G4	✔
Dolly Varden	Salvelinus malma	AFCHA05040	G5	✔
Dolly Varden (anadromous)	Salvelinus malma	AFCHA05040	G5	✔

Habitat Type Level of Biological Organization Taxon Common Name	Scientific Name	ELCODE	G Rank	Mapped Data?
Eulachon	Thaleichthys pacificus	AFCHB04010	G5	☑
Green Sturgeon	Acipenser medirostris	AFCAA01030	G3	☑
Kokanee	Oncorhynchus nerka	AFCHA02040	G5	☑
Mountain Sucker	Catostomus platyrhynchus	AFCJC02160	G5	☐
Nooksack Dace	Rhinichthys sp. 4	AFCJB37110	G3	☐
Pink Salmon, no run info (Puget XAN Ecoregion)	Oncorhynchus gorbuscha	AFCHA02010	G5	☑
Pygmy Longfin Smelt/Harrison/Pitt Lake Smelt	Spirinchus sp. 1	AFCHB03030	G1Q	☐
Salish Sucker	Catostomus sp. 4	AFCJC02260	G1	☐
Sockeye Salmon	Oncorhynchus nerka	AFCHA02040	G5	☑
Sockeye Salmon (Cultus Lake)	Oncorhynchus nerka	AFCHA02040	G5	☐
Sockeye Salmon (Sakinaw Lake)	Oncorhynchus nerka	AFCHA02040	G5	☑
Steelhead Salmon (modelled)	Oncorhynchus mykiss	AFCHA02090	G5	☐
Steelhead Salmon (no run info)	Oncorhynchus mykiss	AFCHA02090	G5	☑
Steelhead Salmon (summer)	Oncorhynchus mykiss	AFCHA02090	G5	☑
Steelhead Salmon (winter)	Oncorhynchus mykiss	AFCHA02090	G5	☑
Threespine stickleback	Gasterosteus aculeatus	AFCPA03010	G5	☑
Western Brook Lamprey	Lampetra richardsoni	AFBAA02090	G4G5	☑
White Sturgeon	Acipenser transmontanus	AFCAA01050	G4	☐
<u>Insects</u>				
Autumn Meadowhawk	Sympetrum vicinum	IIODO61140	G5	☐
Beaverpond Baskettail	Epitheca canis	IIODO29030	G5	☐
Black Petaltail	Tanypteryx hageni	IIODO02010	G4	☑
Blue Dasher	Pachydiplax longipennis	IIODO53010	G5	☑
Emma's Dancer (nez Perce)	Argia emma	IIODO68150	G5	☐
Grappletail	Octogomphus specularis	IIODO89010	G4	☐
Spring Stonefly trictura	Cascadoperla trictura	IIPLE22010	G3G4	☐
Stonefly fraseri	Isocapnia fraseri	IIPLE05040	G1	☐
Stonefly gregsoni	Bolshecapnia gregsoni	IIEPE02010	G2	☑
Stonefly sasquatchi	Bolshecapnia sasquatchi	IIEPE02050	G3	☐
Stonefly tibilalis	Setvena tibilalis	IIPLE2A020	G4	☐
Stonefly vedderensis	Isocapnia vedderensis	IIPLE05110	G4	☐
Vivid Dancer	Argia vivida	IIODO68290	G5	☐

Habitat Type Level of Biological Organization Taxon Common Name	Scientific Name	ELCODE	G Rank	Mapped Data?
Western Pondhawk	Erythemis collocata	IIODO39020	G5	☑
<u>Mammals</u>				
Pacific water Shrew	Sorex bendirii	AMABA01170	G4	☑
<u>Freshwater Ecological Systems</u>				
intermediate,geology_hard_sediments,elevation_low,gradient_mainstem shallow - tributary shallow				☑
intermediate,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem shallow - tributary shallow a				☑
intermediate,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem shallow - tributary shallow b				☑
intermediate,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem steep - tributary steep				☑
intermediate,geology_intrusive - metamorphic,elevation_low,gradient_mainstem shallow - tributary shallow				☑
large,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem shallow - tributary shallow				☑
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem moderate - tributary moderate a				☑
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem moderate - tributary moderate b				☑
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary moderate a				☑
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary moderate b				☑
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary moderate c				☑
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow a				☑
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow b				☑
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow c				☑
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow d				☑
small,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem shallow - tributary shallow				☑

Habitat Type / Level of Biological Organization / Taxon / Common Name / *Scientific Name*	Geographic Section	Global Rank	BC Rank	WA Rank	Mapped Data	Amount Known	Captured in Porfolio	Conservation Goal	% of Goal Captured
<u>Terrestrial</u>									
<u>Terrestrial Ecological Systems</u>									
Alpine composite									
	Northeastern Pacific Ranges				✔	11,799 ha	3,667 ha	3,540 ha	104
	Southeastern Pacific Ranges				✔	9,044 ha	3,172 ha	2,714 ha	117
	Southern Pacific Ranges				✔	3,592 ha	1,301 ha	1,078 ha	121
	Northwestern Cascade Ranges				✔	2,647 ha	818 ha	794 ha	103
East Cascades Mesic Montane Mixed Conifer Forest									
	Northeastern Pacific Ranges				✔	15,937 ha	5,598 ha	4,781 ha	117
	Southeastern Pacific Ranges				✔	31,983 ha	11,026 ha	9,595 ha	115
Montane composite									
	Northeastern Pacific Ranges				✔	16,047 ha	4,813 ha	4,814 ha	100
	Southeastern Pacific Ranges				✔	12,934 ha	3,918 ha	3,881 ha	101
	Southern Pacific Ranges				✔	6,807 ha	3,000 ha	2,042 ha	147
	Northwestern Cascade Ranges				✔	64,209 ha	25,126 ha	19,265 ha	130
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest									
	Northeastern Pacific Ranges				✔	12,520 ha	4,671 ha	3,757 ha	124
	Southeastern Pacific Ranges				✔	12,837 ha	5,328 ha	3,852 ha	138
	Northwestern Cascade Ranges				✔	16,395 ha	5,923 ha	4,920 ha	120
North Pacific Lowland Riparian Forest and Shrubland									
	Northeastern Pacific Ranges				✔	7,732 ha	3,006 ha	2,320 ha	130
	Southeastern Pacific Ranges				✔	5,773 ha	3,288 ha	1,732 ha	190
	Southern Pacific Ranges				✔	11,368 ha	5,822 ha	3,411 ha	171
	Northwestern Cascade Ranges				✔	32,468 ha	17,313 ha	9,742 ha	178
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest									
	Southeastern Pacific Ranges				✔	150 ha	83 ha	45 ha	184

Habitat Type / Level of Biological Organization / Taxon / Common Name / *Scientific Name*	Geographic Section	Global Rank	BC Rank	WA Rank	Mapped Data	Amount Known	Captured in Porfolio	Conservation Goal	% of Goal Captured
	Southern Pacific Ranges				✓	23,886 ha	7,561 ha	7,166 ha	106
	Northwestern Cascade Ranges				✓	165,317 ha	66,658 ha	49,597 ha	134
North Pacific Maritime Mesic Subalpine Parkland									
	Northeastern Pacific Ranges				✓	24,566 ha	9,047 ha	7,370 ha	123
	Southeastern Pacific Ranges				✓	32,445 ha	10,558 ha	9,734 ha	108
	Southern Pacific Ranges				✓	14,840 ha	5,027 ha	4,452 ha	113
	Northwestern Cascade Ranges				✓	82,816 ha	27,333 ha	24,846 ha	110
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest									
	Northeastern Pacific Ranges				✓	11,398 ha	4,834 ha	3,420 ha	141
	Southeastern Pacific Ranges				✓	4,114 ha	2,346 ha	1,234 ha	190
	Southern Pacific Ranges				✓	220,004 ha	105,637 ha	66,002 ha	160
	Northwestern Cascade Ranges				✓	27,064 ha	12,059 ha	8,121 ha	148
North Pacific Mesic Western Hemlock - Silver fir Forest									
	Southern Pacific Ranges				✓	21,406 ha	13,749 ha	6,423 ha	214
	Northwestern Cascade Ranges				✓	2,560 ha	1,152 ha	768 ha	150
North Pacific Montane Massive Bedrock, Cliff and Talus									
	Northeastern Pacific Ranges				✓	5,192 ha	1,943 ha	1,558 ha	125
	Southeastern Pacific Ranges				✓	14,084 ha	4,351 ha	4,226 ha	103
	Southern Pacific Ranges				✓	8,366 ha	3,961 ha	2,510 ha	158
	Northwestern Cascade Ranges				✓	34,821 ha	11,814 ha	10,448 ha	113
North Pacific Montane Riparian Woodland and Shrubland									
	Northeastern Pacific Ranges				✓	6,250 ha	2,764 ha	1,876 ha	147
	Southeastern Pacific Ranges				✓	3,304 ha	1,137 ha	992 ha	115
	Southern Pacific Ranges				✓	7,738 ha	4,308 ha	2,322 ha	186
	Northwestern Cascade Ranges				✓	2,929 ha	1,389 ha	879 ha	158
North Pacific Mountain Hemlock Forest									
	Northeastern Pacific Ranges				✓	30,504 ha	11,337 ha	9,153 ha	124
	Southeastern Pacific Ranges				✓	14,437 ha	4,875 ha	4,332 ha	113
	Southern Pacific Ranges				✓	53,047 ha	21,827 ha	15,916 ha	137

Habitat Type / Level of Biological Organization / Taxon / Common Name / *Scientific Name*	Geographic Section	Global Rank	BC Rank	WA Rank	Mapped Data	Amount Known	Captured in Porfolio	Conservation Goal	% of Goal Captured
	Northwestern Cascade Ranges				✔	51,482 ha	18,854 ha	15,447 ha	122
Northern Interior Spruce-Fir woodland and forest									
	Northeastern Pacific Ranges				✔	5 ha	5 ha	2 ha	250
	Southeastern Pacific Ranges				✔	727 ha	291 ha	218 ha	133
Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest									
	Southeastern Pacific Ranges				✔	163 ha	58 ha	49 ha	118
	Northwestern Cascade Ranges				✔	1,021 ha	812 ha	306 ha	265
Northern Rocky Mountain Subalpine Dry Parkland									
	Northeastern Pacific Ranges				✔	1,423 ha	834 ha	427 ha	195
	Southeastern Pacific Ranges				✔	21,673 ha	6,709 ha	6,502 ha	103
	Northwestern Cascade Ranges				✔	2,449 ha	823 ha	735 ha	112
Old Growth Forest									
	Northeastern Pacific Ranges				✔	228,625 ha	94,137 ha	68,590 ha	137
	Southeastern Pacific Ranges				✔	66,045 ha	28,640 ha	19,815 ha	145
	Southern Pacific Ranges				✔	269,504 ha	162,342 ha	80,854 ha	201
	Northwestern Cascade Ranges				✔	300,154 ha	142,678 ha	90,049 ha	158
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland									
	Northeastern Pacific Ranges				✔	50,765 ha	16,792 ha	15,230 ha	110
	Southeastern Pacific Ranges				✔	99,734 ha	30,258 ha	29,921 ha	101
	Northwestern Cascade Ranges				✔	8,491 ha	2,584 ha	2,547 ha	101
Species									
Amphibians									
Cascades frog *Rana cascadae*									
	Southeastern Pacific Ranges	G3G4			✔	1 occ	1 occ	1 occ	100
	Northwestern Cascade Ranges	G3G4			✔	21 occ	13 occ	12 occ	108

Habitat Type Level of Biological Organization Taxon Common Name *Scientific Name*	Geographic Section	Global Rank	BC Rank	WA Rank	Mapped Data	Amount Known	Captured in Porfolio	Conservation Goal	% of Goal Captured
Western toad ts *Bufo boreas*									
	Southeastern Pacific Ranges	G4			✔	5 occ	3 occ	2 occ	150
	Northwestern Cascade Ranges	G4			✔	8 occ	6 occ	5 occ	120
<u>Birds</u>									
Bald eagle nests *Haliaeetus leucocephalus*									
	Northwestern Cascade Ranges	G5			✔	45 nst	26 nst	11 nst	236
Bald eagle roosts *Haliaeetus leucocephalus*									
	Southeastern Pacific Ranges	G5			✔	1 rst	1 rst	1 rst	100
	Southern Pacific Ranges	G5			✔	10 rst	3 rst	3 rst	100
	Northwestern Cascade Ranges	G5			✔	25 rst	17 rst	5 rst	340
Band-tailed pigeon *Columba fasciata*									
	Northwestern Cascade Ranges	G4			✔	5 occ	5 occ	5 occ	100
Barrow's goldeneye *Bucephala islandica*									
	Northwestern Cascade Ranges	G5			✔	1 occ	1 occ	1 occ	100
Common Loon *Gavia immer*									
	Southeastern Pacific Ranges	G5			✔	4 nst	4 nst	4 nst	100
	Northwestern Cascade Ranges	G5			✔	9 nst	9 nst	9 nst	100
Golden Eagle *Aquila chrysaetos*									
	Northwestern Cascade Ranges	G5			✔	19 nst	18 nst	19 nst	95
Great blue heron *Ardia herodius fannini*									
	Southern Pacific Ranges	G5T4			✔	4 occ	4 occ	4 occ	100

Habitat Type / Level of Biological Organization / Taxon / Common Name / *Scientific Name*	Geographic Section	Global Rank	BC Rank	WA Rank	Mapped Data	Amount Known	Captured in Porfolio	Conservation Goal	% of Goal Captured
	Northwestern Cascade Ranges	G5T4			✔	8 occ	8 occ	8 occ	100
Harlequin duck *Histrionicus histrionicus*									
	Northwestern Cascade Ranges	G4			✔	29 occ	16 occ	13 occ	123
Marbled murrelet *Brachyramphus marmoratus*									
	Northwestern Cascade Ranges	G3G4			✔	77 occ	75 occ	77 occ	97
Marbled murrelet habitat *Brachyramphus marmoratus*									
	Northeastern Pacific Ranges	G3G4			✔	24,841 ha	21,987 ha	21,115 ha	104
	Southern Pacific Ranges	G3G4			✔	115,325 ha	97,257 ha	98,026 ha	99
Northern goshawk *Accipiter gentilis laingi*									
	Northeastern Pacific Ranges	G5			✔	2 occ	2 occ	2 occ	100
	Southeastern Pacific Ranges	G5			✔	3 occ	3 occ	3 occ	100
	Southern Pacific Ranges	G5			✔	1 occ	1 occ	1 occ	100
	Northwestern Cascade Ranges	G5			✔	26 occ	25 occ	26 occ	96
Northern spotted owl *Strix occidentalis caurina*									
	Northeastern Pacific Ranges	G3T3			✔	12 occ	9 occ	9 occ	100
	Southeastern Pacific Ranges	G3T3			✔	10 occ	7 occ	7 occ	100
	Southern Pacific Ranges	G3T3			✔	7 occ	5 occ	5 occ	100
	Northwestern Cascade Ranges	G3T3			✔	5 occ	4 occ	4 occ	100
Northern spotted owl Nests *Strix occidentalis caurina*									
	Northeastern Pacific Ranges	G3T3			✔	4 nst	4 nst	4 nst	100
	Southeastern Pacific Ranges	G3T3			✔	22 nst	21 nst	22 nst	95
	Southern Pacific Ranges	G3T3			✔	1 nst	1 nst	1 nst	100
	Northwestern Cascade Ranges	G3T3			✔	142 nst	138 nst	142 nst	97
Peregrine falcon *Falco peregrinus anatum*									

Habitat Type / Level of Biological Organization / Taxon / Common Name / *Scientific Name*	Geographic Section	Global Rank	BC Rank	WA Rank	Mapped Data	Amount Known	Captured in Porfolio	Conservation Goal	% of Goal Captured
	Northeastern Pacific Ranges	G4T3			✔	1 nst	1 nst	1 nst	100
	Southeastern Pacific Ranges	G4T3			✔	1 nst	1 nst	1 nst	100
	Southern Pacific Ranges	G4T3			✔	5 nst	5 nst	5 nst	100
	Northwestern Cascade Ranges	G4T3			✔	14 nst	14 nst	14 nst	100
Red breasted sapsucker *Sphyrapicus ruber*									
	Northwestern Cascade Ranges	G5			✔	10 occ	10 occ	10 occ	100
Sandhill Crane *Grus canadensis*									
	Southern Pacific Ranges	G5			✔	1 occ	1 occ	1 occ	100
Vaux's swift *Chaetura vauxi*									
	Northwestern Cascade Ranges	G5			✔	7 occ	6 occ	7 occ	86
White-tailed ptarmigan *Lagopus leucurus*									
	Southeastern Pacific Ranges	G5			✔	1 occ	1 occ	1 occ	100
	Northwestern Cascade Ranges	G5			✔	3 occ	3 occ	3 occ	100
<u>Insects</u>									
Arctic blue *Plebejus glandon*									
	Southeastern Pacific Ranges	G5			✔	3 occ	3 occ	3 occ	100
	Northwestern Cascade Ranges	G5			✔	1 occ	1 occ	1 occ	100
Astarte fritillary *Boloria astarte*									
	Southeastern Pacific Ranges	G5			✔	2 occ	2 occ	2 occ	100
common branded skipper *Hesperia comma*									
	Southeastern Pacific Ranges	G5			✔	2 occ	2 occ	2 occ	100
	Northwestern Cascade Ranges	G5			✔	1 occ	1 occ	1 occ	100

Habitat Type / Level of Biological Organization / Taxon / Common Name / *Scientific Name*	Geographic Section	Global Rank	BC Rank	WA Rank	Mapped Data	Amount Known	Captured in Porfolio	Conservation Goal	% of Goal Captured
lustrous copper *Lycaena cuprea henryae*									
	Southeastern Pacific Ranges	G5			☑	1 occ	1 occ	1 occ	100
Melissa arctic *Oeneis melissa*									
	Southeastern Pacific Ranges	G5			☑	2 occ	2 occ	2 occ	100
Vidler's alpine *Erebia vidleri*									
	Northwestern Cascade Ranges	G4G5			☑	1 occ	1 occ	1 occ	100
<u>Mammals</u>									
Gray wolf *Canis lupus*									
	Southeastern Pacific Ranges	G4			☑	3 occ	3 occ	3 occ	100
	Northwestern Cascade Ranges	G4			☑	9 occ	9 occ	9 occ	100
Lynx *Lynx canadensis*									
	Southeastern Pacific Ranges	G5			☑	127,012 ha	53,834 ha	38,104 ha	141
	Northwestern Cascade Ranges	G5			☑	8,244 ha	2,795 ha	2,473 ha	113
Mountain goat *Oreamos americanus*									
	Northeastern Pacific Ranges	G5			☑	59,588 ha	21,069 ha	17,877 ha	118
	Southeastern Pacific Ranges	G5			☑	23,917 ha	8,467 ha	7,175 ha	118
	Southern Pacific Ranges	G5			☑	59,263 ha	29,668 ha	17,779 ha	167
	Northwestern Cascade Ranges	G5			☑	173,657 ha	68,735 ha	52,097 ha	132
Mtn beaver rainieri *Aplodontia rufa rainieri*									
	Southeastern Pacific Ranges	G5T4			☑	30 occ	13 occ	13 occ	100
Mtn beaver rufa *Aplodontia rufa rufa*									

Habitat Type / Level of Biological Organization / Taxon / Common Name / *Scientific Name*	Geographic Section	Global Rank	BC Rank	WA Rank	Mapped Data	Amount Known	Captured in Porfolio	Conservation Goal	% of Goal Captured
	Southeastern Pacific Ranges	G5T4?			✔	7 occ	7 occ	7 occ	100
	Northwestern Cascade Ranges	G5T4?			✔	6 occ	6 occ	6 occ	100
Roosevelt elk *Cervus canadensis*									
	Northwestern Cascade Ranges	G5T4			✔	80,654 ha	35,636 ha	24,196 ha	147
Townsend's big-eared bat *Coryhorhinus townsendii*									
	Northwestern Cascade Ranges	G4			✔	3 occ	3 occ	3 occ	100
Trowbridge's shrew *Sorex trowbridgii*									
	Southern Pacific Ranges	G5			✔	1 occ	1 occ	1 occ	100
	Northwestern Cascade Ranges	G5			✔	3 occ	3 occ	3 occ	100
Wolverine *Gulo gulo*									
	Southeastern Pacific Ranges	G4			✔	1 occ	1 occ	1 occ	100
	Northwestern Cascade Ranges	G4			✔	4 occ	4 occ	4 occ	100
<u>Mollusks</u>									
Conical Spot *Punctum randolphii*									
	Northeastern Pacific Ranges	G4			✔	1 occ	1 occ	1 occ	100
	Southeastern Pacific Ranges	G4			✔	2 occ	2 occ	2 occ	100
	Southern Pacific Ranges	G4			✔	10 occ	7 occ	6 occ	117
	Northwestern Cascade Ranges	G4			✔	6 occ	5 occ	4 occ	125
Northern Tightcoil *Pristiloma arcticum*									
	Southeastern Pacific Ranges	G3G4			✔	1 occ	1 occ	1 occ	100
Oregon Forestsnail *Allogona townsendiana*									
	Southern Pacific Ranges	G3G4			✔	4 occ	4 occ	4 occ	100
	Northwestern Cascade Ranges	G3G4			✔	5 occ	5 occ	5 occ	100

Habitat Type / Level of Biological Organization / Taxon / Common Name / *Scientific Name*	Geographic Section	Global Rank	BC Rank	WA Rank	Mapped Data	Amount Known	Captured in Porfolio	Conservation Goal	% of Goal Captured
Pacific Sideband *Monadenia fidelis*									
	Southeastern Pacific Ranges	G4G5			✔	1 occ	1 occ	1 occ	100
	Northwestern Cascade Ranges	G4G5			✔	1 occ	1 occ	1 occ	100
Pygmy Oregonian *Cryptomastix germana*									
	Southern Pacific Ranges	G3G4			✔	2 occ	2 occ	2 occ	100
	Northwestern Cascade Ranges	G3G4			✔	2 occ	2 occ	2 occ	100
Robust Lancetooth *Haplotrema vancouverens*									
	Northwestern Cascade Ranges	G5			✔	4 occ	4 occ	4 occ	100
Striated Tightcoil *Pristiloma stearnsii*									
	Southern Pacific Ranges	G3			✔	1 occ	1 occ	1 occ	100
Western Flat whorl *Planogyra clappi*									
	Southeastern Pacific Ranges	G3G4			✔	1 occ	1 occ	1 occ	100
	Southern Pacific Ranges	G3G4			✔	1 occ	1 occ	1 occ	100
	Northwestern Cascade Ranges	G3G4			✔	4 occ	4 occ	4 occ	100
Western thorn *Carychium occidentale*									
	Northwestern Cascade Ranges	G3G4			✔	1 occ	1 occ	1 occ	100
<u>Nonvascular Plants</u>									
Lescur's Bartramiopsis Moss *Bartramiopsis lescurii*									
	Northwestern Cascade Ranges	G3G5		S1	✔	1 occ	1 occ	1 occ	100
Luminous Moss *Schistostega pennata*									
	Southeastern Pacific Ranges	G3G5		S2	✔	1 occ	1 occ	1 occ	100

Habitat Type Level of Biological Organization Taxon Common Name *Scientific Name*	Geographic Section	Global Rank	BC Rank	WA Rank	Mapped Data	Amount Known	Captured in Porfolio	Conservation Goal	% of Goal Captured
	Northwestern Cascade Ranges	G3G5		S2	✔	2 occ	2 occ	2 occ	100
Oldgrowth Specklebelly *Pseudocyphellaria rainierensis*									
	Northwestern Cascade Ranges	G3	S1		✔	1 occ	1 occ	1 occ	100
<u>Vascular Plants</u>									
Alaska Harebell *Campanula lasiocarpa*									
	Northwestern Cascade Ranges	G5		S2	✔	7 occ	7 occ	7 occ	100
Alpine Anemone *Anemone drummondii var. drummondii*									
	Southeastern Pacific Ranges	G4T4	S2S3		✔	1 occ	1 occ	1 occ	100
	Northwestern Cascade Ranges	G4T4	S2S3		✔	2 occ	2 occ	2 occ	100
Arctic Aster *Aster sibiricus var. meritus*									
	Northwestern Cascade Ranges	G5T5		S1S2	✔	3 occ	3 occ	3 occ	100
Bearded Sedge *Carex comosa*									
	Southeastern Pacific Ranges	G5	S2S3		✔	1 occ	1 occ	1 occ	100
	Northwestern Cascade Ranges	G5	S2S3		✔	1 occ	1 occ	1 occ	100
Black Lily *Fritillaria camschatcensis*									
	Northwestern Cascade Ranges	G5		S2	✔	12 occ	12 occ	7 occ	171
Blunt-sepaled Starwort *Stellaria obtusa*									
	Northeastern Pacific Ranges	G5	S2S3		✔	1 occ	1 occ	1 occ	100
Bog Clubmoss *Lycopodiella inundata*									
	Southeastern Pacific Ranges	G5		S2	✔	2 occ	2 occ	2 occ	100

Habitat Type / Level of Biological Organization / Taxon / Common Name / *Scientific Name*	Geographic Section	Global Rank	BC Rank	WA Rank	Mapped Data	Amount Known	Captured in Porfolio	Conservation Goal	% of Goal Captured
Canyon Bog-orchid *Platanthera sparsiflora*									
	Northwestern Cascade Ranges	G4G5		S1	✔	1 occ	1 occ	1 occ	100
Cascade Parsley Fern *Cryptogramma cascadensis*									
	Southeastern Pacific Ranges	G5	S2S3		✔	4 occ	4 occ	4 occ	100
	Northwestern Cascade Ranges	G5	S2S3		✔	1 occ	1 occ	1 occ	100
Choris' Bog-orchid *Platanthera chorisiana*									
	Northwestern Cascade Ranges	G3G4		S2	✔	8 occ	7 occ	7 occ	100
Cliff Paintbrush *Castilleja rupicola*									
	Southeastern Pacific Ranges	G2G3	S2		✔	6 occ	6 occ	6 occ	100
Clubmoss Cassiope *Cassiope lycopodioides*									
	Northwestern Cascade Ranges	G4		S1	✔	1 occ	1 occ	1 occ	100
Cooley's Buttercup *Ranunculus cooleyae*									
	Northwestern Cascade Ranges	G4		S1S2	✔	3 occ	3 occ	3 occ	100
Creeping Snowberry *Gaultheria hispidula*									
	Northwestern Cascade Ranges	G5		S2	✔	1 occ	1 occ	1 occ	100
Dwarf Groundsmoke *Gayophytum humile*									
	Northeastern Pacific Ranges	G5	S2S3		✔	1 occ	1 occ	1 occ	100
Elegant Jacob's-ladder *Polemonium elegans*									
	Southeastern Pacific Ranges	G4	S2S3		✔	1 occ	1 occ	1 occ	100

Habitat Type / Level of Biological Organization / Taxon / Common Name / *Scientific Name*	Geographic Section	Global Rank	BC Rank	WA Rank	Mapped Data	Amount Known	Captured in Porfolio	Conservation Goal	% of Goal Captured
Elmera *Elmera racemosa var. racemosa*	Southeastern Pacific Ranges	G4G5T4	S2S3		☑	4 occ	4 occ	4 occ	100
Enander's Sedge *Carex lenticularis var. dolia*	Northeastern Pacific Ranges	G5T3Q	S2S3		☑	1 occ	1 occ	1 occ	100
Few-flowered Sedge *Carex pauciflora*	Northwestern Cascade Ranges	G5		S2	☑	9 occ	8 occ	7 occ	114
Flat-leaved Bladderwort *Utricularia intermedia*	Northwestern Cascade Ranges	G5		S2	☑	1 occ	1 occ	1 occ	100
Geyer's Onion *Allium geyeri var. tenerum*	Northeastern Pacific Ranges	G4G5TNR	S2		☑	1 occ	1 occ	1 occ	100
Giant Helleborine *Epipactis gigantea*	Northwestern Cascade Ranges	G3G4	S2		☑	1 occ	1 occ	1 occ	100
Gray's Bluegrass *Poa arctica ssp. arctica*	Southeastern Pacific Ranges	G5T3T5		S1S2	☑	1 occ	1 occ	1 occ	100
Green-fruited Sedge *Carex interrupta*	Northwestern Cascade Ranges	G3G4	S1		☑	1 occ	1 occ	1 occ	100
Kruckeberg's Holly Fern *Polystichum kruckebergii*	Southeastern Pacific Ranges	G4	S2S3		☑	2 occ	2 occ	2 occ	100

North Cascades Ecoregion Targets and Goals Summary

Habitat Type Level of Biological Organization Taxon Common Name *Scientific Name*	Geographic Section	Global Rank	BC Rank	WA Rank	Mapped Data	Amount Known	Captured in Porfolio	Conservation Goal	% of Goal Captured
Lace Fern *Cheilanthes gracillima*									
	Northeastern Pacific Ranges	G4G5	S2S3		✔	1 occ	1 occ	1 occ	100
	Southern Pacific Ranges	G4G5	S2S3		✔	2 occ	2 occ	2 occ	100
Lance-leaved Figwort *Scrophularia lanceolata*									
	Southeastern Pacific Ranges	G5	S2S3		✔	1 occ	1 occ	1 occ	100
Large-awn Sedge *Carex macrochaeta*									
	Northwestern Cascade Ranges	G5		S1	✔	1 occ	1 occ	1 occ	100
Leafy Mitrewort *Mitella caulescens*									
	Northwestern Cascade Ranges	G5	S2S3		✔	1 occ	1 occ	1 occ	100
Lesser Bladderwort *Utricularia minor*									
	Northwestern Cascade Ranges	G5		S2?	✔	1 occ	1 occ	1 occ	100
Long-styled Sedge *Carex stylosa*									
	Northwestern Cascade Ranges	G5		S1S2	✔	7 occ	7 occ	7 occ	100
Marginal Wood Fern *Dryopteris marginalis*									
	Northeastern Pacific Ranges	G5	S1		✔	1 occ	1 occ	1 occ	100
Menzies' Burnet *Sanguisorba menziesii*									
	Southern Pacific Ranges	G3G4	S2S3		✔	1 occ	1 occ	1 occ	100
Nodding Semaphoregrass *Pleuropogon refractus*									
	Northeastern Pacific Ranges	G4	S3		✔	2 occ	2 occ	2 occ	100

Habitat Type / Level of Biological Organization / Taxon / Common Name / *Scientific Name*	Geographic Section	Global Rank	BC Rank	WA Rank	Mapped Data	Amount Known	Captured in Porfolio	Conservation Goal	% of Goal Captured
	Southern Pacific Ranges	G4	S3		☑	3 occ	3 occ	3 occ	100
Olney's Bulrush *Schoenoplectus americanus*									
	Northeastern Pacific Ranges	G5	S1		☑	1 occ	1 occ	1 occ	100
Oniongrass *Melica bulbosa var. bulbosa*									
	Southeastern Pacific Ranges	G5TNRQ	S2		☑	1 occ	1 occ	1 occ	100
Pacific Waterleaf *Hydrophyllum tenuipes*									
	Northwestern Cascade Ranges	G4G5	S2S3		☑	1 occ	1 occ	1 occ	100
Phantom Orchid *Cephalanthera austiniae*									
	Southern Pacific Ranges	G4	S2		☑	1 occ	1 occ	1 occ	100
	Northwestern Cascade Ranges	G4	S2		☑	5 occ	5 occ	5 occ	100
Pointed Broom Sedge *Carex scoparia*									
	Southern Pacific Ranges	G5	S2S3		☑	1 occ	1 occ	1 occ	100
Poor Sedge *Carex magellanica ssp. irrigua*									
	Southeastern Pacific Ranges	G5T5		S2S3	☑	2 occ	2 occ	2 occ	100
	Northwestern Cascade Ranges	G5T5		S2S3	☑	4 occ	4 occ	4 occ	100
Purple-marked Yellow Violet *Viola purpurea var. venosa*									
	Southeastern Pacific Ranges	G5T4T5	S2S3		☑	2 occ	2 occ	2 occ	100
Regel's Rush *Juncus regelii*									
	Southeastern Pacific Ranges	G4?	S3		☑	1 occ	1 occ	1 occ	100

Habitat Type / Level of Biological Organization / Taxon / Common Name / *Scientific Name*	Geographic Section	Global Rank	BC Rank	WA Rank	Mapped Data	Amount Known	Captured in Porfolio	Conservation Goal	% of Goal Captured
Several-flowered Sedge *Carex pluriflora*									
	Northwestern Cascade Ranges	G4		S1S2	✔	3 occ	3 occ	3 occ	100
Short-fruited Smelowskia *Smelowskia ovalis*									
	Southeastern Pacific Ranges	G5	S2S3		✔	4 occ	4 occ	4 occ	100
	Northwestern Cascade Ranges	G5	S2S3		✔	1 occ	1 occ	1 occ	100
Skunk Polemonium *Polemonium viscosum*									
	Southeastern Pacific Ranges	G5		S1S2	✔	1 occ	1 occ	1 occ	100
Slender Gentian *Gentianella tenella ssp. tenella*									
	Northeastern Pacific Ranges	G4G5T4	S2S3		✔	1 occ	1 occ	1 occ	100
Slender Spike-rush *Eleocharis nitida*									
	Southeastern Pacific Ranges	G3G4	S1		✔	1 occ	1 occ	1 occ	100
Small Northern Bog-orchid *Platanthera obtusata*									
	Northwestern Cascade Ranges	G5		S2	✔	2 occ	2 occ	2 occ	100
Small-fruited Willowherb *Epilobium leptocarpum*									
	Southern Pacific Ranges	G5	S2S3		✔	3 occ	3 occ	3 occ	100
Smoky Mountain Sedge *Carex proposita*									
	Northwestern Cascade Ranges	G4		S2	✔	1 occ	1 occ	1 occ	100
Snow Bramble *Rubus nivalis*									
	Southern Pacific Ranges	G4?	S2		✔	1 occ	1 occ	1 occ	100

Habitat Type / Level of Biological Organization / Taxon / Common Name / *Scientific Name*	Geographic Section	Global Rank	BC Rank	WA Rank	Mapped Data	Amount Known	Captured in Porfolio	Conservation Goal	% of Goal Captured
Soft-leaved Willow *Salix sessilifolia*									
	Northeastern Pacific Ranges	G4	S2S3		✔	2 occ	2 occ	2 occ	100
	Southeastern Pacific Ranges	G4	S2S3		✔	2 occ	2 occ	2 occ	100
	Southern Pacific Ranges	G4	S2S3		✔	1 occ	1 occ	1 occ	100
Spleenwort-leaved Goldthread *Coptis aspleniifolia*									
	Northwestern Cascade Ranges	G5		S2	✔	4 occ	4 occ	4 occ	100
Stalked Moonwort *Botrychium pedunculosum*									
	Southeastern Pacific Ranges	G2G3		S2S3	✔	1 occ	1 occ	1 occ	100
	Northwestern Cascade Ranges	G2G3		S2S3	✔	2 occ	2 occ	2 occ	100
Stiff-leaved Pondweed *Potamogeton strictifolius*									
	Southeastern Pacific Ranges	G5	S2S3		✔	1 occ	1 occ	1 occ	100
Tall Bugbane *Cimicifuga elata*									
	Southeastern Pacific Ranges	G2	S1		✔	1 occ	1 occ	1 occ	100
	Northwestern Cascade Ranges	G2	S1		✔	14 occ	12 occ	12 occ	100
Thompson's Chaenactis *Chaenactis thompsonii*									
	Northwestern Cascade Ranges	G2G3		S2S3	✔	1 occ	1 occ	1 occ	100
Treelike Clubmoss *Lycopodium dendroideum*									
	Southeastern Pacific Ranges	G5		S2	✔	2 occ	2 occ	2 occ	100
	Northwestern Cascade Ranges	G5		S2	✔	11 occ	8 occ	5 occ	160
Triangular-lobed Moonwort *Botrychium ascendens*									
	Southeastern Pacific Ranges	G2G3		S2S3	✔	2 occ	2 occ	2 occ	100
	Northwestern Cascade Ranges	G2G3		S2S3	✔	2 occ	2 occ	2 occ	100

Habitat Type / Level of Biological Organization / Taxon / Common Name / *Scientific Name*	Geographic Section	Global Rank	BC Rank	WA Rank	Mapped Data	Amount Known	Captured in Porfolio	Conservation Goal	% of Goal Captured
Ussurian Water-milfoil *Myriophyllum ussuriense*									
	Northeastern Pacific Ranges	G3	S3		✔	1 occ	1 occ	1 occ	100
	Southern Pacific Ranges	G3	S3		✔	1 occ	1 occ	1 occ	100
Washington Springbeauty *Claytonia washingtoniana*									
	Northeastern Pacific Ranges	G2G4	S2		✔	1 occ	1 occ	1 occ	100
Water Lobelia *Lobelia dortmanna*									
	Northwestern Cascade Ranges	G4G5		S2S3	✔	5 occ	5 occ	5 occ	100
Water-pepper *Polygonum hydropiperoides*									
	Southeastern Pacific Ranges	G5	S2S3		✔	1 occ	1 occ	1 occ	100
Western Mannagrass *Glyceria occidentalis*									
	Southeastern Pacific Ranges	G5	S2S3		✔	1 occ	1 occ	1 occ	100
	Northwestern Cascade Ranges	G5	S2S3		✔	1 occ	1 occ	1 occ	100
Woodland Penstemon *Nothochelone nemorosa*									
	Southern Pacific Ranges	G5	S2S3		✔	2 occ	2 occ	2 occ	100
<u>Other Ecological Features</u>									
Hot Spring									
	Northeastern Pacific Ranges				✔	11 occ	11 occ	11 occ	100
	Southern Pacific Ranges				✔	2 occ	2 occ	2 occ	100
Karst PH									
	Northeastern Pacific Ranges				✔	27 ha	27 ha	22 ha	123
	Southeastern Pacific Ranges				✔	1,568 ha	1,282 ha	1,254 ha	102

Habitat Type / Level of Biological Organization / Taxon / Common Name / *Scientific Name*	Geographic Section	Global Rank	BC Rank	WA Rank	Mapped Data	Amount Known	Captured in Porfolio	Conservation Goal	% of Goal Captured
	Northwestern Cascade Ranges				✔	1,410 ha	1,105 ha	1,128 ha	98
Karst SM									
	Southeastern Pacific Ranges				✔	4,415 ha	1,928 ha	1,324 ha	146
	Southern Pacific Ranges				✔	1,963 ha	1,118 ha	589 ha	190
	Northwestern Cascade Ranges				✔	38,903 ha	12,806 ha	11,671 ha	110
Karst TM									
	Northeastern Pacific Ranges				✔	3,327 ha	1,116 ha	998 ha	112
<u>Communities</u>									
Carex (livida, utriculata) / Sphagnum spp. Herbaceous Vegetation Community *Carex (livida, utriculata) / Sphagnum spp. Herbaceous Vegetation*									
	Northwestern Cascade Ranges	G1G2			✔	20 ha	20 ha	20 ha	100
Carex aquatilis var. dives - Carex utriculata Herbaceous Vegetation Community *Carex aquatilis var. dives - Carex utriculata Herbaceous Vegetation*									
	Northwestern Cascade Ranges				✔	13 ha	13 ha	13 ha	100
Carex cusickii - (Carex aquatilis var. dives) / Sphagnum spp. Herbaceous Vegetation Community *Carex cusickii - (Carex aquatilis var. dives) / Sphagnum spp. Herbaceous Vegetation*									
	Northwestern Cascade Ranges				✔	20 ha	20 ha	20 ha	100
Carex interior - Hypericum anagalloides Herbaceous Vegetation Community *Carex interior - Hypericum anagalloides Herbaceous Vegetation*									
	Northwestern Cascade Ranges	G2?Q			✔	43 ha	43 ha	43 ha	100
Carex pellita (=C. lanuginosa) Herbaceous Vegetation Community *Carex pellita (=C. lanuginosa) Herbaceous Vegetation*									
	Northwestern Cascade Ranges	G3			✔	19 ha	19 ha	19 ha	100
Deschampsia caespitosa Herbaceous Vegetation Community *Deschampsia caespitosa Herbaceous Vegetation*									
	Northwestern Cascade Ranges	G4			✔	23 ha	23 ha	23 ha	100

Habitat Type / Level of Biological Organization / Taxon / Common Name / *Scientific Name*	Geographic Section	Global Rank	BC Rank	WA Rank	Mapped Data	Amount Known	Captured in Porfolio	Conservation Goal	% of Goal Captured
Eriophorum chamissonis / Sphagnum spp. Herbaceous Vegetation Community *Eriophorum chamissonis / Sphagnum spp.*									
	Northwestern Cascade Ranges				✔	63 ha	63 ha	63 ha	100
Ledum groenlandicum - Myrica gale / Sphagnum spp. Shrubland Community *Ledum groenlandicum - Myrica gale / Sphagnum spp.*									
	Northwestern Cascade Ranges	G2			✔	7 ha	7 ha	7 ha	100
Picea sitchensis / Polystichum munitum Forest Community *Picea sitchensis / Polystichum munitum*									
	Northwestern Cascade Ranges	G4?			✔	104 ha	104 ha	104 ha	100
Picea sitchensis / Rubus spectabilis Dry Community *Picea sitchensis / Rubus spectabilis*									
	Northeastern Pacific Ranges				✔	31,247 ha	31,247 ha	31,247 ha	100
Populus balsamifera ssp. trichocarpa / Salix sitchensis - Rubus parviflorus Community *Populus balsamifera ssp. trichocarpa / Salix sitchensis - Rubus parviflorus*									
	Northeastern Pacific Ranges				✔	313 ha	313 ha	313 ha	100
Quercus garryana - Acer macrophyllum - Prunus spp. Community *Quercus garryana - Acer macrophyllum - Prunus spp.*									
	Northeastern Pacific Ranges				✔	111 ha	111 ha	111 ha	100
	Southeastern Pacific Ranges				✔	202 ha	202 ha	202 ha	100
Rhynchospora alba - (Vaccinium oxycoccus) / Sphagnum tenellum Herbaceous Vegetation Community *Rhynchospora alba - (Vaccinium oxycoccus) / Sphagnum tenellum*									
	Northwestern Cascade Ranges	G3			✔	40 ha	40 ha	40 ha	100
Spiraea douglasii / Carex aquatilis var. dives Shrubland Community *Spiraea douglasii / Carex aquatilis var. dives*									
	Northwestern Cascade Ranges	G4			✔	16 ha	16 ha	16 ha	100
Thuja plicata - Tsuga heterophylla / Lysichiton americanus Forest Community *Thuja plicata - Tsuga heterophylla / Lysichiton americanus*									

Habitat Type / Level of Biological Organization / Taxon / Common Name / *Scientific Name*	Geographic Section	Global Rank	BC Rank	WA Rank	Mapped Data	Amount Known	Captured in Porfolio	Conservation Goal	% of Goal Captured
	Northwestern Cascade Ranges	G2			✔	95 ha	95 ha	95 ha	100
Tsuga heterophylla - (Thuja plicata) / Ledum groenlandicum / Sphagnum spp. Woodland Community									
Tsuga heterophylla - (Thuja plicata) / Ledum groenlandicum / Sphagnum spp.									
	Northwestern Cascade Ranges				✔	66 ha	66 ha	66 ha	100
Tsuga mertensiana - Abies amabilis / Elliottia pyroliflorus Woodland Community									
Tsuga mertensiana - Abies amabilis / Elliottia pyroliflorus									
	Northwestern Cascade Ranges	G3G4			✔	959 ha	959 ha	959 ha	100
Freshwater									
Species									
Amphibians									
Coastal tailed frog									
Ascaphus truei									
	Southern Coastal Streams EDU	G4	S4	S3S4	✔	54 occ	23 occ	13 occ	177
	Lower Fraser EDU	G4	S4	S3S4	✔	110 occ	52 occ	13 occ	400
Pacific Giant Salamander									
Dicamptodon tenebrosus									
	Lower Fraser EDU	G5	S2	S5	✔	23 occ	12 occ	13 occ	92
Red-legged frog									
Rana aurora									
	Lower Fraser EDU	G4	S4	S3S4	✔	21 occ	18 occ	19 occ	95
Western toad									
Bufo boreas									
	Lower Fraser EDU	G4	S3S4	S4	✔	11 occ	11 occ	11 occ	100
Birds									
Western grebe									
Aechmophorus occidentalis									
	Southern Coastal Streams EDU	G5	S3B,S5N	S1B,S3N	✔	1 occ	occ	1 occ	

North Cascades Ecoregion Targets and Goals Summary

Habitat Type / Level of Biological Organization / Taxon / Common Name / *Scientific Name*	Geographic Section	Global Rank	BC Rank	WA Rank	Mapped Data	Amount Known	Captured in Porfolio	Conservation Goal	% of Goal Captured
Fishes									
Bull Trout *Salvelinus confluentus*									
	Southern Coastal Streams EDU	G3	S3	S3	✔	44 km	21 km	22 km	95
	Lower Fraser EDU	G3	S3	S3	✔	584 km	308 km	292 km	105
Bull Trout - Coastal and Puget Sound habitat *Salvelinus confluentus pop. 3*									
	Puget Sound EDU	G3T2Q			✔	9,862 score	5,148 score	4,931 score	104
Chinook - Puget Sound habitat *Oncorhynchus tshawytscha pop. 15*									
	Puget Sound EDU	G5T2Q			✔	3,290 score	2,080 score	1,644 score	127
Chinook Salmon (no run info) *Oncorhynchus tshawytscha*									
	Southern Coastal Streams EDU	G5	S3S4	SNR	✔	333 km	231 km	166 km	139
	Lower Fraser EDU	G5	S3S4	SNR	✔	826 km	615 km	414 km	149
Chum Salmon - Pacific Coast habitat *Onchorhynchus keta pop. 5*									
	Puget Sound EDU	G5T3Q			✔	13,593 score	8,667 score	6,796 score	128
Chum Salmon (Fraser XAN Ecoregion) *Oncorhynchus keta*									
	Fraser River XAN	G5	S3	S5	✔	1,046 km	719 km	523 km	137
Chum Salmon (Puget XAN Ecoregion) *Oncorhynchus keta*									
	Puget Sound/Georgia Basin XAN	G5	S3	S5	✔	593 km	299 km	297 km	101
Coastal Cutthroat Trout - Puget Sound habitat *Oncorhynchus clarki clarki pop. 7*									
	Puget Sound EDU	G4T3Q			✔	28,151 score	14,798 score	14,075 score	105

Habitat Type / Level of Biological Organization / Taxon / Common Name / *Scientific Name*	Geographic Section	Global Rank	BC Rank	WA Rank	Mapped Data	Amount Known	Captured in Porfolio	Conservation Goal	% of Goal Captured
Coastal Cutthroat Trout, Clarki Subspecies (anadromous) *Oncorhynchus clarki clarki*									
	Southern Coastal Streams EDU	G4	S4	SNR	✔	127 km	68 km	38 km	179
	Lower Fraser EDU	G4	S4	SNR	✔	276 km	198 km	83 km	239
Coho Salmon *Oncorhynchus kisutch*									
	Southern Coastal Streams EDU	G4	S3	SNR	✔	1,156 km	580 km	578 km	100
	Lower Fraser EDU	G4	S3	SNR	✔	1,585 km	1,047 km	792 km	132
Coho Salmon - Puget Sound/Straight of Georgia habitat *Onchorhynchus kisutch pop. 5*									
	Puget Sound EDU	G4T3Q			✔	34,869 score	20,149 score	17,434 score	116
Cultus Lake Sculpin *Cottus sp. 2*									
	Lower Fraser EDU	G1	--	S1	✔	636 ha	636 ha	191 ha	333
Cutthroat Trout, Clarkil Subspecies *Oncorhynchus clarkiI clarkiI*									
	Southern Coastal Streams EDU	G4	S4	SNR	✔	1,225 km	536 km	368 km	146
	Lower Fraser EDU	G4	S4	SNR	✔	1,473 km	950 km	442 km	215
Dolly Varden *Salvelinus malma*									
	Southern Coastal Streams EDU	G5	S3	S3S4	✔	912 km	443 km	274 km	162
	Lower Fraser EDU	G5	S3	S3S4	✔	722 km	401 km	217 km	185
Dolly Varden (anadromous) *Salvelinus malma*									
	Southern Coastal Streams EDU	G5	S3	S3S4	✔	69 km	61 km	21 km	290
Eulachon *Thaleichthys pacificus*									
	Southern Coastal Streams EDU	G5	S4	S2S3	✔	13 km	4 km	4 km	100
	Lower Fraser EDU	G5	S4	S2S3	✔	158 km	150 km	47 km	319

Habitat Type / Level of Biological Organization / Taxon / Common Name / *Scientific Name*	Geographic Section	Global Rank	BC Rank	WA Rank	Mapped Data	Amount Known	Captured in Porfolio	Conservation Goal	% of Goal Captured
Green Sturgeon *Acipenser medirostris*									
	Southern Coastal Streams EDU	G3	S2N	S1N	☑	4 km	4 km	1 km	400
	Lower Fraser EDU	G3	S2N	S1N	☑	26 km	25 km	8 km	313
Kokanee *Oncorhynchus nerka*									
	Southern Coastal Streams EDU	G5	S2S3	SNR	☑	258 km	155 km	129 km	120
	Lower Fraser EDU	G5	S2S3	SNR	☑	141 km	83 km	71 km	117
Mountain Sucker (ha) *Catostomus platyrhynchus*									
	Lower Fraser EDU	G5	S2S3	S3?	☑	3 ha	3 ha	1 ha	300
Mountain Sucker (km) *Catostomus platyrhynchus*									
	Lower Fraser EDU	G5	S2S3	S3?	☑	76 km	75 km	23 km	326
Nooksack Dace *Rhinichthys sp. 4*									
	Lower Fraser EDU	G3	SNR	S1	☑	45 km	45 km	13 km	346
Olympic Mudminnow habitat *Novumbra hubbsi*									
	Puget Sound EDU	G3			☑	22 ha	22 ha	11 ha	200
Pacific Lamprey habitat *Lampetra tridentata*									
	Puget Sound EDU	G5			☑	50 ha	41 ha	15 ha	273
Pink Salmon - Even-year habitat *Onchorhynchus gorbuscha*									
	Puget Sound EDU	GQ			☑	499 score	485 score	250 score	194
Pink Salmon - Odd-year habitat *Onchorhynchus gorbuscha*									

Habitat Type / Level of Biological Organization / Taxon / Common Name / *Scientific Name*	Geographic Section	Global Rank	BC Rank	WA Rank	Mapped Data	Amount Known	Captured in Porfolio	Conservation Goal	% of Goal Captured
	Puget Sound EDU	G5			✔	9,637 score	5,249 score	4,818 score	109
Pink Salmon, no run info (Fraser XAN Ecoregion) *Oncorhynchus gorbuscha*									
	Fraser River XAN	G5	S2	S5	✔	797 km	596 km	399 km	149
Pink Salmon, no run info (Puget XAN Ecoregion) *Oncorhynchus gorbuscha*									
	Puget Sound/Georgia Basin XAN	G5	S2	S5	✔	383 km	220 km	191 km	115
Pygmy Longfin Smelt/Harrison/Pitt Lake Smelt *Spirinchus sp. 1*									
	Lower Fraser EDU	G1Q	--	S1	✔	27,271 ha	27,255 ha	8,181 ha	333
River Lamprey habitat *Lampetra ayresi*									
	Puget Sound EDU	G4			✔	6 ha	6 ha	2 ha	300
Salish Sucker *Catostomus Sp 4*									
	Puget Sound EDU	GQ			✔	13 occ	13 occ	4 occ	325
Salish Sucker (ha) *Catostomus sp. 4*									
	Lower Fraser EDU	G1	S1	S1	✔	20 ha	20 ha	6 ha	333
Salish Sucker (km) *Catostomus sp. 4*									
	Lower Fraser EDU	G1	S1	S1	✔	78 km	49 km	23 km	213
Sockeye Salmon *Oncorhynchus nerka*									
	Southern Coastal Streams EDU	G5	S2S3	SNR	✔	197 km	97 km	99 km	98
	Lower Fraser EDU	G5	S2S3	SNR	✔	766 km	569 km	383 km	149
Sockeye Salmon - Baker River habitat *Onchorhynchus nerka pop. 5*									

North Cascades Ecoregion Targets and Goals Summary

Habitat Type / Level of Biological Organization / Taxon / Common Name / *Scientific Name*	Geographic Section	Global Rank	BC Rank	WA Rank	Mapped Data	Amount Known	Captured in Porfolio	Conservation Goal	% of Goal Captured
	Puget Sound EDU	G5T3Q			☑	310 score	155 score	155 score	100
Sockeye Salmon (Cultus Lake) *Oncorhynchus nerka*									
	Lower Fraser EDU	G5	S2S3	SNR	☑	13 km	13 km	13 km	100
Sockeye Salmon (Sakinaw Lake) *Oncorhynchus nerka*									
	Southern Coastal Streams EDU	G5	S2S3	SNR	☑	14 km	14 km	14 km	100
Steelhead - Puget Sound habitat *Onchorhynchus mykiss*									
	Puget Sound EDU	G5			☑	23,103 score	13,233 score	11,552 score	115
Steelhead Salmon (no run info) *Oncorhynchus mykiss*									
	Southern Coastal Streams EDU	G5	S5	S5	☑	582 km	291 km	291 km	100
	Lower Fraser EDU	G5	S5	S5	☑	660 km	398 km	330 km	121
Steelhead Salmon (summer) *Oncorhynchus mykiss*									
	Southern Coastal Streams EDU	G5	S5	S5	☑	17 km	17 km	17 km	100
	Lower Fraser EDU	G5	S5	S5	☑	41 km	38 km	41 km	93
Steelhead Salmon (winter) *Oncorhynchus mykiss*									
	Southern Coastal Streams EDU	G5	S5	S5	☑	61 km	61 km	61 km	100
	Lower Fraser EDU	G5	S5	S5	☑	53 km	47 km	53 km	89
Threespine stickleback *Gasterosteus aculeatus*									
	Southern Coastal Streams EDU	G5	S5	S5	☑	193 km	110 km	58 km	190
	Lower Fraser EDU	G5	S5	S5	☑	720 km	528 km	215 km	246
Western Brook Lamprey *Lampetra richardsoni*									
	Southern Coastal Streams EDU	G4G5	S3S4	S4	☑	14 km	8 km	4 km	200
	Lower Fraser EDU	G4G5	S3S4	S4	☑	140 km	98 km	42 km	233

Habitat Type / Level of Biological Organization / Taxon / Common Name / *Scientific Name*	Geographic Section	Global Rank	BC Rank	WA Rank	Mapped Data	Amount Known	Captured in Porfolio	Conservation Goal	% of Goal Captured
Western Brook Lamprey habitat *Lamptera richardsoni*									
	Puget Sound EDU	G5			✔	707 ha	653 ha	212 ha	308
White Sturgeon *Acipenser transmontanus*									
	Lower Fraser EDU	G4	S3B,S4N	S2	✔	862 ha	840 ha	258 ha	326
<u>Insects</u>									
Autumn Meadowhawk *Sympetrum vicinum*									
	Lower Fraser EDU	G5	S5	S3S4	✔	8 occ	8 occ	8 occ	100
Beaverpond Baskettail *Epitheca canis*									
	Lower Fraser EDU	G5	S4	S3	✔	5 occ	5 occ	5 occ	100
Black Petaltail *Tanypteryx hageni*									
	Southern Coastal Streams EDU	G4	S4	S3	✔	1 occ	1 occ	1 occ	100
Blue Dasher *Pachydiplax longipennis*									
	Southern Coastal Streams EDU	G5	S5	S3S4	✔	6 occ	5 occ	6 occ	83
	Lower Fraser EDU	G5	S5	S3S4	✔	2 occ	2 occ	2 occ	100
Emma's Dancer (nez Perce) *Argia emma*									
	Lower Fraser EDU	G5	S5	S3S4	✔	5 occ	5 occ	5 occ	100
Grappletail *Octogomphus specularis*									
	Lower Fraser EDU	G4	S4	S2	✔	4 occ	4 occ	4 occ	100
Spring Stonefly trictura *Cascadoperla trictura*									

Habitat Type Level of Biological Organization Taxon Common Name *Scientific Name*	Geographic Section	Global Rank	BC Rank	WA Rank	Mapped Data	Amount Known	Captured in Porfolio	Conservation Goal	% of Goal Captured
	Lower Fraser EDU	G3G4	SNR	SNR	✔	2 occ	2 occ	2 occ	100
Stonefly fraseri *Isocapnia fraseri*									
	Lower Fraser EDU	G1	--	SNR	✔	1 occ	1 occ	1 occ	100
Stonefly gregsoni *Bolshecapnia gregsoni*									
	Southern Coastal Streams EDU	G2	--	SNR	✔	2 occ	2 occ	2 occ	100
Stonefly sasquatchi *Bolshecapnia sasquatchi*									
	Lower Fraser EDU	G3	--	SNR	✔	1 occ	1 occ	1 occ	100
Stonefly tibilalis *Setvena tibilalis*									
	Lower Fraser EDU	G4	SNR	SNR	✔	1 occ	1 occ	1 occ	100
Stonefly vedderensis *Isocapnia vedderensis*									
	Lower Fraser EDU	G4	--	--	✔	3 occ	3 occ	3 occ	100
Vivid Dancer *Argia vivida*									
	Lower Fraser EDU	G5	S5	S2	✔	2 occ	2 occ	2 occ	100
Western Pondhawk *Erythemis collocata*									
	Southern Coastal Streams EDU	G5	S5	S3	✔	2 occ	2 occ	2 occ	100
	Lower Fraser EDU	G5	S5	S3	✔	1 occ	1 occ	1 occ	100
<u>Mammals</u>									
Pacific water Shrew *Sorex bendirii*									
	Southern Coastal Streams EDU	G4	S5?	S1S2	✔	1 occ	1 occ	1 occ	100
	Lower Fraser EDU	G4	S5?	S1S2	✔	11 occ	10 occ	10 occ	100

Habitat Type / Level of Biological Organization / Taxon / Common Name / *Scientific Name*	Geographic Section	Global Rank	BC Rank	WA Rank	Mapped Data	Amount Known	Captured in Porfolio	Conservation Goal	% of Goal Captured
Vascular Plants									
Leafy Pondweed habitat *Potamogeton foliosus*									
	Puget Sound EDU	G5			☑	53 ha	47 ha	16 ha	294
Water Lobelia *Lobelia dortmanna*									
	Puget Sound EDU	G4G5			☑	7 occ	7 occ	13 occ	54
Freshwater Ecological Systems									
Cascade foothills headwaters - glacial drift and alluvium , low to mid elevation, mixed gradient									
	Puget Sound EDU				☑	18 occ	9 occ	5 occ	180
Cascade foothills headwaters - glacial drift, mid elevations, mixed gradient									
	Puget Sound EDU				☑	11 occ	4 occ	3 occ	133
Cascades headwaters, sedimentary, mid elevation									
	Puget Sound EDU				☑	19 occ	8 occ	6 occ	133
Cascades tributary headwaters - granitic, low to mid elevation									
	Puget Sound EDU				☑	28 occ	9 occ	8 occ	113
Fraser/Nooksack coastal plain - sandstone, low elevation, low gradient									
	Puget Sound EDU				☑	11 occ	3 occ	3 occ	100
intermediate,geology_hard_sediments,elevation_low,gradient_mainstem shallow - tributary shallow									
	Puget Sound EDU				☑	62,493 ha	20,858 ha	18,748 ha	111
	Southern Coastal Streams EDU				☑	380,798 ha	119,273 ha	114,239 ha	104
	Lower Fraser EDU				☑	102,067 ha	30,699 ha	30,620 ha	100

Habitat Type / Level of Biological Organization / Taxon / Common Name / *Scientific Name*	Geographic Section	Global Rank	BC Rank	WA Rank	Mapped Data	Amount Known	Captured in Porfolio	Conservation Goal	% of Goal Captured
intermediate,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem shallow - tributary shallow a									
	Southern Coastal Streams EDU				✔	138,747 ha	53,159 ha	41,624 ha	128
	Lower Fraser EDU				✔	98,725 ha	75,691 ha	29,617 ha	256
intermediate,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem shallow - tributary shallow b									
	Southern Coastal Streams EDU				✔	19,778 ha	5,827 ha	5,933 ha	98
	Lower Fraser EDU				✔	313 ha	313 ha	94 ha	333
intermediate,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem steep - tributary steep									
	Southern Coastal Streams EDU				✔	492,275 ha	142,965 ha	147,682 ha	97
	Lower Fraser EDU				✔	249,900 ha	134,625 ha	74,970 ha	180
intermediate,geology_intrusive - metamorphic,elevation_low,gradient_mainstem shallow - tributary shallow									
	Southern Coastal Streams EDU				✔	173,532 ha	62,343 ha	52,060 ha	120
	Lower Fraser EDU				✔	24,127 ha	10,517 ha	7,238 ha	145
large,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem shallow - tributary shallow									
	Southern Coastal Streams EDU				✔	161,381 ha	46,850 ha	48,414 ha	97
	Lower Fraser EDU				✔	4,080 ha	1,610 ha	1,224 ha	132
large,geology_intrusive-metamorphic,elevation_low,gradient_mainstem steep_tributary moderate									
	Lower Fraser EDU				✔	190,238 ha	190,238 ha	57,071 ha	333
Nooksack coastal plain headwaters - glacial drift and outwash, low elevation, low to moderate gradient									
	Puget Sound EDU				✔	13 occ	8 occ	4 occ	200
North Cascades - mafic , mid elevation, mixed gradient									
	Puget Sound EDU				✔	17 occ	10 occ	5 occ	200
North Cascades headwaters - granitic , mid to high elevation, moderate to high gradient									

Habitat Type / Level of Biological Organization / Taxon / Common Name / *Scientific Name*	Geographic Section	Global Rank	BC Rank	WA Rank	Mapped Data	Amount Known	Captured in Porfolio	Conservation Goal	% of Goal Captured
	Puget Sound EDU				✔	119 occ	37 occ	36 occ	103
North Cascades headwaters - mostly volcanic, mid to high elevation, moderate to high gradient									
	Puget Sound EDU				✔	13 occ	4 occ	4 occ	100
Northern Cascades headwaters - sandstone, moderate to high elevation, moderate to high gradient									
	Puget Sound EDU				✔	29 occ	10 occ	9 occ	111
Puget lowland headwaters north - glacial drift, low elevation, low to moderate gradient									
	Puget Sound EDU				✔	21 occ	6 occ	6 occ	100
Puget lowland headwaters west - glacial drift, low elevation, low to moderate gradient									
	Puget Sound EDU				✔	49 occ	25 occ	15 occ	167
Puget uplands and islands headwaters - glacial drift, low to mid elevation, low to moderate gradient									
	Puget Sound EDU				✔	76 occ	37 occ	23 occ	161
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem moderate - tributary moderate a									
	Southern Coastal Streams EDU				✔	172,294 ha	70,318 ha	51,688 ha	136
	Lower Fraser EDU				✔	88,813 ha	25,647 ha	26,644 ha	96
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem moderate - tributary moderate b									
	Puget Sound EDU				✔	22,531 ha	6,300 ha	6,759 ha	93
	Southern Coastal Streams EDU				✔	128,262 ha	38,811 ha	38,479 ha	101
	Lower Fraser EDU				✔	88,816 ha	26,515 ha	26,645 ha	100
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary moderate a									
	Southern Coastal Streams EDU				✔	72,820 ha	56,405 ha	21,846 ha	258
	Lower Fraser EDU				✔	7,398 ha	3,219 ha	2,219 ha	145
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary moderate b									
	Puget Sound EDU				✔	13,160 ha	4,502 ha	3,948 ha	114

Habitat Type / Level of Biological Organization / Taxon / Common Name / *Scientific Name*	Geographic Section	Global Rank	BC Rank	WA Rank	Mapped Data	Amount Known	Captured in Porfolio	Conservation Goal	% of Goal Captured
	Southern Coastal Streams EDU				✔	295,217 ha	219,018 ha	88,565 ha	247
	Lower Fraser EDU				✔	294,734 ha	149,646 ha	88,420 ha	169
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary moderate c									
	Southern Coastal Streams EDU				✔	97,933 ha	28,679 ha	29,380 ha	98
	Lower Fraser EDU				✔	78,413 ha	23,333 ha	23,524 ha	99
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow a									
	Puget Sound EDU				✔	41,330 ha	18,091 ha	12,399 ha	146
	Southern Coastal Streams EDU				✔	508,178 ha	173,630 ha	152,453 ha	114
	Lower Fraser EDU				✔	575,025 ha	164,815 ha	172,507 ha	96
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow b									
	Puget Sound EDU				✔	22,134 ha	6,428 ha	6,640 ha	97
	Southern Coastal Streams EDU				✔	303,965 ha	87,058 ha	91,190 ha	95
	Lower Fraser EDU				✔	164,535 ha	35,430 ha	49,361 ha	72
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow c									
	Southern Coastal Streams EDU				✔	26,868 ha	7,859 ha	8,060 ha	98
	Lower Fraser EDU				✔	14,728 ha	4,258 ha	4,418 ha	96
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow d									
	Puget Sound EDU				✔	3,039 ha	727 ha	912 ha	80
	Southern Coastal Streams EDU				✔	15,474 ha	4,396 ha	4,642 ha	95
	Lower Fraser EDU				✔	3,646 ha	1,479 ha	1,094 ha	135
small,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem shallow - tributary shallow									
	Puget Sound EDU				✔	3,640 ha	1,095 ha	1,092 ha	100
	Southern Coastal Streams EDU				✔	101,346 ha	29,984 ha	30,404 ha	99
	Lower Fraser EDU				✔	27,996 ha	11,375 ha	8,399 ha	135

<u>Communities</u>

Habitat Type Level of Biological Organization Taxon Common Name *Scientific Name*	Geographic Section	Global Rank	BC Rank	WA Rank	Mapped Data	Amount Known	Captured in Porfolio	Conservation Goal	% of Goal Captured
North Pacific Bog and Fen Community *North Pacific Bog and Fen*									
	Puget Sound EDU	GQ			☑	17 occ	15 occ	8 occ	188
North Pacific Shrub Swamp Community *North Pacific Shrub Swamp*									
	Puget Sound EDU	GQ			☑	7 occ	6 occ	3 occ	200

APPENDIX 6 – SETTING GOALS: HOW MUCH IS ENOUGH?

Appendix 6 – Setting Goals: How Much Is Enough?

Conservation goals are the ecological criteria that we establish for determining the persistence and variability of conservation targets across an ecoregion. Although it is impossible to say with certainty the exact number or distribution of any species, community, or ecological system that will ensure its persistence in the face of climatic or other environmental changes, conservation goals provide guidance as to "how much is enough?" (Noss, 1996; Soule and Sanjayan, 1998; TNC, 2004).

Establishing conservation goals is one of the most crucial steps in the ecoregional conservation assessment process as it forms the basis from which to gauge the success of how well the North Cascades portfolio of conservation areas performs in conserving the ecoregion's biodiversity. Conservation goals set the context for planning and implementation, and measuring progress towards meeting established goals and objectives. These goals also provide a clear purpose for decisions and lend accountability and defensibility to the assessment (Pressey, Cowling, and Rouget, 2003).

Setting conservation goals is also one of the most difficult steps in the assessment process. There is no scientific consensus on how much area or how many occurrences are necessary to conserve targets across their ranges. In highly fragmented regions, estimating historic conditions can be difficult, and setting goals based upon current conditions may result in targets not persisting over the long term. As a result, setting goals for conservation targets in the assessment primarily involves reliance on expert opinion and decisions based on the best available science at the time and is likely to have a high degree of uncertainty (Groves et al., 2000).

The difficulty inherent in setting conservation goals for the biodiversity targets cannot deter conservation practitioners from making these judgment calls as it is unlikely that more accurate estimates will be developed by the next generation of research, except perhaps on a species-by-species basis. Given the global "biodiversity crisis", there are irreparable consequences in delaying conservation efforts until new procedures or better estimates become available. As human populations continue to grow, many large habitat blocks will face development pressure to meet human needs.

Given our limited knowledge, numerical objectives for target representation must be considered 'working hypotheses' in nearly all cases. They also, to a certain degree, reflect societal risk (i.e., the risk of losing a species known to be endangered) (Comer, 2005). They need to be clearly stated, well documented and measurable. They should be treated in an adaptive approach where they are refined through time by monitoring and re-evaluating the status and trends of targets. Levels of uncertainty and risk should be a component of goal setting and documentation.

Conservation goals define the abundance and spatial distribution of viable target occurrences necessary to adequately conserve those targets in an ecoregion and provide an estimate of how much effort will be necessary to sustain those targets well into the future. Individual target goals contribute to development of a portfolio that depicts characteristic landscape settings that support all of the ecoregion's biodiversity. Conservation goals are set for coarse-filter targets such as ecosystems or vegetation types and fine-filter targets such as species or populations that are not captured by coarse filter targets. Coarse-filter vegetation maps have the advantage of covering the entire ecoregion, thereby eliminating the inherent spatial and taxonomic bias of species datasets (Lombard, Cowling, Pressey, and Rebelo, 2003; Pressey et al., 2003).

Conservation goals define the overall ecoregional assessment design: how many components and where they should be placed. Setting conservation goals seeks to incorporate the "three R's" as outlined by Tear et al. (2005): representation, redundancy, and resilience. Representation means capturing "some of everything" of the ecological element or target of interest (e.g., a population, species, or watershed type). Redundancy is necessary to reduce to an acceptable level the risk of losing representative examples of these targets. This also recognizes the fundamental importance of establishing multiple examples of protected populations to prevent environmental conditions or infrequent catastrophic events from affecting all protected populations simultaneously. The establishment of multiple populations might also preserve a large portion of the genetic variation that occurs across a broad landscape (Cox, Kautz, MacLaughlin, and Gilbert, 1994). Resilience, often referred to as the quality or health of an ecological element, is the ability of the element to persist through severe hardships. These concepts capture many of the other concepts and principles now considered important in conservation efforts, and provide a template for conserving evolutionary potential (Tear et al., 2005). Once a portfolio has been designed, gaps in progress towards goals inform the adequacy of proposed areas of biodiversity significance and existing conservation areas in maintaining biodiversity targets. Those gaps also inform inventory needs and define restoration needs to regenerate viability and integrity of target occurrences.

Conservation goals incorporate abundance and distribution goals. Abundance goals are the number, or percent area, of occurrences necessary for a target to persist. These goals provide redundancy. Distributional goals capture representation and define how the target occurrences should be arrayed spatially across an ecoregion. Conservation of multiple, viable examples of each target, located across its geographic and ecological range, addresses the ecological and genetic variability of the target, and provides sufficient redundancy and representation for persistence in the face of environmental stochasticity and human perturbations (Comer, 2005).

Abundance Goals

Abundance goals should take into account attributes of target scale and pattern. Targets can be grouped according to these attributes so planners do not need to set goals for each target individually. For instance, terrestrial communities and ecological systems are often grouped as Matrix, Large Patch and Small Patch and Linear types (Figure 2). Freshwater ecological systems are grouped by different sizes, such as headwaters and small tributaries, or small, medium and large rivers. Commonly, smaller communities and ecological systems, and locally occurring targets, are given higher abundance goals because they historically had more numerous occurrences and are more susceptible to disturbances than those that are larger and more widely distributed.

Abundance goals are set using both number of occurrences and percent area of targets. Number of occurrences is appropriate for species, community and small patch ecological system targets, where occurrences are represented as point locations. In addition, in fragmented landscapes where large patch and matrix forming ecological systems are distinct occurrences, applying these types of goals may be appropriate. Percent-area goals are often used for targets such as matrix forming, large patch and linear ecological systems which often occur as extensive mapped polygons on the landscape, and distinct, multiple occurrences are not common. It typically makes little sense to set goals based on number of occurrences, but instead on the percent area of the historic and extant area of the ecological system.

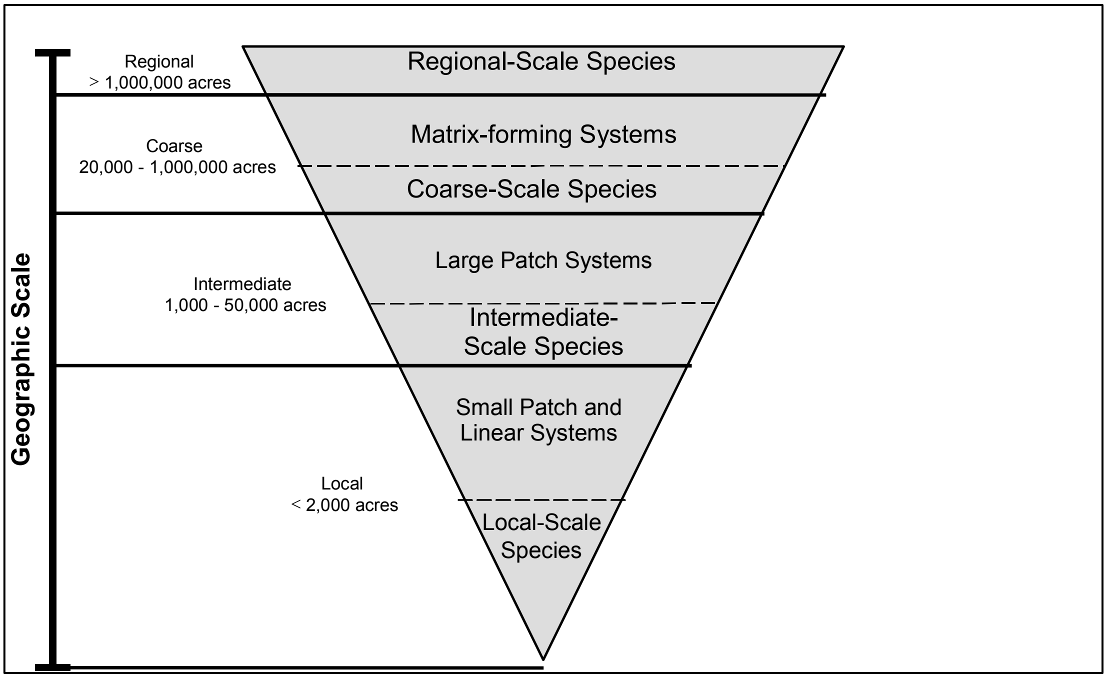

Figure 1. Categories representing geographical scale of conservation targets. Spatial ranges are approximate and overlapping (Poiani et al. 2000)

Distribution Goals

Ecoregions are not homogeneous. They contain environmental gradients and non-random distributions of biodiversity. Ecoregions are stratified in a variety of ways to delineate broad patterns of environmental gradients. In order to help capture occurrences of targets across their natural range of genetic and environmental variation and to provide sufficient replication to ensure persistence in the face of predicted or unpredicted environmental change, we subdivided the ecoregion into stratification units and set representation goals for conservation targets within those units. For example, if the range of a species spans the entire ecoregion, it is preferable to select viable occurrences throughout the ecoregion, rather than clustered in one local area (TNC, 2004). The ecoregion was stratified into four terrestrial (ecosections) and covered portions of three freshwater (Ecological Drainage Units) sections. Along with ecoregion-wide goals, representation goals for terrestrial targets were set using the terrestrial sections and freshwatergoals were stratified across EDUs. Conservation goal values for most species and system targets were set using default values developed by The Nature Conservancy and NatureServe that account for both the geographic scale and distribution of targets (Comer 2001, 2003; Appendix 19).

Table 1. Target distribution (Groves et al. **2000)**

TARGET DISTRBUTION
Endemic: Target occurs primarily in one ecoregion. >90% of global distribution in ecoregion.
Limited: Target distribution is centered in a few ecoregions. <90% of global distribution is with in the ecoregion, and distribution is limited to 2-4 ecoregions.
Disjunct: Target is a distinct occurrence in the ecoregion isolated from other occurrences in adjacent ecoregions. Distribution in ecoregion likely reflects significant genetic differentiation from main range due to historic isolation. Roughly >2 ecoregions (or several hundred kilometers) separate this ecoregion from other more central parts of its range.
Widespread: Target occurs across several to many ecoregions. Goals should be established across the range of the targets, if possible.
Peripheral: Target has a small percentage of its distribution in the ecoregion. <10% of global distribution in ecoregion. Global distribution >3 ecoregions.

Table 2. Initial representation objectives for coarse filter and fine filter targets, expressed as three levels for developing "High Risk", "Moderate Risk" and "Low Risk" conservation scenarios

P = population EOs; N= nest EOs, based on z = 0.3

<table>
<tr><th rowspan="4">Distribution Relative to Ecoregion</th><th colspan="6">Spatial Pattern of Occurrence</th></tr>
<tr><th colspan="3">Matrix, Large Patch and Linear Ecological Systems</th><th colspan="3">Small Patch Ecological Systems and All Rare Communities Fine Filter Species Targets</th></tr>
<tr><th colspan="3">Default Area or Length, per Section or Ecological Drainage Unit* (% of historic)</th><th colspan="3">Default Number of Occurrences**</th></tr>
<tr><th>“High Risk” Scenario</th><th>“Moderate Risk” Scenario</th><th>“Low Risk” Scenario</th><th>“Higher Risk” Scenario</th><th>“Moderate Risk” Scenario (Default)</th><th>“Lower Risk” Scenario</th></tr>
<tr><td>Endemic</td><td rowspan="4">18%</td><td rowspan="4">30%</td><td rowspan="4">48%</td><td>P: 25
N: 63</td><td>P: 50
N: 125</td><td>P: 75
N: 188</td></tr>
<tr><td>Limited</td><td>P: 13
N: 34</td><td>P: 25
N: 67</td><td>P: 38
N: 101</td></tr>
<tr><td>Widespread/ Disjunct</td><td>P: 7
N: 19</td><td>P: 13
N: 38</td><td>P: 20
N: 57</td></tr>
<tr><td>Peripheral</td><td>P: 4
N: 12</td><td>P: 7
N: 23</td><td>P: 11
N: 35</td></tr>
</table>

Summary

Key Steps in Setting Goals:

- Characterize species, community and ecological system targets by their range-wide distribution patterns (endemic, limited, disjunct, widespread, peripheral).
- Characterize targets by their spatial scale: regional, coarse-scale, intermediate, and local-scale.
- Evaluate existing stratification units of ecoregions or develop stratification units to delineate major environmental gradients such as climate, geology and elevation to provide a spatial framework to set distributional goals.
- Set abundance and distribution goals for every target either on an individual basis or as groups of targets with similar characteristics. Consult experts and existing guidance, recovery plans and conservation plans for specific targets when available. Use number of species, community and ecological system (when feasible) occurrences, and use percent area of matrix and large ecological systems to set goals. Review adjacent ecoregional assessments and information on wide-ranging species to inform goals.

- Document assumptions, data gaps and long term steps to monitor and re-evaluate goals.
- Once an ecoregional portfolio/vision has been developed, quantify its adequacy in terms of fulfilling the abundance and distribution goals for each target.
- Identify the potential for further data acquisition and/or surveys to document additional numbers of target occurrences to make progress in meeting goals by adding them to future iterations of ecoregional portfolios. Identify restoration needs and objectives to make progress in meeting goals where further data acquisition and/or surveys are not a great potential for further information.

Conservation Goals for Terrestrial Targets

Coarse-filter Targets

A coarse-filter strategy is aimed at maintaining the ecological processes that support the vast majority of species; thus permitting us to avoid targeting numerous species individually. In addition to maintaining non-target species, coarse-filter strategies emphasize the conservation of ecosystem services (*e.g.,* carbon sequestration, water filtration, nutrient regulation, etc.). While goals for species correctly emphasize the health and viability of their populations, coarse-filter goals focus on representing ecological variability and environmental gradients. Put another way, we hope to use the coarse filter to ‘keep common species common.’

Ecological systems are used as coarse filter targets. As such, they capture many common, untracked and unknown species as well as serving directly as large-scale conservation targets themselves. Many goals for ecological systems have been based on species diversity/area curves. These curves are conceptual models that provide an approximation of the proportion of species that might be lost given the reduction in habitat areas. These relationships grew from empirical observations of island biogeography (MacArthur and Wilson, 1967), and have been shown to exist for habitat islands in terrestrial and freshwaterlandscapes. Estimations of terrestrial species loss associated with the percent habitat remaining suggest that 30-40% of the historic area of a given community or ecological system would likely contain 80-90% of the species that occur in them (Groves, 2003). This model has not been tested, and regional analyses of species/area relationships would better inform goal setting using this as a framework.

All targets were represented across major biophysical gradients in order to capture environmental representation, ecological variability and potential genetic variability of targets. Representation of targets across major biophysical gradients also helps to ensure that each regional scenario encompasses native ecological system diversity while providing a hedge against a changing climate. This can be accomplished in several ways. First, as mentioned earlier, targets could be represented in each of the ecoregional sections/EDUs/geographical subdivisions of their natural distribution. Second, for large patch, linear, and matrix forming systems (both terrestrial and freshwater), they can be represented in combination with biophysical land units and freshwater biophysical environments to help represent ecological variability and gradients. For example, scenarios were generated in MARXAN that applied percent objectives to terrestrial/biophysical environment and riverine system/biophysical environment combinations; ensuring that the major biophysical gradients of each system would be represented in proportion to their occurrence for the ecoregion as a whole.

Terrestrial system targets were assigned area-based goals in stratification units where they represented a matrix-type system. Goals were set equal to 30% of the estimated historical (*circa* ~1860) extent of the system in the ecoregion. We used area rather than individual occurrences of these targets due to their distribution over large areas and our ability to map them as large polygons across the landscape. Our estimate of the historical extent of these large-scale system types was developed by examining relevant literature and current landcover data, combined with expert opinion.

Conservation Goals for Freshwater Targets

Coarse-filter Targets

The TNC freshwater ecosystem classification approach is spatially hierarchical and Ecological Drainage Units (EDUs) are similarly scaled and serve the same purpose for freshwater targets. So in reality we apply more than one stratification scheme for a given ecoregional assessment. Some degree of target occurrence replication is provided within each Section/EDU of their historical range within the ecoregion. The goals for freshwater system targets were also set equal to 30% of the occurrences of each system target up to a maximum of three occurrences. Because system targets were nested within EDUs, there was no stratification of their goals across EDUs.

Fine-filter Targets

For targets in each EDU where the source data was habitat-based (spawning and rearing), goals were applied based on recommendations by The Nature Conservancy/NatureServe (Comer 2001, 2003; Appendix 19), with changes to the recommendations as shown in Tables 3 and 4.[1] Variations from the TNC/NatureServe goals were based upon expert knowledge of the freshwater team. NOAA fisheries biologists agreed that 50% of spawning and rearing habitat should be used for salmon in the USA, regardless of whether the targets are listed. Goals for targets (some freshwater targets and all non-freshwaterr targets) where the source data identified the number of occurrences were based on TNC/NatureServe recommendations, with modifications based on the amount available. See Appendix 5 for target and goal summaries.

Table 3. Goals for Salmonid Fine-filter Targets

	British Columbia	Stratified By	Washington	Stratified By
Chinook Salmon	30%	EDU	50% 30%	ESU or EDU
Chum Salmon	30%	XAN	30%	EDU
Coho Salmon	30%	EDU	30%	EDU
Coho Salmon - Fraser	50%		n/a	n/a
Pink Salmon	30%	XAN	30%	EDU
Sockeye Salmon	30%	EDU	50% 30%	ESU or EDU

[1] FISS and SaSI had attributes for spawning, rearing and holding areas for each species. These were merged for this analysis by species. In the next iteration spawning, rearing and holding should remain separate and goals set for each type of habitat, so all are represented in the portfolio.

	British Columbia	Stratified By	Washington	Stratified By
Sockeye Salmon—Sakinaw Lake	50%		n/a	n/a
Sockeye Salmon—Cultus Lake	50%		n/a	n/a
Steelhead Salmon	30%	EDU	50% 30%	ESU or EDU
Aquatic Non-Salmonid	30%	EDU	30%	EDU

Table 4. Freshwater fine filter animals targets: Marxan goals.

Taxonomic Group	Target Species	Scientific Name	Applied Goal	Stratified By
Amphibian	Coastal Tailed Frog	*Ascaphus truei*	26 EOs	EDU
Bird	Western Grebe	*Aechmorphorus occidental*	1 EO	EDU
Mammal	Pacific Water Shrew	*Sorex bendirii*	12 EOs	EDU
Amphibian	Western Toad	*Bufo boreas*	6 EOs	EDU
Amphibian	Red-legged Frog	*Rana aurora*	21 EOs	EDU
Amphibian	Pacific Giant Salamander	*Dicamptodon tenebrosus*	23 EOs	EDU
Freshwater Fish—Anadromous Salmonid	Sockeye Salmon	*Oncorhynchus nerka*	50% of watersheds that occurs in	EDU
Freshwater Fish—Anadromous Salmonid	Chum Salmon	*Oncorhynchus keta*	50% of watersheds that occurs in	XAN
Freshwater Fish—Anadromous Salmonid	Coho Salmon	*Oncorhynchus kisutch*	50% of watersheds that occurs in	EDU
Freshwater Fish—Anadromous Salmonid	Chinook Salmon	*Oncorhynchus tshawytscha*	50% of watersheds that occurs in	EDU
Freshwater Fish—Anadromous Salmonid	Pink Salmon	*Oncorhynchus gorbuscha*	50% of watersheds that occurs in	XAN
Freshwater Fish—Anadromous Salmonid	Steelhead	*Oncorhynchus mykiss*	50% of watersheds that occurs in	EDU
Freshwater Fish—Anadromous Salmonid	Steelhead (Winter-run)	*Oncorhynchus mykiss*	100% of watersheds that occurs in	EDU
Freshwater Fish—Anadromous Salmonid	Steelhead (Summer-run)	*Oncorhynchus mykiss*	100% of watersheds that occurs in	EDU
Freshwater Fish	Kokanee	*Oncorhynchus nerka*	50% of watersheds that occurs in	EDU
Freshwater Fish	Sockeye Salmon (Cultus	*Oncorhynchus nerka*	100% of watersheds that	EDU

	Lake)		occurs in	
Taxonomic Group	**Target Species**	**Scientific Name**	**Applied Goal**	**Stratified By**
Freshwater Fish	Sockeye Salmon (Sakinaw Lake)	*Oncorhynchus nerka*	100% of watersheds that occurs in	EDU
Insects—Plecoptera	A Stonefly	*Bolshecapnia gregsoni*	2 EOs	EDU
Insects—Plecoptera	A Stonefly	*Bolshecapnia sasquatch*	1 EOs	EDU
Insects—Plecoptera	A Spring Stonefly	*Cascadoperla trictura*	2 EOs	EDU
Insects—Plecoptera	A Stonefly	*Isocapnia fraseri*	1 EOs	EDU
Insects—Plecoptera	A Stonefly	*Setvena tibialis*	1 EOs	EDU
Insects—Plecoptera	A Stonefly	*Isocapnia vedderensis*	3 EOs	EDU
Insects—Odonata	Emma's Dancer	*Argia emma*	5 EOs	EDU
Insects—Odonata	Vivid Dancer	*Argia vivida*	2 EOs	EDU
Insects—Odonata	Beaverpond Baskettail	*Epitheca canis*	5 EOs	EDU
Insects—Odonata	Western Pondhawk	*Erythemis collocata*	3 EOs	EDU
Insects—Odonata	Grappletail	*Octogomphus specularis*	4 EOs	EDU
Insects—Odonata	Blue Dasher	*Pachydiplax longipennis*	8 EOs	EDU
Insects—Odonata	Autumn Meadowhawk	*Sympetrum vicinum*	8 EOs	EDU
Insects—Odonata	Black Petaltail	*Tanypteryx hageni*	1 EOs	EDU
Freshwater Fish	Green Sturgeon	*Acipenser medirostris*	30% of watersheds that occurs in	EDU
Freshwater Fish	White Sturgeon (Lower Fraser)	*Acipenser transmontanus*	30% of watersheds that occurs in	EDU
Freshwater Fish	Mountain Sucker	*Catostomus platyrhynchus*	30% of watersheds that occurs in	EDU
Freshwater Fish	Salish Sucker	*Catostomus sp. 4*	30% of watersheds that occurs in	EDU
Freshwater Fish	Threespine Stickleback	*Gasterosteus aculeatus*	30% of watersheds that occurs in	EDU
Freshwater Fish	Western Brook Lamprey	*Lampetra richardsoni*	30% of watersheds that occurs in	EDU
Freshwater Fish	Coastal Cutthroat Trout	*Oncorhynchus clarki clar*	30% of watersheds that occurs in	EDU
Freshwater Fish	Nooksack Dace	*Rhinichthys cataractae*	30% of watersheds that occurs in	EDU
Freshwater Fish	Bull Trout	*Salvelinus confluentus*	50% of watersheds that occurs in	EDU
Freshwater Fish	Dolly Varden	*Salvelinus malma*	30% of watersheds that occurs in	EDU
Freshwater Fish	Pygmy Longfin Smelt	*Spirinchus sp. 1*	30% of watersheds that occurs in	EDU

Taxonomic Group	Target Species	Scientific Name	Applied Goal	Stratified By
Freshwater Fish	Eulachon	*Thaleichthys pacificus*	30% of watersheds that occurs in	EDU
Freshwater Fish	Cultus Lake Sculpin	*Cottus sp. 2*	30% of watersheds that occurs in	EDU
Freshwater Fish	Cutthroat Trout (Anadromous)	*Oncorhynchus clarki clarki*	30% of watersheds that occurs in	EDU
Freshwater Fish	Dolly Varden (Anadromous)	*Salvelinus malma*	30% of watersheds that occurs in	EDU

APPENDIX 7 – TERRESTRIAL AND FRESHWATER ECOLOGICAL SECTIONS DEFINITIONS

Appendix 7 – Terrestrial and Freshwater Ecological Sections Definitions

Appendix 7.1. Terrestrial Ecosection Descriptions[2]

The North Cascades and Pacific Ranges Ecoregion is divided into four sub-sections that closely match the BC Ecoregion Classification's ecosections in the Pacific Ranges ecoregion. For analytical purposes the Eastern Pacific Ranges ecosection was split into two sections (Northeastern Pacific Ranges and Southeastern Pacific Ranges) to create four sections that were of somewhat equal size. The section boundary followed the middle of the Fraser River from just south of Spuzzum, BC to approximately 4 km north of Laidlaw, BC. The North Cascades ecosections are the Northeastern Pacific Ranges, Southeastern Pacific Ranges, Southern Pacific Ranges and Northwestern Cascade Ranges (Map 3).

The **Northeastern Pacific Ranges** is a section with steep, rugged, often ice-capped mountains located in the northeastern portion of the ecoregion entirely within BC. This ecosection contains the upper reaches of Harrison Lake and Lillooet Lake as well as Mount Meager at the northern extent of the ecosection. The Fraser River splits this ecosection with the Southeastern Pacific Ranges.

The **Southeastern Pacific Ranges** ecosection is a rugged inland area that has transitional climates including some rainshadow. It is located on the eastern flank of the ecoregion and spans the BC-WA border. This ecosection contains Ross Lake and the Skagit River flows through it.

The **Southern Pacific Ranges** ecosection is characterized by high rainfall on steep, rugged mountains located in the northwest portion of the ecoregion entirely within BC. This ecosection contains the only marine component of the ecoregion. Several inlets are contained within this ecosection. Portions of Howe Sound, Jervis Inlet and Desolation Sound are contained within this ecosection, as well as Pitt, Stave, Harrison, and Powell Lakes. Mount Garibaldi is located on the eastern border of the ecosection shared with the Northeastern Pacific Ranges ecosection.

The **Northwestern Cascade Ranges** ecosection is composed of a block of rugged mountains extending from southern Washington into southern British Columbia. This ecosection includes several large, composite volcanoes. This ecosection contains Mount Baker and Glacier Peak as well as Baker Lake and Shannon Lake. The Skagit River flows through the ecosection on its way to Puget Sound.

Appendix 7.2. Zoogeographic History of Freshwater Fishes in the Southern Coastal Streams, Fraser, and Puget Sound EDUs

Virtually all of British Columbia and the northern portion of Washington State were covered by Wisconsinan glaciers. Figure 2 illustrates a set of schematics of the ice sheet retreat from B.C. and WA and the major postglacial colonization routes. The major

[2] Terrestrial ecosection descriptions from Demarchi (1996) and "Ecoregions of BC" webpage: http://srmwww.gov.bc.ca/ecology/ecoregions/humidtemp.html

freshwater dispersal routes include: the upper Columbia River, the Missouri River watershed, south from the Nahanni River and from the upper Yukon River.

Panel (c) of Figure 2 illustrates that large proglacial lakes formed near the margins of retreating ice sheets at the junction of the upper Skeena, Fraser, and Peace rivers ("1", Lake Prince George) and also near where the middle Fraser and Columbia rivers (Lake Oliver, Penticton Quilchena, etc) come into close contact ("2"). Ice dams blocked the current outlets to the Pacific Ocean of both the Skeena and Fraser rivers. Consequently, during deglaciation the Fraser used to exit to the sea at the current mouth of the Columbia River as the Fraser flowed through the Columbia via the Okanagan valley and river system. In addition, glacial Lake Prince George (2 in Figure 3) facilitated the connection between the upper Fraser and upper Peace River as well as between the upper Skeena River and the Fraser. Such interdrainage connections resulted in faunal transfers between these river systems. These lakes were part of a large series or proglacial lakes across North America (Figure 3). The largest were associated with the margins of the Laurentide Ice Sheet as it retreated in a northeast direction in North America. Large lakes such as glacial lakes Agassiz (8/9), Tyrell (7) McConnell (6), Miette (4) and Edmonton (5) covered huge areas of North America and facilitated a great deal of exchange of aquatic faunas (indicated by arrows) among now isolated areas (see McPhail and Lindsey 1970; McPhail and Lindsay, 1986).

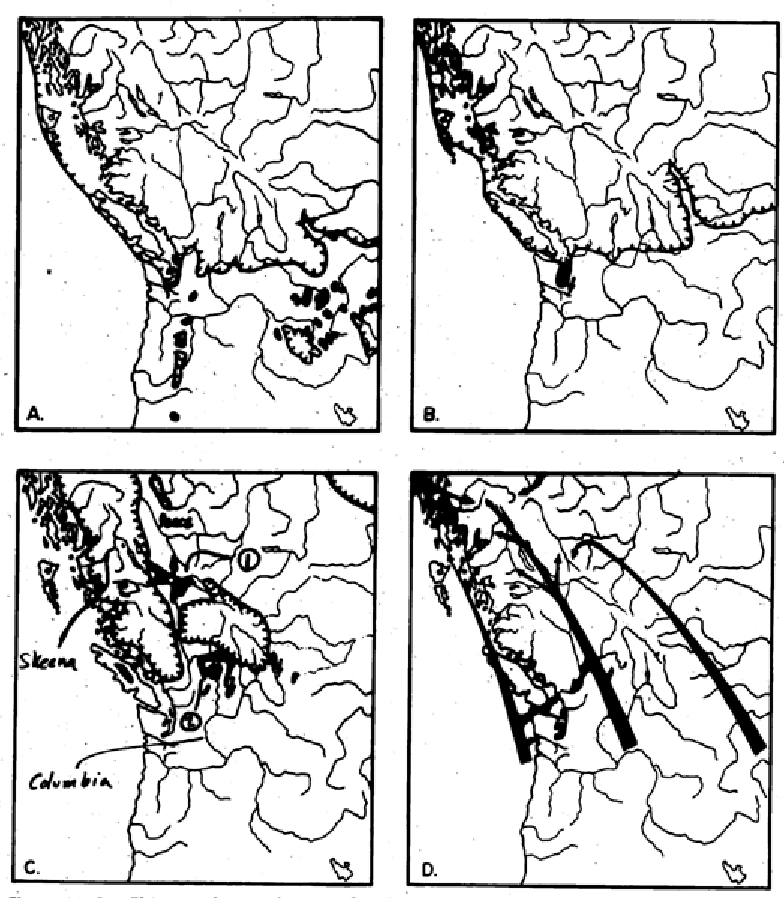

Figure 16.2 Late Pleistocene drainage changes in Cascadia: (A) maximum glaciation; (B) early deglaciation; (C) late deglaciation; and (D) major postglacial dispersal routes.

Figure 2. Ice sheet retreat from BC and WA and the major post-glacial colonization routes (from Hocutt and Wiley, 1986).

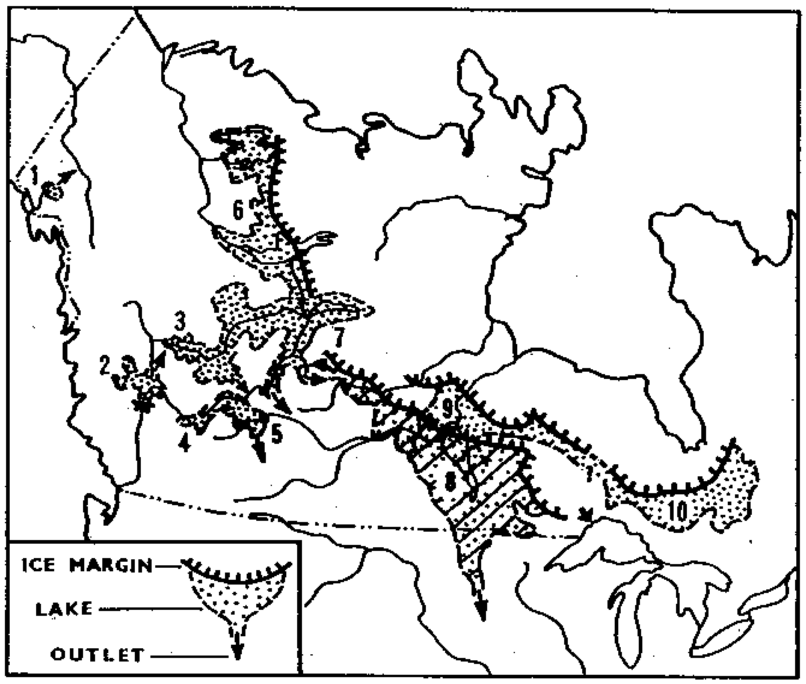

Figure 3. Post-glacial lakes of the last glacial recession (Hocutt and Wiley, 1986).

The Columbia River is the major post-glacial recolonization “route” of the Cascadia region, acting as a migration route for fishes from the Columbia north to the Stikine River (McPhail and Lindsey, 1986). Interdrainage connections among these major river systems has resulted in the observation that most of the freshwater fish faunas of these glaciated rivers are of Columbia origin. The table below shows the extent of "faunal similarity" of major Pacific coast rivers with the Columbia (McPhail and Lindsey, 1986):

River	Similarity to Columbia River (All Freshwater Fishes)	Similarity to Columbia River (Stenohaline[3] Species)
Fraser	84%	74%
Chehalis	85%	72%
Skeena	78%	60%
Nass	80%	63%
Stikine	71%	51%

[3] Limited to or able to live only within a narrow range of saltwater concentrations.

Interdrainage connections have strongly influenced the biogeography and evolution of fishes in this region. The upper Skeena and Fraser rivers are the only rivers west of the continental divide with populations of the white sucker (*Catostomus commersoni*), a fish of Mississippi origin that entered the western rivers via faunal transfers between these rivers and (probably) the Peace River via glacial Lake Prince George. Similarly, the largescale sucker (*Catostomus macrocheilus*) is of Pacific basin origin (McPhail and Lindsay 1986).

APPENDIX 8 – MARXAN METHODOLOGY

Appendix 8 – MARXAN Methodology

In order to address the complexity and large amount of data used in the analyses, and to ensure the analysis is repeatable so that the reserve systems can be readily re-evaluated and modified over time as conditions change and new information is acquired, the assessment team chose to use the optimal reserve selection algorithm MARXAN[4] (Marine Reserve Design Using Spatially Explicit Annealing) (Ball and Possingham, 2000). MARXAN is a stand-alone, optimization application that was developed to assist in designing a marine reserve system for the Great Barrier Reef in Australia and has gone on to be used in a variety of terrestrial and freshwaterconservation planning settings around the world.[5] The application comes from a lineage of successful selection algorithms, beginning with SIMAN, SPEXAN, and SITES (Ball and Possingham, 2000). In Canada, the application is used by many organizations, including Parks Canada, Department of Fisheries and Oceans, World Wildlife Fund, Living Oceans Society and is being considered by the BC Government (Evans et al., 2004; Loos, 2006). Developed by Dr. Hugh Possingham, University of Queensland, and Dr. Ian Ball, at the Australian Antarctic Division in Tasmania, MARXAN receives spatially-explicit data generated through GIS and applies spatial optimization algorithms to achieve a reasonably efficient solution to the problem of selecting a system of spatially cohesive reserves that meet a suite of conservation targets (both coarse and fine filter) simultaneously.

We used MARXAN's simulated annealing algorithm (Kirkpatrick et al,. 1983) for the analysis. The solution offered by simulated annealing consistently produces results closer to optimum than other algorithms (Stewart et al., 2003). Heuristic optimization algorithms, such as greedy heuristic[6] – an extremely fast step-wise iterative process by which the assessment unit that improves the portfolio the most is sequentially added at each step until all goals are reached - might come closer to achieving a set of sites that offers the highest quality representation of the conservation targets, but creates a solution with a much larger footprint on the landscape. Simulated annealing is seen as more useful than other optimization techniques that have also been developed by mathematicians because it can be used to identify a large number of near-optimal portfolios which can then be used by planners to explore multiple scenarios when designing conservation networks (CLUZ, 2006).

MARXAN is not meant to replace decision making; it is a decision support tool. Automated output (a portfolio or solution) from the program was reviewed and refined by the Assessment Team and other experts familiar with the ecoregion. This was necessary to compensate for gaps in the input data and other limitations of the automated portfolio, such as information which could not be easily quantified. Input received through expert reviews was used to modify the computer-generated portfolio.

Simulated Annealing

MARXAN uses simulated annealing to achieve an objective function - to find the lowest cost portfolio or solution. MARXAN evaluates the effectiveness of its solutions by

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4 More information about this analytical tool can be found by visiting the following website: http://www.ecology.uq.edu.au/MARXAN.htm).

5 See Loos 2006, pp 20 for a partial list of users

6 MARXAN can also be used to develop greedy heuristic solutions.

measuring cost against goals and calculating whether a particular change to a portfolio would improve its effectiveness. Successful (effective) portfolios have the lowest costs. Cost is defined as a cost for each assessment unit included in the solution and a penalty for not achieving goals for each target[7]. These cost elements are further described in the inputs section below. To achieve the objective function, MARXAN incorporates three basic elements (CLUZ, 2006): iterative improvement, random cost increases and repetitiveness.

Iterative improvement:

The first element of the simulated annealing process is based on iterative improvement. MARXAN starts by creating a portfolio based on randomly selecting a number of assessment units. It then improves on this random selection by using iterative improvement: repeating the same simple set of rules a number of times to reduce the cost of the solution. In MARXAN's case the rules are:

1. Calculate the cost of the planning portfolio.
2. Choose an assessment unit at random and change its status (i.e. add or remove from the portfolio).
3. Calculate the new cost of the changed planning portfolio.
4. If the new portfolio has a lower cost than the original portfolio then make the change permanent. Otherwise, do not make the change.

This is one iteration and MARXAN can be used to repeat the process a number of times, so that the portfolio cost is gradually reduced. In general, a conservation planning exercise will use a large number of iterations.

Random and occasional cost increase

By itself, the iterative improvement strategy is unlikely to identify the most effective portfolio. This is because the process can get trapped in local optima by only accepting short term improvements instead of making changes that increase the portfolio cost in the short term which would allow long term improvements. (See Figure 3)

MARXAN overcomes this problem by adding a random element to the iterative process that allows changes to the portfolio that increases the cost value. This allows MARXAN to make "bad choices" - when it checks whether the random change to the portfolio reduces the total cost it will occasionally allow changes that make the portfolio more costly in the hope that it might achieve greater success later in the process.

This is illustrated in the Figure 4 (Loos, 2006) where **A** is a local optima, **B** represents a short term cost increase and **C** represents a more optimum solution.

[7] See Ball and Possingham, 2000 pp. 9 for more details

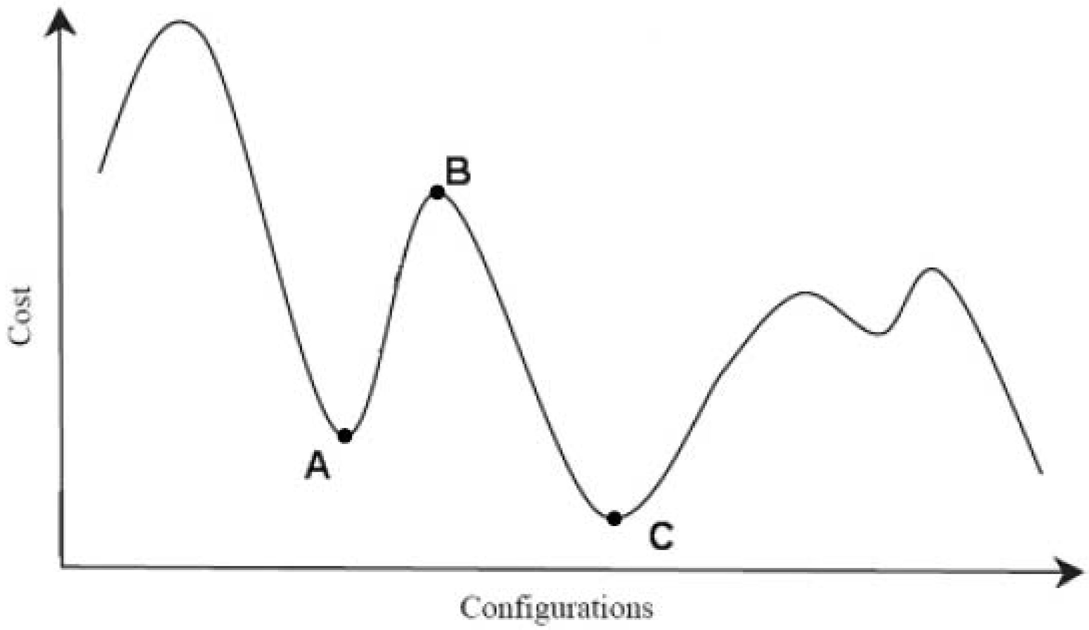

Figure 4. Local optima (Loos, 2006).

MARXAN is influenced by the size of the cost increase and is more likely to accept large increases to the portfolio cost at the beginning of the iterative process, as this is when these "backward steps" are most likely to produce long-term benefits. As the algorithm progresses, it becomes more particular as to how much additional cost it is willing to accept to move closer to achieving the assigned conservation goals. This is referred to as the cooling process (see below). If the cost (BLM and/or SI described below) of adding an assessment unit is too high in comparison with the penalty of not adding that unit (and the targets it contains) to the solution, the application may reject selecting that unit, even at the risk of not achieving all goals for the conservation targets.

Repetition and irreplaceability scores

Finally, MARXAN can run the process described above a number of times, which also increases the chances of finding a low-cost portfolio. MARXAN then identifies the most efficient portfolio from the different runs, presented as the automated solution. This "best" solution forms the basis for the delineated portfolio. MARXAN also provides information from each of the runs, counting the number of times an assessment unit appeared in the portfolios produced by the different runs. This "summed solution" forms the basis of the irreplaceability analysis conducted for this assessment (see Appendix 15).

This combination of 1) iterative improvement, 2) random backward steps towards the beginning of the process and 3) repetition, help ensure that an effective solution will be found. Increasing the number of iterations and increasing the number of repeats will also increase the likelihood of achieving effective solutions. However, increasing the number of iterations beyond a certain point will not increase the likelihood of finding other efficient solutions.

The following section describes some of the parameters used in the MARXAN analysis.

MARXAN Parameters

Several factors, besides the number and type of targets, influence the MARXAN analysis. These include type of assessment units, assessment unit cost measures (suitability index), penalty applied for dispersed rather than clustered assessment units in results ('boundary length modifier'), penalty applied for failure to meet target goals ("species penalty factor"), the goal level for each target, the spatial stratification of the analyses units, and the number of repeat runs of the algorithm (and number of iterations within each run).

Assessment Units

The assessment units (AUs) are the basis for the MARXAN analysis. They can be any shape or size based on based on natural, administrative, or arbitrary features, however the size and shape of AUs can have a major effect of the MARXAN model output (Pressey and Logan, 1998).

Considerable debate exists in the literature, and among terrestrial and freshwaterspecialists, regarding the most appropriate assessment unit for MARXAN and the decision of which analysis unit to use involves trade-offs (Loos, 2006). Benefits of unit types are outlined below:

Grids or hexagons have the advantage of consistent size, which helps to avoid area-related bias. Natural assessment units (such as watersheds):

- are more likely to represent ecological systems or landscape patterns and may be more easily understood than a hexagon's abstract representation of the landscape during expert review..

Squares:

- allow for nested analysis, and are units which may be easier to grasp for some users.

Grids or hexagons:

- have the advantage of consistent size, which helps to avoid area-related bias.

Considering squares verses hexagons, squares allow for nested analysis, and are units which may be easier to grasp for some users Hexagons have a number of advantages over squares or natural assessment units or squares (G. Wilhere, personal communication, March

29, 2006; Z. Ferdana, personal communication, March 30, 2006; J. Ardron, personal communication, March 29, 2006), including:

- Larger area-to-edge ratio than squares (hexagons are closer in shape to circles than squares), allowing for more compact reserves. Squares artificially inflate this value because of their jagged edges (Warman, 2004).
- Shared edge with each of its neighbors, allowing for more compact and better shaped reserves (reserves which better reflect the features they are set up to conserve).
- The centroid-to-centroid distances between a hexagon and its 6 neighbors are all equal. A square has 2 different distances: between neighbors on an edge and neighbors on a vertex. This is particularly important when considering animal migration in target selection.
- When projected on the earth's surface, hexagons suffer less distortion than squares (White et al., 1992).
- In terms of data representation (or sampling), the larger area to edge ratio of hexagons (compared to squares), should result in fewer misassignments of target occurrences to AUs. That is, assuming square or hexagon AUs of equal area, element occurrences will be less likely to fall on or near an edge when using hexagons. Therefore, fewer occurrences will be assigned to the wrong AU due to spatial imprecision of the occurrence locations[8].
- Hexagons can also be easily aggregated into larger units, providing more flexibility in modeling.
- Appropriately sized hexagons can accurately communicate the scale of the results of the modeling process, whereas watershed boundaries are generally drawn at a much finer scale and imply greater precision than this stage of the modeling process delivers.

Warman et al., (2004) conducted analysis on the impact of various sizes of assessment units. Generally the smaller in area the assessment unit, the more spatially explicit the outputs can be. However, small size needs to be balanced against computational constraints and limitations in resolution of data[9].

Assessment units used for similar work were reviewed before determining which units to use in this assessment. The Willamette Valley – Puget Trough – Georgia Basin Ecoregional Assessment team used 750-ha hexes in the reserve selection model SITES, from which very detailed portfolio sites were later derived; this resulted in some presentation and display issues (Floberg *et al*., 2004). The Pacific Northwest Coast Ecoregional Assessment team used USGS HUC 6 watersheds in Washington and Oregon and third order watersheds in British Columbia for both the terrestrial and freshwater analyses; this approach had allowed for easy integration of the terrestrial and freshwater portfolios. The Coast Information Team Ecosystem Spatial Analysis conducted for the British Columbia’s Central and North Coasts

[8] See Appendix 12 for further information
[9] With 9,587 – 500 ha analysis units, initial MARXAN runs (10 runs at 1 million iterations per run) took approximately 10 hours to complete. The final analysis (50 runs at 10 million iterations per run) took 31 hours.

and Haida Gwaii utilized 500-ha hexes; this approach provided easy integration of terrestrial and marine coastal sites (Rumsey et al., 2004).

For the North Cascades terrestrial analysis we chose 500-hectare hexagons, generated by using the ArcView SITES extension, as our assessment unit. This size of assessment unit allowed for the efficient representation of local-scale targets in small functional sites while allowing for aggregation of ecological systems into extensive landscape scale conservation areas (Neely et al., 2001).

Each of the 9,587 units covering the study area was given a unique identifier. Terrestrial assessment units covered the entire ecoregion, any area within 5 km of the ecoregion boundary and all gaps between the buffer of the revised North Cascades Ecoregion boundary and adjacent Ecoregions which have already been assessed.

For the North Cascades freshwater analysis, we chose watersheds as assessment units, in order to represent the connectivity and ecological integrity of freshwater systems. Furthermore the freshwater ecosystem (coarse filer) were already mapped as watersheds. Freshwater assessment units in British Columbia consisted of third order watersheds. Freshwater assessment units for Washington consisted of USGS hydrologic unit code (HUC) watershed boundaries. In the Southern Coastal Streams, Lower Fraser (including Fraser Canyon) and Puget Sound EDUs there were 1,327 assessment units ranging in size from 37 to 149,646 hectares with a mean size of 6,611 hectares. Each assessment unit was assigned a unique identifier.

Assessment Unit Cost - Suitability Index

The MARXAN model seeks to minimize the total cost of the portfolio by selecting the set of hexagons that comprises as many targets as possible, up to some specified representation goal, with the least cost. The "suitability" of an assessment unit for selection is its negative cost. Suitability or negative cost can be quantified in a variety of ways, such as acquisition cost, some combination of acquisition plus management cost, or opportunity cost.

We chose to use primarily human impacts to define the suitability index. Assessment units with lower levels of human impacts should be chosen over those with higher levels of impacts, when other factors are equal. This general rule should lead to selection of areas that are more likely to contain viable examples of species and ecological systems. Furthermore, the automated solution generated by MARXAN is more likely to contain analysis units which have the least potential for conflict with human uses, thereby helping to ensure long-term conservation success.

Generally, human use costs consist of factors such as urban or residential areas, areas of high levels of resource extraction and areas with significant infrastructure development. The assumption is that these areas are likely to have reduced habitat effectiveness for many conservation targets and ecological systems. The specific factors used to represent human impacts are described in greater detail in Appendix 14.

Boundary Cost - Boundary Length Modifier

The boundary cost is the "cost" between two adjacent assessment units. This user-defined value can be a simple measure of the length of the edge between adjacent assessment units or incorporate more complex factors such as the ecological or conservation value of the adjacent assessment units (Munro, 2006). Using edge length as the boundary cost means that a portfolio containing a connected patch of units will have a lower boundary cost than a number of scattered, unconnected units. We calculated the boundary cost as a simple assessment unit edge length (in meters) using an AML provided with SITES software (http://www.biogeog.ucsb.edu/projects/tnc/download.html).

MARXAN then multiplies this value by an arbitrary, user-defined *Boundary Length Modifier* (BLM) constant. The BLM controls the relative importance placed on minimizing the boundary cost of the portfolio. Increasing the BLM number increases the cost of having a fragmented portfolio.

As MARXAN's objective is to minimize costs, the BLM can be used to impact the cohesiveness or "clumpiness" of the automated portfolio. Using a low BLM would result in a solution that satisfies conservation goals for all targets with a minimum of area, but the fragmented nature of the solution provides a limited framework from which to design a connected, network of conservation areas that could be expected to provide the habitat security or effectiveness needed for conservation targets.

Conversely, high BLM values generate highly clumped conservation solutions with fewer, larger areas with low edge to area ratios. Areas selected in such solutions are more likely to meet size and connectivity requirements of conservation targets. However, the high clumping factor will sweep areas into a conservation solution less because of inherent conservation values, and more because of the position or location of assessment units relative to the objective of reducing boundary length. Thus, highly clumped solutions tend to be 'inefficient' from the perspective that more area contains less conservation value than a more fragmented solution. Figure 5 (Loos, 2006) shows the effects of assigning of higher BLM.

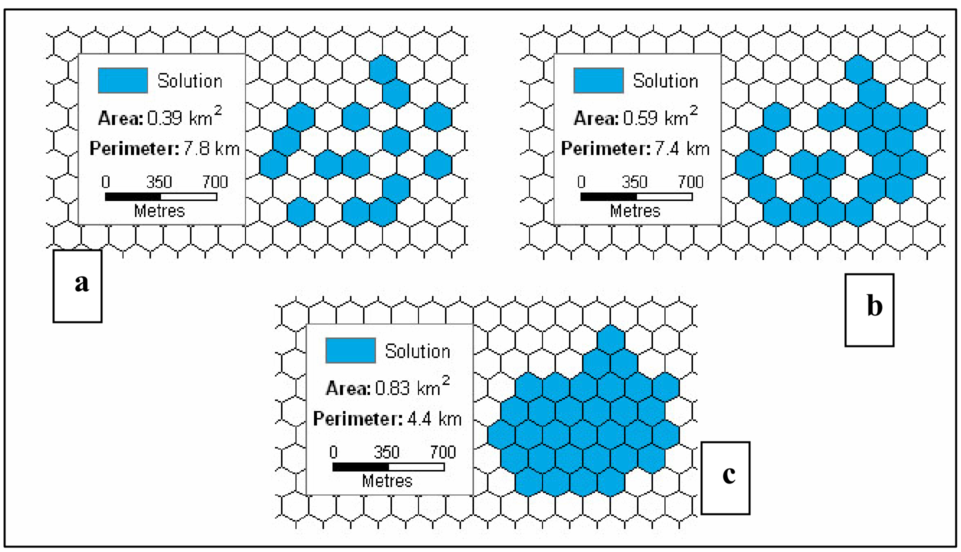

Figure 5. The effects of increasing clustering on solution area and perimeter.

a) Scattered (typical of low BLM). b) Slightly more clustered (typical of medium BLM). The perimeter has decreased, and the area has increased. c) Highly clustered (typical of high BLM). The perimeter has decreased significantly and the area has increased.

There is a point where the area in the automated solution increases dramatically with an increase in the BLM. The 'ideal' BLM is one that decreases boundary length, but does not cause an overly large increase in area (Possingham *et al.*, 2000). In order to explore the balance between efficiency and contiguity, we varied the BLM parameter through a series of trial runs, while maintaining the relative contribution of human use costs. The selected BLM modifier variable (0.0001) was found to provide a balance between the increased regional and system values of high contiguity and the selection of AU representing high values for conservation targets.

Goals

To run the MARXAN algorithm, goals for each of the target species/systems are required. Goals for the representation of various conservation elements (e.g., terrestrial systems, fine filter targets) are user defined and described in Appendix 6.

MARXAN software requires strict enforcement of input file structures to run correctly. This entailed significant effort in applying the spatial data collected by the coarse filter and fine filter teams into the assessment units. See Appendix 12 for a description of assigning the coarse and fine filter data to assessment units.

Species Penalty Factor

MARXAN calculates whether the goal for each conservation feature is met by a portfolio and adds a cost derived from the *Species Penalty Factor* (SPF)[10] for any target whose goal has not been met. The SPF is a multiplicative factor which applies a penalty to the portfolio for not achieving conservation target goals. Setting a high SPF will increase the likelihood that a feature's target will be met (Smith, 2005).

Different penalty values can be established for each conservation feature. The SPF can be set based on how important or desirable a target is or can be set to nudge MARXAN towards selecting assessment units which contain targets whose goal has not been achieved in earlier runs where no SPF was applied. We initially used the same penalty factor (one) for all targets. The assessment team leads reviewed the results of the MARXAN runs and concluded higher SPF were required for targets whose conservation goal was not achieved. Subsequently, we assigned an SPF of two to those targets whose goals were not achieved – with the exception of terrestrial aggregate systems.

Spatial Stratification

To ensure that the analysis units containing conservation targets selected by MARXAN were distributed throughout the ecoregion, goals were set for each target across the ecoregion and across each ecosection in which the target fell. For freshwater targets, goals were set for each EDU in which a target was located.

Clumping (Spatial Aggregation)

Habitat aggregation or clumping is required to promote viability (persistence) of some elements. MARXAN incorporates population and ecological viability factors by letting the user specify the minimum viable clump size for each conservation feature and only

[10] Some literature refers to this term as the conservation feature penalty factor.

counting viable clumps when determining whether the conservation targets have been met. This feature can also be used to set targets for the number of clumps, so that a target for a particular species could be 20,000 ha of habitat made up of at least 3 clumps of a minimum size of 6,000 ha.

Aside from aggregated terrestrial systems we did not include any clumping goals in the MARXAN input. We felt the 500-ha hexagons were already sufficiently large. In practice, the hexagons naturally clump together, given an appropriately applied Boundary Length Modifier.

Repeat Runs

During the initial testing and analysis, for each set of parameters (BLM, cost, goals etc) in the North Cascades ERA we made 10 repeat runs, each comprised of 1 million iterations of assessment unit selection. Each of the 10 runs contained the same scenario (inputs). For the final solutions presented in this report, the application was instructed to undertake 50 repeat runs, with each comprised of 10 million iterations of assessment unit selection. Longer runs (more iterations) are more likely to provide a more optimal solution. The "best" of the 50 runs is presented on Maps 18 and 20, while the summed solution (irreplaceability) is presented on Maps 14 and 16.

Factors Not Employed

Separation Distance

Separation distance is a risk spreading mechanism which can be optionally applied in MARXAN. It assumes that there is a requirement to protect against the dangers of a localised disaster (such as wildfires or disease epidemics) destroying the total reserve holding of the given conservation feature. If set for a conservation feature, a given number of assessment units holding that conservation feature within the solution must be separated by the specified number of assessment units.

While we did not apply a separation factor for any of the targets, we achieved similar results by assigning targets an ecoregion goal as well as a goal for each ecosection that contained the target.

Cost Threshold Penalty (CPF)

The CPF function allows the user to set a maximum total portfolio cost. This means the user can ensure that MARXAN identifies portfolios that are less costly than a specified value, although these portfolios may be less effective at meeting the goals for conservation targets. We did not set any predetermined maximum portfolio costs.

Temperature

The closer you are to the end of a MARXAN run the less likely MARXAN is to accept changes that increase the cost. The cost increase that is acceptable diminishes as the run progresses in what is known as the annealing or cooling schedule. This factor is controlled by the temperature decreases. For the North Cascades ERA this value was set at 10,000 based on input from the assessment team.

Selecting the Initial System

MARXAN allows users to start with a random reserve selection or to lock in or exclude certain assessment units, such as those which fall within protected areas. The assessment team chose to start with a random selection of assessment units.

Limitations

MARXAN was developed for marine reserve design rather than terrestrial. Meir et al. (2004) suggests that private land ownership and irreversible habitat change are more common factors on land than in the ocean. When terrestrial sites targeted for protection are privately owned, it takes time for the government to procure them for the network; conversely, any delays in designation increase the likelihood those habitats will experience irreversible change. As a result, computer-generated plans for terrestrial networks can fall out of date rapidly, even within a year, due to changes in habitat. The resulting networks, if still based on the original plan, are less than optimal.

Due to the complexity of MARXAN, a lack of documentation, and the amount of work involved, it was not possible to experiment with many of the settings described above.

Experimentation could be conducted on the size of the automated reserve system by first locking in all protected areas and then building out a reserve system.

More work on setting defensible criteria for selecting the optimum BLM should be considered. Possingham et al. (2000) suggest one possible method. As shown in Figure 6, as the boundary length modifier is increased, both the boundary length and boundary length/area measures decrease. This occurs at the expense of increased total portfolio area. In the example below the best balance between total area and clustering seems to be achieved with a boundary length modifier between 0.5 and 1. Here the area is increasing, but the boundary length is decreasing at a greater rate.

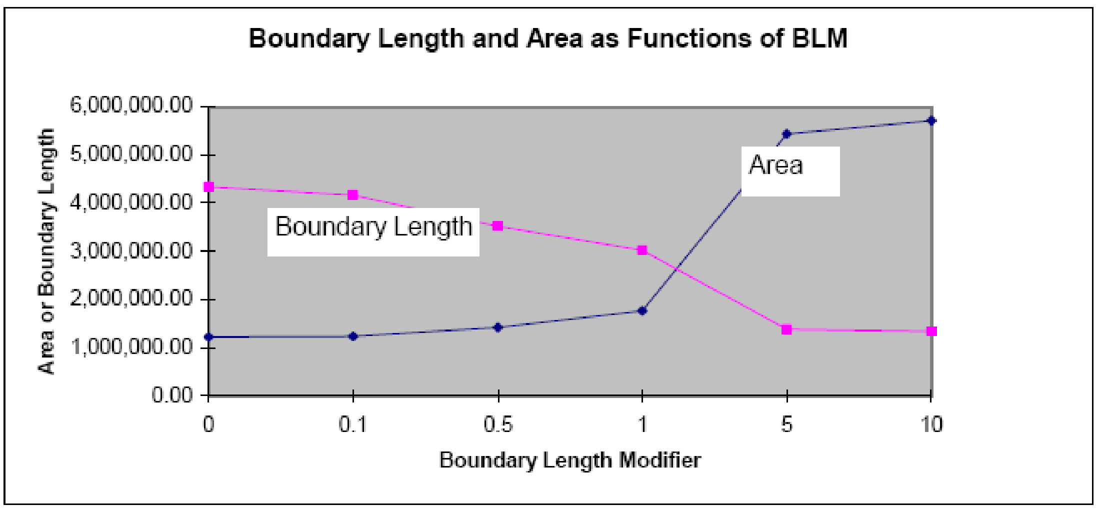

Figure 6. Boundary length versus area (from Possingham et al.**, 2000).**

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Z. Ferdana, March 30, 2006
J. Ardron, March 29, 2006
S. Farone, Sept 4, 2004

APPENDIX 9 – TERRESTRIAL AND FRESHWATER METHODOLOGY

Appendix 9 – Terrestrial And Freshwater Methodology

1.0 Introduction

The North Cascades and Pacific Ranges Ecoregional Assessment (ERA) was undertaken in order to identify a network of priority areas for biodiversity conservation, by creating a spatially explicit assessment of where the ecoregion's biodiversity values are located and what condition they are in. The ERA integrated two basic approaches to conservation planning often referred to as "coarse-filter" and "fine-filter" methodologies:

- "Coarse-filter" approaches seek to ensure representation of the biological features in the ecoregion and the range of environmental conditions under which they occur. Conserving representative samples of communities is seen as an efficient way to maintain high levels of species diversity. Coarse-filter strategies focus on higher levels of biological organization in part due to the realization that the "biodiversity crisis" cannot be stemmed with a species by species approach (Hunter, Jr. et al. 1988)

- "Fine-filter" approaches seek to protect concentrations of ecological communities; rare or at-risk ecological communities; rare physical habitats; concentrations of species; locations of at-risk species; locations of highly valued species or their habitats; locations of major genetic variants. These are species, communities, and habitats that may pass through the screen of the coarse- filter and therefore require special attention.

Each of these approaches arrives at different sets of conservation priorities. The data utilized for the two approaches varies greatly in type, spatial scale and resolution, and completeness. The ERA process utilizes and integrates a large amount of detailed information. It requires location-specific information for conservation targets as well as the past, current, and potential future status of lands and waters where they occur. Our team used the best available information for this assessment but recognizes that new and more comprehensive data will continually become available. Therefore, the ERA should be regarded as a living document and an initial step in an iterative and dynamic assessment process. Additionally, an effective ERA process is always cognizant of moving the planning process towards implementation from the beginning (Groves 2003).

Our rationale in applying a diversity of approaches to the conservation planning process is that it spreads the risk of failure of any single approach and potentially achieves a more comprehensive set of goals (Lindenmayer et al. 2002; Noss et al. 2002; Rumsey et al. 2004). The coarse-filter/fine-filter approach seeks to incorporate resiliency and redundancy into the network of conservation areas. The conservation targets that occur within the priority conservation areas should be resilient to natural and human-caused disturbances. Resiliency incorporates the concepts of population viability and ecological integrity. This implies that the conservation targets (e.g., species, communities, and ecosystems) chosen in the portfolio are of sufficient quality to persist for a long period of time. In creating the portfolio, we are also seeking to incorporate redundancy in the selection of priority conservation areas by representing conservation targets multiple times within the network of conservation areas. The idea behind incorporating redundancy into the portfolio is to avoid extinction or endangerment of the conservation targets caused by natural disasters and human related impacts (Groves 2003).

To undertake this ecoregional assessment, the two approaches were applied to terrestrial and freshwater environments using the following process (Groves et al. 2000; Groves 2003; Groves et al. 2002):

1. Select conservation targets (e.g., fine-filter "special elements" and coarse-filter ecological systems) that are used to characterize the biodiversity values within the ecoregion. These targets are essentially surrogates for overall biodiversity, which cannot be measured in its entirety.

2. Collect data for special element occurrences and create ecosystem classifications that are used to map the distribution of targets within the ecoregion.

3. Using available data, assess the potential viability of targets, assess existing conservation areas for their biodiversity values, and map human impacts in the ecoregion.

4. Set conservation goals to serve as benchmarks for identifying conservation priorities and as initial hypotheses about the level of effort and land allocation required to conserve biodiversity.

5. Integrate information for special elements and ecosystem representation in freshwater and terrestrial environments to create a spatially explicit assessment of conservation values for the ecoregion.

6. From that assessment, use goals and viability measures to develop options for creating a portfolio of conservation areas that will effectively conserve the region's biodiversity in the long term.

This information is then used to create a conservation solution or "portfolio" of landscapes and watersheds, which when taken together and managed appropriately, allowing species to move and survive environmental changes, could ensure the long-term survival of the ecoregion's biodiversity (Hunter, Jr. et al. 1988).

2.0 Terrestrial Methodology

Terrestrial Coarse-filter

The coarse-filter analysis is intended to identify and protect high-quality examples of all ecosystems in the ecoregion across their natural range of variation along environmental gradients (Groves 2003; Hunter, Jr. et al. 1988; Noss 1987). One of the strongest arguments for the representation strategy is that it is likely to capture species, genes, communities, and other elements of biodiversity that are poorly known or surveyed. For example, there is rarely comprehensive distribution information for bacteria, fungi, bryophytes, and many invertebrate groups. The coarse-filter in effect serves as a buffer for our lack of knowledge and information about biogeography (Hunter, Jr 1991).

Given that species distributions are determined largely by environmental factors, such as climate and substrate, and that vegetation and other species assemblages respond to gradients of these factors across the landscape, protecting examples of all types of vegetation or physical environmental classes is thought to capture the vast majority of species without having to consider those taxa individually (Noss and Cooperrider 1994). It has been estimated that 85-90% of all species can be protected by the coarse-filter (Groves 2003; Hunter, Jr. et al. 1988; Noss 1987). In regions with relatively low endemism, the coarse-filter is predicted to perform better than in regions with high endemism, where species populations are highly localized (Noss and Cooperrider 1994; Rumsey et al. 2004).

Terrestrial systems

A terrestrial ecological system is defined as a group of plant community types (associations) that tend to co-occur within landscapes with similar ecological processes, substrates, and/or environmental gradients (Comer et al. 2003; O'Neill 2001). Ecological processes include natural disturbances such as fire and flooding. Substrates may include a variety of soil surface and bedrock features, such as shallow soils, alkaline parent materials, sandy/gravelling soils, or peatlands (as described and classified by NRCS 1998). Finally, environmental gradients include local climates, hydrologically defined patterns in coastal zones, arid grassland or desert areas, or montane, alpine or subalpine zones (e.g. Bailey 1995, 1998; Takhtajan 1986).

A given terrestrial ecological system will typically occur on a landscape at intermediate geographic scales of 10s to 1,000s of hectares and persist for 50 or more years. Selecting this temporal scale shares some aspects with the "habitat type" approach to describe potential vegetation (Daubenmire 1952; Pfister and Arno 1980), but differs in that no "climax" vegetation is implied, and all seral components are explicitly included in the systems concept. Ecological system units are intended to provide "meso-scale" classification units for applications to resource management and conservation (Walter 1985). They may serve as practical units on their own or in combination with classification units defined at different spatial scales.

Upland and wetland ecological system units are defined to emphasize the natural or semi-natural portions of the landscape. Areas with very little natural vegetation, such as agricultural row crops and urban landscapes, are excluded from ecological systems. The temporal scale or bounds chosen also integrate successional dynamics into the concept of each unit. The spatial characteristics of ecological systems vary on the ground, but all fall into several recognizable and repeatable categories. With these temporal and spatial scales bounding the concept of ecological systems, we may then integrate multiple ecological factors – or *diagnostic classifiers* - to define each classification unit, not unlike the approach of Di Gregorio and Jansen (2000).

Multiple environmental factors are evaluated and combined in different ways to explain the spatial occurrence of vegetation associations. Continental-scale climate as well as broad patterns in phytogeography, are reflected in ecological division units that spatially frame the classification at subcontinental scales (e.g. Bailey 1998; Takhtajan 1986). We integrated bioclimatic categories to consistently characterize life zone concepts (e.g. maritime, lowland, montane, subalpine, alpine). Within the context of biogeographic and bioclimatic factors, ecological composition, structure, and function are strongly influenced by factors determined by local physiography, landform, and surface substrate. Some environmental variables are described through existing, standard classifications (e.g. soil and hydrogeomorphology) and serve as excellent diagnostic classifiers for ecological systems (NRCS, 1998; Cowardin et al., 1979; Brinson, 1993). Many dynamic processes are also sufficiently understood and described to serve as diagnostic classifiers (Anderson et al. 1999). The recurrent juxtaposition of recognizable vegetation communities provides an additional criterion for multi-factor classification (Austin and Heyligers 1989).

Ecological classification ideally proceeds through several phases, including qualitative description, quantitative data gathering, analysis, and field-testing. Our approach presented here is qualitative and rule-based, setting the stage for subsequent quantitative work. We relied on available interpretations of vegetation and ecosystem patterns across the study area and we reviewed associations of the International Vegetation Classification/National Vegetation Classification (IVC/NVC) in order to help define the limits of systems concepts (NatureServe, 2005). In recent years, how well a systems approach could facilitate mapping of ecological patterns at intermediate-scales across the landscape has also been tested (Marshall et al. 2000; Moore et al. 2001; Hall et al. 2001; Nachlinger et al. 2001; Neely et al. 2001; Menard and Lauver 2002; Tuhy et al, 2002; Comer et al. 2002).

Methods

The terrestrial systems technical team goal was to provide a framework that assessed and captured the terrestrial biodiversity of the North Cascades and Pacific Ranges Ecoregion at the coarsest scales of the assessment. To accomplish that goal, the terrestrial team developed: 1) a list of and definitions of fine-filter, rare plant associations, and coarse-filter, ecological systems - targets of the ecoregion, 2) spatial representations of the targets, 3) statement of limitations, confidence levels and uncertainties in the representation of coarse-filter and fine-filter targets, and 4) how conservation goals are defined given this context.

- **Develop target lists**

The technical team developed target lists for plant associations and ecological systems.

Plant Associations

The technical team mapped 17 terrestrial and wetland plant associations as conservation targets based on element occurrence information maintained by the BC CDC and the WNHP. The CDC and WNHP records were reviewed and revised by Matt Fairbarns (Aruncus Consulting) and Chris Chappell (WNHP). Records that were considered to be too old or erroneous were eliminated.

Available information on the known occurrences of individual plant communities and ecological systems varied considerably in quantity and quality both among associations and ecological systems and across jurisdictions. The best available data were compiled from a number of sources. Data sources are listed in Appendix 4.

Known locations of rare natural communities, also known technically as plant association occurrence data, were obtained from the WNHP and BC CDC databases. Very few occurrences were documented. This is because data collection has tended to focus on rare plant and animal species rather than on plant associations. The classification, survey, mapping, delineation and documentation of individual stands of rare and of-concern plant associations are relatively new to science and conservation biologists. Many more stands are known to occur on the landscape than are documented in conservation databases. Nonetheless, these limited datasets were used to capture small scale and rare natural communities rather than depending solely on the results of the coarse-filter analysis to represent them.

Ecological Systems

By using the NatureServe Ecological System Classification (Comer et al. 2003), ecologists from WNHP and NatureServe developed a list of 29 ecological systems that occur in the

North Cascades ecoregion and its buffer area. Appendix 11 contains descriptions for the 29 ecological systems, and includes ecological attributes, concept summaries and component plant associations.

Due to a lack of available spatial data the set of mapped targets was reduced to 14 matrix-forming, large patch, small patch and linear systems. The technical team developed a GIS model to map these 14 system targets, as described in Section 3.1.1.4 and in Appendix 9 and illustrated in Map 7.

- **Spatial representations of the targets**

Five GIS maps were developed to represent vegetation diversity across the ecoregion. Information on methods and data sources used to create these layers is presented in Sections 3.1.1.4 to 3.1.1.9. The following layers were developed:

- <u>Vegetation Map of Ecological Systems:</u> An ecoregion-wide map of ecological systems was created by combining several existing vegetative coverages. Fourteen of the 29 ecological systems known to occur in the ecoregion could be mapped on an ecoregion-wide scale. Some map units were a combination of small patch systems (for example, montane shrubland and alpine systems). Areas which had no vegetation coverage were filled in with coarser data, and agriculture and urban areas were mapped as such.

- <u>Riparian Areas Map:</u> Ecoregional data for small scale wetlands (bogs, fens, riparian areas) were lacking, so a coverage was created by modeling riparian areas.

- <u>Stratified Matrix-Forming Ecological Systems:</u> To represent topographic variation within one system, finer scale Ecological Land Units were modeled so more detailed variation within any one ecological system could be captured (e.g., north vs. south facing slopes). Refer to Appendix 9.1 for details of this modeling process.

- <u>Old-growth Forest Map:</u> Remaining old-growth areas, regardless of which ecological system they belonged to, were also mapped. This information was overlaid on the map of ecological systems and these forests were specifically targeted for inclusion in the portfolio.

- <u>Minimum Dynamic Areas:</u> Lower elevation forests and upper montane forests were combined into two aggregated units to be able to select entire and adjoining watersheds to meet a need for large, landscape-scale preserves that are at least 30,000 ha in size. This minimum dynamic area is the threshold size required to sustain a natural or near natural fire regime in the future.

The geographic distributions of 14 upland systems were modeled as intersecting combinations of climate zone and existing vegetation. After cross-tabulating maps of climate zone and existing vegetation type, the technical team assigned each possible combination to an ecological system map unit, resulting in a tabular decision matrix that was translated into a GIS map. The GIS decision matrix and map were then subjected to several iterations of review and revision by experts in BC and WA. The GIS decision matrix is shown in Appendices 9.1.3., 9.1.4., and 9.1.5.

Available source data varied considerably between BC and WA. In BC, climatic setting was represented by Biogeoclimatic Ecosystem Classification (BEC); existing vegetation was represented by the Broad Ecosystem Inventory (BEI). Together these are known as Broad

Ecosystem Units (BEU). In WA, climatic setting was represented by Shining Mountains vegetation zones; existing vegetation was represented by a vegetation map developed for the North Cascades Grizzly Bear Ecosystem Evaluation (NCGBE) and by the National Land Cover Dataset (NLCD). In order to accommodate the difference in spatial scale between the BC BEU data and the WA land cover data, both the NCGBE and NLCD were re-sampled with a 50 ha moving window to better approximate the 50 ha minimum mapping unit of the polygonal BEU data. Refer to Appendix 4 for details of the data sources.

Several additional datasets from WA were incorporated to make the following adjustments:

- the two North Pacific Douglas Fir-Western Hemlock Forest systems were divided between the Dry-Mesic and the Mesic-Wet according to Plant Association Groups (PAGs) (Henderson 2001);

- the two North Pacific Western Hemlock-Silver Fir Forest systems were distinguished as the Dry-Mesic and the Mesic according to orographic zones[11] delineated on a map from Henderson (1992, page 10); and,

- an occurrence of East Cascades Mesic Montane Mixed-Conifer Forest and Woodland in the Ross Lake Valley was manually delineated.

Finally, to remove degraded or recently converted occurrences of these upland systems, several ancillary GIS sets, specifically Baseline Thematic Mapping (BTM) in BC and the National Land Cover Dataset (NLCD) and Land Use and Land Cover dataset (LULC) in WA, were compiled to identify areas that had been recently logged or converted to urban or agricultural land use. Any system occurrences that coincided with the recently logged, urban or agricultural areas were re-assigned as such.

Alpine and Montane Composite Targets

Mapping the seven defined non-forest systems, listed below, presented a unique challenge for two reasons. First, vegetation maps derived from satellite imagery, which were used to map systems in WA, generally are not accurate in distinguishing these large-patch and small-patch occurrences from recent timber harvests. This is because the spectral signature of early-seral vegetation is similar to that of native assemblages such as herbaceous balds and bluffs, montane shrublands and grasslands, montane dry tundra and avalanche chutes. Second, BEU, the GIS dataset of existing vegetation types in BC, follows a thematic classification of non-forest vegetation types that does not match the corresponding GIS dataset in WA. Therefore, it was not possible to map these individual ecological systems accurately and consistently across the international border. Instead, two new map units were defined that would represent composites of the alpine vegetated systems and the montane non-forested vegetated systems, as shown below. These two composite map units function as terrestrial coarse-filter targets in the automated site selection.

Riparian Ecological Systems

To map riparian systems, riparian areas were initially delineated with a GIS model according to flow accumulation and local topography. Next, this preliminary delineation was edited based on photo-interpretation of GeoCover satellite imagery. Lakes and land

[11] Related to, or caused by, physical geography (such as mountains or sloping terrain).

currently under agriculture or urban land use were removed, according to land use/land cover as represented by the BTM, NLCD and LULC. Finally, the remaining riparian areas were assigned to a lowland or montane riparian ecological systems based on climatic zones represented by the Shining Mountains vegetation zones.

Stratifying Matrix-forming Systems (Ecological Land Units)

Of the 14 upland ecological systems mapped, 5 matrix-forming systems covered most of the mapped area. They spanned broad physical gradients and thereby encompassed significant ecological and genetic variability. To represent this variability, a cluster analysis was done to classify the landscape using four topographic indices that are known to correspond to vegetation patterns and that are readily mapped from a digital elevation model (DEM). The resulting clusters identified map units that function to stratify the matrix-forming systems and thereby influence the automated selection of potential conservation areas. The four topographic indices are topographic position measured by a moving window of 300 m radius; topographic position measured by a moving window of 2,000 m radius; an index of annual clear-sky insolation (SolarFlux) (Rich et al. 1995); and slope.

In each of the four ecoregional sub-sections, the landscape was classified into nine abiotic units or landforms. This produced 36 abiotic map units ecoregion-wide that were used to stratify matrix-forming systems in the coarse-filter analysis. By stratifying the large area of matrix-forming ecological systems the spectrum of diversity found on all landforms could be captured.

Old-growth Forest

The historical extent of old-growth forest has been significantly diminished in the ecoregion. Because old-growth forest provides critical habitat for a number of declining native species, it was treated as a specific coarse-filter target. To accomplish this, a GIS delineation of existing late-seral forest stands was developed. In BC, the delineation was based on stand-level age attributes specified by forest cover (TEM 1997). In WA, the delineation was based on basal diameter (quadratic mean diameter [QMD]) specified by the Interagency Vegetation Mapping Project (IVMP 2002).

Minimum Dynamic Area (MDA)

The terrestrial systems team conducted a literature review to determine the minimum dynamic area (MDA) terrestrial systems historically required to ensure survival or re-colonization of the ecological system following a natural disturbance that removes most or all individuals. This is determined by the ability of some number of individuals or patches to survive, and the size and severity of stochastic events (Pickett and Thompson 1978). MDAs were used to determine the minimum patch size of each terrestrial system to be captured by the MARXAN site selection algorithm. These goals were later adjusted by the team based on how the algorithm performed in meeting the goals when capturing terrestrial systems. In areas with at least 30,000 ha of continuous forest, mapped ecological systems were generalized into lower elevation forests and higher elevation forests, and a goal of 30% of each of these aggregated systems was set. Refer to Appendix 1- Glossary for further explanation of the MDA concept.

- **Goals for coarse-filter targets**

MARXAN requires that goals be set for conservation targets. Ideally, the setting of these goals is an attempt to capture ecological and genomic variation across the ecoregion and to ensure species persistence by including a number of viable populations, all of which reduces the risk of extirpation. As yet, there is no scientific consensus about how much of an ecological system or an area of habitat is needed to maintain most species within an ecoregion (Soule and Sanjayan 1998).

Conservation goals are established for ecological systems at the ecoregion level and for each ecological section. This is to ensure that targets are represented across their natural distribution in the ecoregion so that the natural diversity of each ecological system is expressed. For ecological systems with small patch distributions and for rare communities considered as conservation targets, goals were established as numbers of occurrences to be represented within the portfolio. The number of occurrences varied for systems and communities depending on their distribution relative to the ecoregion, with distribution being classified as Endemic, Peripheral, Limited, or Widespread:

- ***Endemic:*** ≥ 90% of the species' global distribution falls within the ecoregion
- ***Peripheral:*** < 10% of the species' global distribution falls within the ecoregion
- ***Limited:*** the species' distribution is limited to 2–3 ecoregions
- ***Widespread:*** the species' global distribution falls within > 3 ecoregions

All small patch ecological systems goals were set at 3 occurrences per ecological section. Most of the large patch and matrix systems goals remained at 30% except for those systems that were deemed to be peripheral to the ecoregion or were well represented in large protected areas (such as North Pacific Mountain Hemlock Forest). Goals for ecological systems in the North Cascades ecoregion are listed in Appendices 5 and 6.

2.1 GIS Delineation of Riparian Areas

While riparian habitat has high biodiversity value and is highly threatened, ecoregional assessments in the US have typically not included riparian ecological systems as terrestrial coarse-filter targets. This is because regional maps of riparian areas often do not exist or are inadequate, and manual delineation via photo-interpretation is laborious and costly. The semi-automated method described here enables the GIS analyst to map riparian areas consistently and quickly across large areas using GIS data that is widely available.

The GIS algorithm is designed to identify areas that are (1) influenced by fluvial processes (transport and deposition of alluvial materials and soils), (2) periodically inundated during floods, and (3) likely to exhibit hydrologic conditions that are the principal controls of spatial pattern of riparian vegetation.

The method consists of two steps. The first step, which is largely automated and scripted in AML, derives an initial riparian delineation from a digital elevation model (DEM). In the second step, the user edits the initial riparian delineation to remove lakes, agricultural fields, urban areas and artifacts.

The accuracy of the result is limited by the horizontal and vertical resolution of the DEM and by the topography of the study area. Like most DEM-derived flow models, the GIS algorithm functions best in areas of varied terrain. In areas of low relief, such as coastal plains and large river deltas, the model output will require some manual editing in the form of heads-up digitizing based on aerial photos or satellite imagery.

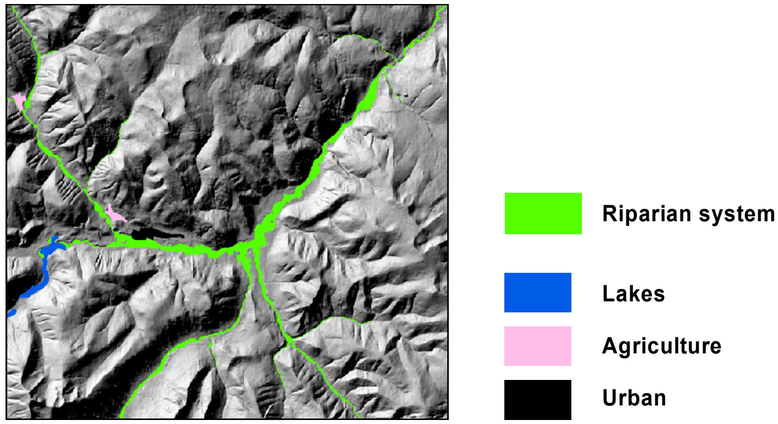

Figure 7. Sample result of automated delineation.

A. Background

This method was developed and applied in the Okanagan and North Cascades ecoregions to map riparian ecological systems, as defined by NatureServe, at the ecoregional level and at a relatively coarse geographic scale. The DEM-derived component has been tested at several DEM resolutions, from 25m to 90m cell size. We found that resolutions as coarse as 90m can yield useful results.

As it is currently written, the AML script calculates model parameters based on the DEM resolution and the desired minimum catchment size, as specified by the user. The recommended default minimum catchment size of 20km^2 was appropriate for the characteristic topography and DEM resolution available in the Okanagan and North Cascades ecoregions. For best results, it may help to compare the results generated using a variety of minimum catchment area values.

This minimum catchment size may be thought of as the minimum area necessary to provide flow accumulation that will produce alluvial deposition at low stream gradients. The choice of minimum catchment size value will profoundly affect the modeled distribution of stream lines and associated riparian areas. A higher value will result in a more sparse pattern of stream lines, restricted to higher flow accumulation, that may exclude smaller riparian areas higher in the stream network. A lower value will result in a more dense, dendritic pattern of stream lines that may over-represent smaller, upstream riparian areas.

B. Requirements

Data:

- Digital Elevation Model (DEM), projected and with units in meters - the initial delineation is derived from the DEM via a flow model.

- Imagery - for reviewing results. NASA Geocover imagery is useful and widely available (https://zulu.ssc.nasa.gov/mrsid/mrsid.pl)
- Landcover data – optional but very useful for removing lakes, agriculture and urban areas.
- DEM-derived hillshade grid – for reviewing results. Can be created with Spatial Analyst in ArcView or ArcGIS.

Software:

- ArcINFO workstation, v 7.x or later, to run the two AML scripts.
- ArcView 3.x, ArcView 8.x, ArcGIS 8.x or 9.x to view and edit the initial delineation.

Hardware:

Disk space depends on the extent of the study area and the resolution of the DEM. When applied to a 25m DEM of a 50,000 km2 ecoregion, 2-3 GB of disk space were required to accommodate the intermediate grids. The same process run using a 90m DEM might require only 500MB.

The GIS algorithm is demanding in terms of processing, so a fast CPU is recommended.

C. Method Outline

Functional AML commands shown in blue.

REM statements also contained in the AML script are shown in *green italics*.

C.1. dataprep.aml generates the filled DEM and flow accumulation grid.

To begin, copy the two AML files and a DEM grid of the study area into a single directory. The DEM grid must be projected and the units must be in meters. Run dataprep.aml (Arc: &r dataprep.aml). When prompted, enter the name of the input DEM grid. This will generate a filled DEM (FILL1), calculate a flowaccumulation grid (FACC1i) and calculate a slope grid (SLOPEi). These grids only need to be generated once, and will serve as the input data for the automated delineation in ripmethod.aml.

If your study area is large and your DEM cell size is less than 60m, this routine may take several hours to finish and tie up your CPU, so you may wish to start this process at the end of the day and let it run overnight.

```
/* USAGE: &r dataprep.aml
/* INPUT: projected DEM, units in meters
/* OUTPUT: FILL1, FACC1i, SLOPEi

&sv dem = [response 'Enter name of the input DEM grid']

/* fill sinks, derive flow accumulation and slope
```

```
grid

FILL %dem% fill1 SINK # fdir1
facc1 = FLOWACCUMULATION(fdir1)
/* to save space and time, converts floating point facc1 grid to integer
facc1i = INT(facc1 + 0.5)
&if [exists facc1i -grid] eq .TRUE. &then &do
kill facc1 all
&end
&else &do
&type ERROR – facc1i not created
&end

/* derive slope; this will be used by the cost function
slope = SLOPE(FILL1)
/* to save space and time, converts floating point slope grid to integer
SLOPEi = Int((slope) + 0.5)
&if [exists SLOPEi -grid] eq .TRUE. &then &do
kill slope all
&end
&else &do
&type SLOPEi not created
&end

quit
```

C.2. ripmodel.aml generates the initial automated delineation of riparian areas

Run ripmodel.aml in the same workspace (Arc: &r ripmodel.aml). When prompted, enter the desired minimum catchment size (see discussion in the section A). This routine should take less time that dataprep.aml, but may still require several hours to finish and tie up your CPU. The final results are a grid (rip2c_20) and a polygon coverage (rip2c_20ply) that represent the initial automated riparian delineation.

To test alternate parameter values, particularly the minimum catchment size, copy FILL1, FACC1i, SLOPEi and ripmodel.aml into a new directory and run the routine using a different minimum catchment size. It is also possible to adjust other parameters within the body of the AML script, such as the cost surface factors or the elevation difference used to identify the riparian zone. Note that the names of the output grids include the minimum catchment size value.

```
/* USAGE: &r ripmodel.aml
/* INPUT: FILL1, FACC1i, SLOPEi
/* OUTPUT: rip2c, rip2c_poly and other grids produced by intermediate steps

&if [exists FILL1 -grid] eq .FALSE. &then &do
&type ERROR – FILL1 does not exist.
&goto exit
&end
```

```
&if [exists FACC1i -grid] eq .FALSE. &then &do
&type ERROR – FACC1i does not exist.
&goto exit
&end
&if [exists SLOPEi -grid] eq .FALSE. &then &do
&type ERROR – SLOPEi does not exist.
&goto exit
&end

/* Get cellsize from DEM
&sv catch = [response 'Enter minimum catchement size in square km (enter 20 as default) ']
&describe FILL1
&sv demres = %GRD$DX%

/* re-classify flow accumulation to create grid of stream reaches
/* facc threshold calculated from DEM resolution and catchement size
&sv facccut =  ( %catch% / ( %demres% * %demres% ) ) * 1000000

grid

strmgrd%catch% = setnull(facc1i < %facccut%, 1)

/* assigns elevation values to the stream grid
setmask strmgrd%catch%
strmelv%catch% = fill1
setmask off
```

COSTBACKLINK function: for every cell within the max search distance, finds the least cost path to the stream (i.e. the shortest and least-steep path), and assigns the elevation of that closest stream cell. This makes it possible to calculate, for every cell, the difference b/w its elevation and the elevation of the nearest point in the stream.

Usage: COSTBACKLINK(<source_grid>, <cost_grid>, #, {o_allocate_grid}, {max-distance}, #)

o_allocate_grid: as used here, this assigns the elevation of the least-cost-distance (closest) stream cell.

max-distance: used here to reduce processing time, the max-distance value limits the distance from the stream within which the algorithm will measure distance.

```
/*** COSTBACKLLINK using linear distance

/* creates a grid for which all cell values = 1
setcell FILL1
setwindow FILL1
setmask FILL1
mask = 1
```

```
setmask off

/* max cost distance of 2000 meters
cb_lin%catch% = COSTBACKLINK(strmelv%catch%, mask, #, al_lin%catch%, 2000, #)

/* calculate change in elevation relative to closest stream cell
ch_lin%catch% = fill1 - al_lin%catch%

/* classify elevation difference to delineate riparian zone
rip1_%catch% = CON(ch_lin%catch% <= 3, 1, -99)

/** focal majority filter to remove single-cell-width artifacts
rip1sn = CON(ISNULL(rip1_%catch%), -99, rip1_%catch%)
rip1_fm1 = FOCALMAJORITY(rip1sn, CIRCLE, 1, DATA)
rip1_fm2 = FOCALMAJORITY(rip1_fm1, CIRCLE, 1, DATA)
rip1_fm3 = FOCALMAJORITY(rip1_fm2, CIRCLE, 1, DATA)
rip2lin%catch% = SETNULL(rip1_fm3 == -99, rip1_fm3)
/* removes intermediate steps to save disk space
&if [exists rip2lin%catch% -grid] eq .TRUE. &then &do
kill (! rip1sn rip1_fm1 rip1_fm2 rip1_fm3 !) all
&end
&else &do
&type ERROR - rip2lin%catch% not created
&end

/*** COSTBACKLLINK using slope-weighted distance

/* max cost distance of 1000 x accumulated slope values
cb_slp%catch% = COSTBACKLINK(strmelv%catch%, slopei, #, al_slp%catch%, 1000, #)
/* calculate change in elevation relative to closest stream cell
ch_slp%catch% = fill1 - al_slp%catch%
/* classify elevation difference to delineate riparian zone
rip1slp%catch% = CON(ch_slp%catch% <= 3, 1, -99)
/** focal majority filter to remove single-cell-width artifacts
rip1slp_sn = CON(ISNULL(rip1slp%catch%), -99, rip1slp%catch%)
rip1slp_fm1 = FOCALMAJORITY(rip1slp_sn, CIRCLE, 1, DATA)
rip1slp_fm2 = FOCALMAJORITY(rip1slp_fm1, CIRCLE, 1, DATA)
rip1slp_fm3 = FOCALMAJORITY(rip1slp_fm2, CIRCLE, 1, DATA)
rip2slp%catch% = SETNULL(rip1slp_fm3 == -99, rip1slp_fm3)
/* removes intermediate steps to save disk space
&if [exists rip2slp%catch% -grid] eq .TRUE. &then &do
kill (!rip1slp_sn rip1slp_fm1 rip1slp_fm2 rip1slp_fm3 !) all
&end
&else &do
&type ERROR - rip2slp%catch% not created
&end

/* isolates only areas identified by both distance routines.
/* this removes artifacts unique to each distance measurement.
setmask rip2lin%catch%
rip2c_%catch% = rip2slp%catch%
```

quit

/* converts grid output to polygon, to allow manual editing
GRIDPOLY rip2c_%catch% rip2c_%catch%ply #

Cleanup: Once you're satisfied with the automated delineation represented by the grid (rip2c_##) and polygon coverage (rip2c_##ply), you can delete the other grids produced by intermediate steps in this routine.

C.3. Post-processing to remove artifacts, lakes, agriculture and urban areas

The automated delineation will include lakes and, depending on the study area, will also include areas that have been converted to agriculture and urban land use. Lakes, agriculture and urban areas can be removed using landcover data. The automated delineation will also include artifacts, or "mistakes," especially in areas of low topographic relief. These can be edited manually using aerial photos or satellite imagery such as the NASA Geocover. A useful rule of thumb for this manual editing is to choose and maintain a single on-screen map scale, to ensure that the edits are applied at a consistent scale across the study area.

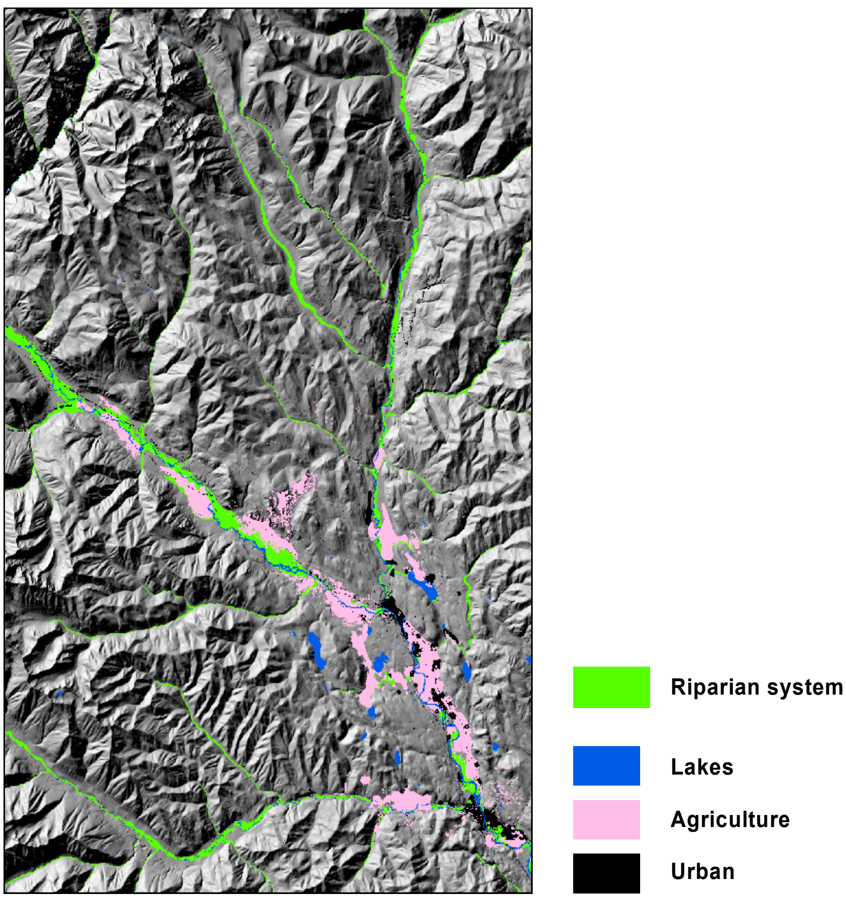

Figure 8. Sample result of automated delineation.

This illustrates the effect of removing agricultural fields, lakes, and urban areas.

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2.2 Classifying and Mapping Landforms via Cluster Analysis

This document describes a fast, flexible method for classifying and mapping landforms through a cluster analysis of four topographic factors that are known to correspond to vegetation patterns and that are readily mapped from a digital elevation model (DEM). The four factors are:

a. Topographic position, relative to a 300 meter-radius circular neighborhood

b. Topographic position, relative to a 2,000 meter-radius circular neighborhood

c. Solar Flux, an index of clear-sky insolation

d. Slope

In ecoregional assessments, the suite of terrestrial coarse-filter targets typically includes several matrix-forming ecological systems that each cover a large total area, spanning broad physical gradients and thereby encompassing significant ecological and genetic variability. The method described here was developed for two Ecoregional Assessments, of the North Cascades and the Okanagan Ecoregions, as a means of spatially stratifying the matrix-forming systems, thereby describing the range of topographic settings occupied by each. As such, the topographic units serve as proxies for variation in the physical environment that influences genotypic and floristic diversity. Several empirical studies of the relationship between abiotic conditions and biotic composition include Burnett et al. (1998), Nichols et al. (1998), and Kintsch and Urban (2002). To read more regarding the coarse-filter strategy, see Hunter (1991), and its role in Ecoregional Assessment, see Groves (2003).

This technique of classifying and mapping landforms is intended to function as one component of an established method for classifying the abiotic environment into Ecological Land Units (ELUs), originally developed by Anderson et al. (1998). ELUs are mapped as unique, user-defined combinations of elevation zones, geology or soil types, and landforms (defined as unique combinations of topographic position, aspect classes, and slope classes). In the Okangan ERA, the spatial stratification to define targets for site selection follows a method developed and applied for several Ecoregional Assessments in the Western US, wherein matrix-forming systems were stratified by ELUs.

When compared with user-defined landform classifications based on GIS rules established a priori, this method has several advantages and several limitations. Because this method requires no assumptions or empirical measurements regarding vegetation response to topographic gradients, results may be generated quickly. The full routine, including the cluster analysis, runs entirely in ARC/INFO GRID. The method is flexible in that the user specifies the number of map units based on the practical needs of the analysis. Because the clustering is driven by the terrain of the study area and the characteristic interaction of the four topographic indices, each study area will produce a characteristic landform classification.

Conversely, two limitations of this method are that it does not allow inclusion of expert knowledge regarding vegetation response to specific topographic thresholds, and does not allow the inclusion of categorical data, such as surficial geology or elevation zones, in the cluster analysis. By combining the mapped landforms with maps of soils or elevation zones, the user can further describe the abiotic template of the study area.

A. OVERVIEW

Both ecoregions, and the Okanagan in particular, are highly transitional, climatically and biogeographically. In order to map the characteristic ecological systems of the ecoregion at a consistent geographic scale, a GIS model was developed through several iterations of data mining and expert review, utilizing a variety of spatial datasets and tools. The resulting map depicts the distribution of ecological systems (28 systems in the Okanagan; 14 in the North Cascades) and functions as a coarse-filter representation of the distribution of biodiversity characteristic of each ecoregion.

Model components include:

1. Climate & Landcover: Upland systems were mapped as combinations of climate zone, physiography and vegetation structure.

2. Riparian ecological systems: The distinct linear pattern of riparian systems was modeled via an automated, DEM-derived delineation of riparian areas.

3. Physical Landscape Classification: Of the full set of mapped ecological systems, a subset of matrix-forming upland systems were spatially stratified through the method described in this document. As a result, the set of terrestrial coarse-filter targets represented in the site selection included the full set of ecological systems as well as each unique combination of matrix-forming system and landform. This ensured that, for a given matrix-forming system, in order to meet area representation goals, the automated site selection would capture the full range of topographic gradients across which the target system occurs, and thereby presumably capture characteristic variation in genotypes and understory vegetation.

B. REQUIREMENTS

<u>Data</u>: Digital Elevation Model (DEM)

<u>Software</u>: GRID license on ARC/INFO workstation , v 7.x or later.

<u>Hardware</u>: Disk space depends on the extent of the study area and the resolution of the DEM. When applied to a 25m DEM of a 50,000 km^2 ecoregion, 2 GB of disk space were required. The same process run using a 90m DEM might require only 500MB of disk space. <u>Processing Time</u>: The initial steps of generating the topographic indices are demanding in terms of processing. For example, a 6 million ha study area with a 25m DEM running on a 2.8 GHz CPU required approximately 57 hours of processing time (the same analysis of a 90m DEM would require approximately 7 hours total processing time). The topographic position and Solar Flux calculations took approximately 15 hours and 41 hours, respectively. Therefore, unless you have a dual-processor computer, it’s recommended that

you run the topographic position calculations overnight and the SolarFlux calculations over a weekend, The cluster analysis and mapping runs relatively quickly; each ISOCLUSTER and MLCLASSIFY step takes approximately 5 minutes to complete.

C. DISCUSSION OF METHOD AND RATIONALE

Choice of topographic factors

The set of four topographic factors and corresponding GIS indices described here were chosen because:

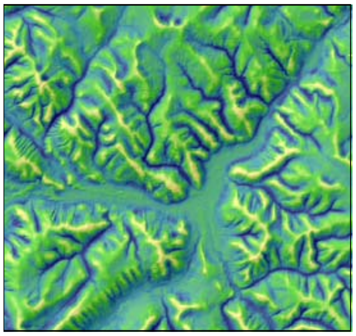
a) Each produced a pattern that was meaningful for describing variation at the specific spatial scale of analysis, determined principally by the size of the terrestrial assessment units (500ha hexagons).

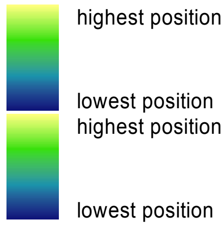
b) The four indices showed low spatial autocorrelation (the STACKSTATS command produces covariance and correlation statistics for the set of input indices).

c) All four factors are proxies for temperature and soil moisture and, hence, the water balance, and thereby serve as proxies for vegetation response.

The ideal number and choice of factors depends on the specific objectives of the analysis and on the geography, climate, and landscape ecology of the study area. Solar Flux, while a useful proxy in the temperate latitudes, may be a less significant proxy for vegetation pattern in the tropics or at high latitudes, i.e. boreal or arctic landscapes. Elevation, though strongly correlated with variation in precipitation and temperature, was not included as a factor in this assessment because the mapped pattern of matrix-forming systems already followed elevation zones. Several other indices that were evaluated but not used include the Compound Topographic Index (CTI - Evans, J. 2001), Relative Slope Position (RSP - Townsend, P. 1999), and Curvature (see ARC/INFO help menu for documentation of the CURVATURE command).

Topographic Position is a proxy for relative exposure, or topographic convergence, and for soil properties, all of which affect temperature and moisture regimes. The GIS index (Fels & Zobel 1995, Weiss 2001) is a measure of local elevation relative to the circular neighborhood; deep valleys receive high negative values, sharp ridges receive high positive values, while sideslopes and flat areas receive values near zero. Two indices were calculated, using two neighborhood radii, 300m and 2,000m, to capture the corresponding environmental variation at two scales.





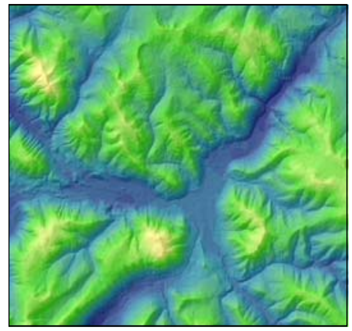


Figure 9. Topographic position.

neighborhood radius = 300meters

Figure 10. Topographic position.

neighborhood radius = 2,000meters

Solar flux (Rich 1995) is an index of annual clear-sky insolation, or radiation load, which affects temperature and moisture regimes. This is a function of aspect and slope, as well as latitude and shading from local terrain, and the time period chosen for the calculation. For a detailed discussion of the Solar Flux routine and parameters, see the user's manual, sf95_manual.html.

Because the objective of the Solar Flux analysis was simply to represent the possible range of environmental variation due to insolation, and in order to reduce processing time, index values were only calculated on three days during the year, the spring and fall equinoxes and the summer solstice. While the Solar Flux routine does allow the user to specify atmospheric transmissivity, note that this analysis did not recognize any geographic or seasonal variation in cloud cover. Solar Flux is recognized as a meaningful proxy for vegetation pattern in the temperate latitudes, but may be less meaningful in the tropics or high latitudes.

NOTE: Other routines exist for calculating insolation. This routine requires that you define the parameters in text files, but allows you to limit the calculation to just a few sample days during the year. A small number of sample days is adequate for a regional-level, non-predictive analysis, and will reduce the total run time.

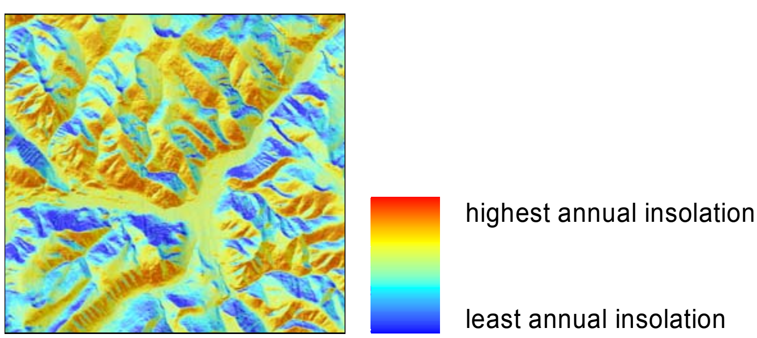


Figure 11. Solar flux.

Slope is a proxy for soil properties and drainage, which affects temperature and moisture regimes.

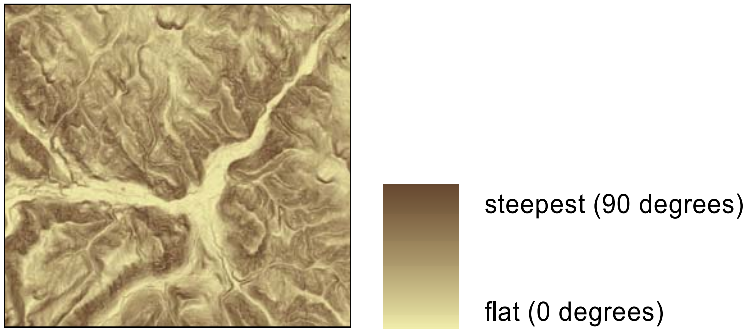


Figure 12. Slope.

Cluster Analysis

The cluster analysis functions similarly to an unsupervised classification of spectral bands used in remote sensing. The ISODATA (migrating means) algorithm produces groups with similar internal heterogeneity and with a minimum size criterion. This ensures that every mapped cluster represents a significant fraction of the landscape. For more information regarding this specific technique of cluster analysis, see the ISOCLUSTER item in the ARC/INFO help menu. For more information regarding cluster analysis, see http://www.nicholas.duke.edu/landscape/classes/env358/mv_pooling.pdf, and multivariate statistics in general, see http://www.nicholas.duke.edu/landscape/classes/env358/mv_syl.html.

For best results of the cluster analysis, all four input variables should have similar ranges of values. In this case, that is accomplished by reclassifying each range of values into a series of 33 bins according to deviation from the mean, wherein each bin spans ¼ standard deviation of the original range.

The GIS routine will define and map clusters at three group levels - 5, 10, and 15 clusters. Each cluster is defined by the corresponding four mean index values, which are listed in a signature file. To map the signatures defined in the cluster analysis, the MLCLASSIFY command assigns every grid cell to a cluster through a maximum-likelihood classification. To derive landform clusters at group levels other than 5, 10, or 15, simply edit clustermap.aml to change the number of classes specified in the ISOCLUSTER command, and change the corresponding MLCLASSIFY command to use the new signature file. While the resulting clusters are identified only by a number, you can create descriptive names for each landform based on the signature file and visual inspection of the map units. Note that the values in the signature file are based on the re-scaled indices, wherein the mean equals 16.

The Okanagan ecoregion is partitioned into five physiographically and climatically distinct sections; the North Cascades ecoregion contains four sections. We analyzed each sub-section independently, identifying and mapping characteristic landforms in each. In the Okanagan, we chose to classify 12 landforms per section, resulting in 60 landforms mapped across the ecoregion. In the North Cascades, we chose to classify 9 landforms per section, resulting in 36 landforms mapped across the ecoregion. In each ecoregion, we chose the number of landform classes after some experimentation, and determined that 12 and 9landforms, respectively, were enough to capture significant environmental variation while still yielding a tractable number of targets. Figures 13 and 14 compare the results of deriving 5 versus 8 landforms per section in the North Cascades.

It's possible to apply a signature file generated from one study area (delineated by the grid stack of factors) to a different study area. In the Okanagan, signature files were derived for each ecoregional section, excluding a buffer, but the clusters were mapped to a larger area that included a 15 kilometer buffer of the ecoregion. This required creating two sets of factor grids and grid stacks – one excluding the buffer, for deriving the signature files with ISOCLUSTER, and one including the buffer, for mapping the clusters with MLCLASSIFY.

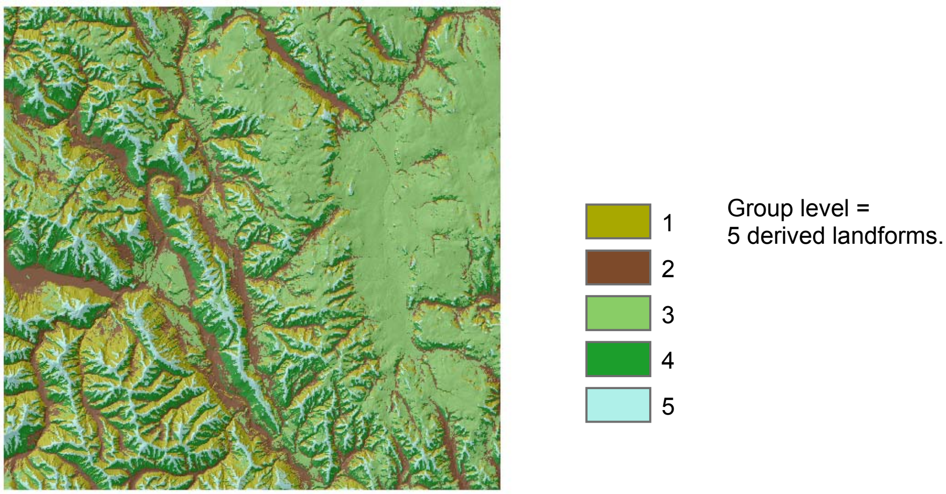


Figure 13. Mapped results of cluster analysis.

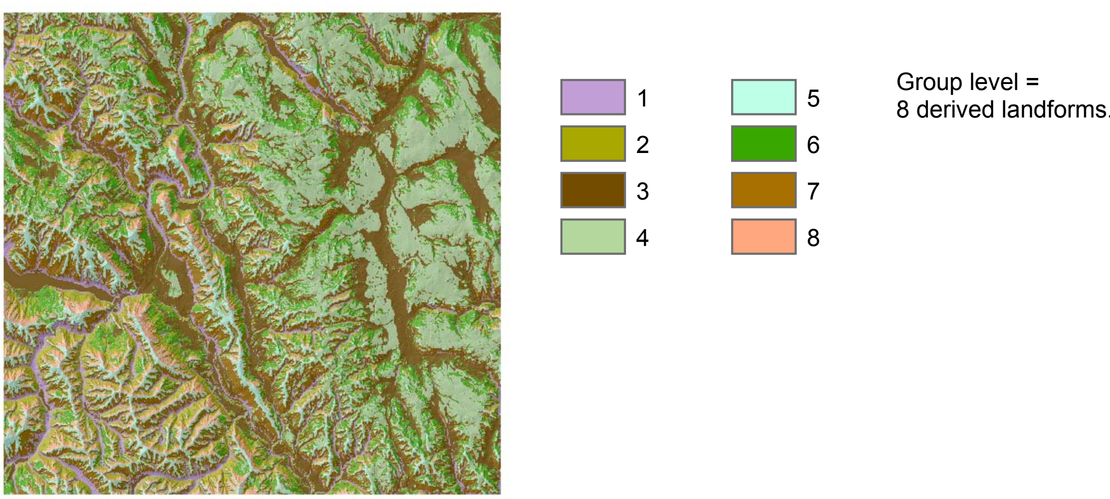


Figure 14. Mapped results of cluster analysis.

D. METHOD

This section describes how to reproduce the analysis conducted for the North Cascades Ecoregional Assessment.

Step 1: Derive topographic position & slope

1. Create an ARC/INFO workspace by copying the study area DEM and the 'tpos.aml' into an empty directory named \gridwork\.

2. Open an ARC/INFO workstation session, and navigate to the 'gridwork' workspace.

   (for example, with Arc: **w D:\Northcascadesdressup\test1\gridwork**)

3. Run tpos.aml

   (Usage: Arc: **&r tpos.aml**)

4. When prompted, enter the DEM name, the first neighborhood radius (in meters), and the second neighborhood radius (in meters). The suggested radii are 300m and 2000m.

The AML script will generate the following grids:

- topographic position at the first neighborhood radius
- topographic position at the second window neighborhood radius
- zonal SD & zonal mean of each – used to re-scale the index values.
- slope, as an integer grid

Step 2: Derive Solar Flux

1. Decompress the contents of solarflux.tar.gz into the 'gridwork' directory. This will create a sub-directory called \gridwork\solarflux\

2. Copy the station files (j81.sf, j172.sf) into the \solarflux\ directory. Steps 3-7 describe how to edit the station files to fit your study area.

3. Choose the dates and the hour increment for which you would like to calculate the solar flux. Convert these to the Julian calendar (0-365). Note that the two equinoxes, March 21 and September 21, receive virtually identical clear-sky insolation, and do not need to be calculated separately.

4. Determine the approximate latitude, in degrees, of a point near the center of the study area. Using this latitude value, determine the approximate time of sunrise and sunset for each date selected in step 2, using the ephemeris generator at http://ssd.jpl.nasa.gov/cgi-bin/eph

5. Create a station file for each day selected in step 2 by editing the following lines in j81.sf. The station files are text files that set the parameters of the analysis. j81.sf and j172.sf are included as templates. Edit the following lines in each station file:

   day <julian calendar day>   for example, for March 21st: **81**

start_time <start time> for example, for 9am: **9.0**

end_time <end time> for example, for 6pm: **18.0**

increment <hour increment> for example, hourly: **1**

latitude <latitude> for example, for latitude=50: **50**

in_grid <location of input dem grid> for example:
D:\ncascades\gridwork\NC_dem

hillshade_on_outgrid <name of output grid> for example: **j81**

6. In /solarflux/solarflux.aml, edit the pathname in the following line:

   &sv sfpath /apps/solarflux

   (for example, change to **&sv sfpath D:\ncascades\gridwork\solarflux**).

7. Open an ARC/INFO workstation session, and navigate to the solarflux workspace.

   (for example, with Arc: **w D:\ncascades\gridwork\solarflux**)

   ignore the message '**WARNING: New location is not a workspace.**'

   NOTE: the dem grid does not have to be located in \solarflux\, but the dem path must be specified in the station files.

8. Start GRID and run the solarflux routine from the GRID prompt, as follows:

   Arc: grid

   Grid: &r SOLARFLUX FILE < list of station files >

   if you had chosen two dates and created the corresponding station files, the syntax would be: **Grid: &r SOLARFLUX FILE j81.sf j172.sf**

   When prompted with **Enter Station File:**, press <enter>

   NOTE: The solarflux calculation may take several hours to finish and tie up your CPU, so you may wish to start this process at the end of the day and let it run overnight.

9 Once the solarflux calculations are complete, calculate composite annual solar flux. For example, the following calculates composite solar flux as the sum of the two equinoxes and the summer solstice. Values are divided by 10,000 to allow building a grid VAT; the reduced precision is insignificant for this analysis.

   Grid: SFLUX1 = INT((2 * j81 / 10000) + (j172 / 10000) + 0.5)

10. Once you're satisfied with the result, delete the intermediate grids, which are floating-point and take up a lot of disk space.

Step 3: Re-scale the index values

1 Copy sflux1 into the \gridwork\ workspace

2. Navigate to the \gridwork\ workspace. If the names of the four factor grids are not tpi300, tpi2000, slope_i, and sflux1, change the factor names in rescale.aml.

3. Run rescale.aml (**GRID: &r rescale.aml**)

The resulting re-scaled grids will be the input factors for the cluster analysis. The name of each re-scaled grid will have an 'rc' suffix.

Step 4: Run cluster analysis and map the results

1. Navigate to the \gridwork\ workspace. If the names of the four factor grids are not tpi300, tpi200, slope_i, and sflux1, change the factor names in clustermap.aml, including the 'rc' suffix.

2. Run clustermap.aml (**GRID: &r clustermap.aml**)

NOTES:

Clusters containing fewer than the minimum number of cells specified by ISOCLUSTER will be subsumed into the most similar cluster. Hence, the number of mapped clusters may be less than the specified number of classes.

Occasionally the ISOCLUSTER analysis will generate erroneous results, and the subsequent MLCLASSIFY command will generate an error message similar to:

ERROR: The covariance matrix of input class 7 is singular.

MLClassify failed!

This problem can be corrected by changing the sampling interval or the number of classes specified in the ISOCLUSTER command (for example, changing the sampling interval from 10 to 11), and running MLCLASSIFY again with the new signature file.

2.3 GIS Decision Matrix 1

Cross-tabulation of NCGBE level 2 vs. Veg Zones (Shining Mountains)

code	NCGBE level 2	PONDER-OSA PINE	INTERIOR DOUGLAS-FIR	INTERIOR GRAND FIR	MONTANE SPRUCE	INTERIOR SUBALPINE FOREST	INTERIOR ALPINE	Shining Mountains Veg Zones COASTAL ALPINE	MOUNTAIN HEMLOCK	PACIFIC SILVER FIR	COASTAL WESTERN HEMLOCK	COASTAL DOUGLAS-FIR
		13	6	7	10	8	3	2	9	14	5	4
18	Shrub Steppe (Herb)		Montane non-forested composite						Montane non-forested composite		Montane non-forested composite	
19	Shrub Steppe (PUTR)		Montane non-forested composite								Montane non-forested composite	
20	Shrub Steppe (ARTR)										Montane non-forested composite	
2	PIPO		Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest		Northern Interior Spruce-Fir woodland and forest	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Northern Rocky Mountain Subalpine Dry Parkland		Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	North Pacific Maritime Douglas-Fir Western Hemlock Forest (SEE NOTE 1.)	
3	PIPO-PSME		Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest	Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest	Northern Interior Spruce-Fir woodland and forest				Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	North Pacific Maritime Douglas-Fir Western Hemlock Forest (SEE NOTE 1.)	
4	PSME-Mixed Conif-E		Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest	East Cascades Mesic Montane Mixed Conifer Forest	Northern Interior Spruce-Fir woodland and forest	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Northern Rocky Mountain Subalpine Dry Parkland		Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	North Pacific Western Hemlock - Silver fir Forest (SEE NOTE 2.)	North Pacific Maritime Douglas-Fir Western Hemlock Forest (SEE NOTE 1.)	

Cross-tabulation of NCGBE level 2 vs. Veg Zones (Shining Mountains)

		PONDER-OSA PINE	INTERIOR DOUGLAS-FIR	INTERIOR GRAND FIR	MONTANE SPRUCE	INTERIOR SUBALPINE FOREST	INTERIOR ALPINE	Shining Mountains Veg Zones COASTAL ALPINE	MOUNTAIN HEMLOCK	PACIFIC SILVER FIR	COASTAL WESTERN HEMLOCK	COASTAL DOUGLAS-FIR
5	PSME-Mixed Conif-W		East Cascades Mesic Montane Mixed Conifer Forest							North Pacific Western Hemlock - Silver fir Forest (SEE NOTE 2.)	North Pacific Maritime Douglas-Fir Western Hemlock Forest (SEE NOTE 1.)	
6	ABLA2-PIEN-PICO-E	Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Northern Interior Spruce-Fir woodland and forest	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Northern Rocky Mountain Subalpine Dry Parkland	North Pacific Maritime Mesic Parkland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	North Pacific Maritime Douglas-Fir Western Hemlock Forest (SEE NOTE 1.)	
7	ABLA-PIEN-PICO-W					Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Northern Rocky Mountain Subalpine Dry Parkland	North Pacific Maritime Mesic Parkland	North Pacific Mountain Hemlock Forest	North Pacific Mountain Hemlock Forest		
8	PIEN Riparian		*riparian*		*riparian*	*riparian*			*riparian*	*riparian*	*riparian*	
9	Young mgd PSME(MBSNF)								North Pacific Western Hemlock - Silver fir Forest (SEE NOTE 2.)	North Pacific Western Hemlock - Silver fir Forest (SEE NOTE 2.)	North Pacific Maritime Douglas-Fir Western Hemlock Forest (SEE NOTE 1.)	
10	TSHE-E			East Cascades Mesic Montane Mixed Conifer Forest						North Pacific Western Hemlock - Silver fir Forest (SEE NOTE 2.)	North Pacific Maritime Douglas-Fir Western Hemlock Forest (SEE NOTE 1.)	

Cross-tabulation of NCGBE level 2 vs. Veg Zones (Shining Mountains)

		PONDER-OSA PINE	INTERIOR DOUGLAS-FIR	INTERIOR GRAND FIR	MONTANE SPRUCE	INTERIOR SUBALPINE FOREST	INTERIOR ALPINE	Shining Mountains Veg Zones COASTAL ALPINE	MOUNTAIN HEMLOCK	PACIFIC SILVER FIR	COASTAL WESTERN HEMLOCK	COASTAL DOUGLAS-FIR
11	TSHE-W		East Cascades Mesic Montane Mixed Conifer Forest						North Pacific Western Hemlock - Silver fir Forest (SEE NOTE 2.)	North Pacific Western Hemlock - Silver fir Forest (SEE NOTE 2.)	North Pacific Maritime Douglas-Fir Western Hemlock Forest (SEE NOTE 1.)	North Pacific Maritime Douglas-Fir Western Hemlock Forest (SEE NOTE 1.)
12	ABAM-E	Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest			North Pacific Western Hemlock - Silver fir Forest (SEE NOTE 2.)	North Pacific Mountain Hemlock Forest	Northern Rocky Mountain Subalpine Dry Parkland	North Pacific Maritime Mesic Parkland	North Pacific Mountain Hemlock Forest	North Pacific Western Hemlock - Silver fir Forest (SEE NOTE 2.)	North Pacific Western Hemlock - Silver fir Forest (SEE NOTE 2.)	
13	ABAM-W		East Cascades Mesic Montane Mixed Conifer Forest			North Pacific Mountain Hemlock Forest		North Pacific Maritime Mesic Parkland	North Pacific Mountain Hemlock Forest	North Pacific Western Hemlock - Silver fir Forest (SEE NOTE 2.)	North Pacific Western Hemlock - Silver fir Forest (SEE NOTE 2.)	
14	TSME-E	Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest				Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Northern Rocky Mountain Subalpine Dry Parkland	North Pacific Maritime Mesic Parkland	North Pacific Mountain Hemlock Forest	North Pacific Mountain Hemlock Forest	North Pacific Western Hemlock - Silver fir Forest (SEE NOTE 2.)	
15	TSME-W					Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Northern Rocky Mountain Subalpine Dry Parkland	North Pacific Maritime Mesic Parkland	North Pacific Mountain Hemlock Forest	North Pacific Mountain Hemlock Forest	North Pacific Western Hemlock - Silver fir Forest (SEE NOTE 2.)	
16	PIAL					Northern Rocky Mountain Subalpine Dry Parkland	Northern Rocky Mountain Subalpine Dry Parkland	North Pacific Maritime Mesic Parkland	North Pacific Maritime Mesic Parkland	North Pacific Mountain Hemlock Forest		

Cross-tabulation of NCGBE level 2 vs. Veg Zones (Shining Mountains)

		PONDER-OSA PINE	INTERIOR DOUGLAS-FIR	INTERIOR GRAND FIR	MONTANE SPRUCE	INTERIOR SUBALPINE FOREST	INTERIOR ALPINE	Shining Mountains Veg Zones COASTAL ALPINE	MOUNTAIN HEMLOCK	PACIFIC SILVER FIR	COASTAL WESTERN HEMLOCK	COASTAL DOUGLAS-FIR
17	LALY					Northern Rocky Mountain Subalpine Dry Parkland	Northern Rocky Mountain Subalpine Dry Parkland	North Pacific Maritime Mesic Parkland	North Pacific Maritime Mesic Parkland			
22	Alpine Meadow -E					Alpine composite	Alpine composite	Alpine composite	Alpine composite			
23	Alpine Meadow -W					Alpine composite	Alpine composite	Alpine composite	Alpine composite	North Pacific Maritime Mesic Parkland		
25	Subalp Lush Meadow -SW	Montane non-forested composite				North Pacific Maritime Mesic Parkland	North Pacific Maritime Mesic Parkland	North Pacific Maritime Mesic Parkland	North Pacific Maritime Mesic Parkland	North Pacific Maritime Mesic Parkland	Montane non-forested composite	
26	Subalp Lush Meadow -W					North Pacific Maritime Mesic Parkland	North Pacific Maritime Mesic Parkland	North Pacific Maritime Mesic Parkland	North Pacific Maritime Mesic Parkland	North Pacific Maritime Mesic Parkland	Montane non-forested composite	
27	Subalp Meadow -mesic-dry-E	Montane non-forested composite			Northern Rocky Mountain Subalpine Dry Parkland	Northern Rocky Mountain Subalpine Dry Parkland	Northern Rocky Mountain Subalpine Dry Parkland	North Pacific Maritime Mesic Parkland	North Pacific Maritime Mesic Parkland	North Pacific Maritime Mesic Parkland		
28	Subalp Meadow -mesic-dry-W					North Pacific Maritime Mesic Parkland	Northern Rocky Mountain Subalpine Dry Parkland	North Pacific Maritime Mesic Parkland	North Pacific Maritime Mesic Parkland	North Pacific Maritime Mesic Parkland		
29	Subalp Heather-VADE Meadow					North Pacific Maritime Mesic Parkland	North Pacific Maritime Mesic Parkland	North Pacific Maritime Mesic Parkland	North Pacific Maritime Mesic Parkland	North Pacific Maritime Mesic Parkland		

Cross-tabulation of NCGBE level 2 vs. Veg Zones (Shining Mountains)

								Shining Mountains Veg Zones				
		PONDER-OSA PINE	INTERIOR DOUGLAS-FIR	INTERIOR GRAND FIR	MONTANE SPRUCE	INTERIOR SUBALPINE FOREST	INTERIOR ALPINE	COASTAL ALPINE	MOUNTAIN HEMLOCK	PACIFIC SILVER FIR	COASTAL WESTERN HEMLOCK	COASTAL DOUGLAS-FIR
54	Subalp VASC-VACA				Northern Rocky Mountain Subalpine Dry Parkland	Northern Rocky Mountain Subalpine Dry Parkland	Northern Rocky Mountain Subalpine Dry Parkland	North Pacific Maritime Mesic Parkland				
30	Subalpine Mosaic-E		Northern Rocky Mountain Subalpine Dry Parkland		North Pacific Maritime Mesic Parkland	Northern Rocky Mountain Subalpine Dry Parkland	Northern Rocky Mountain Subalpine Dry Parkland	North Pacific Maritime Mesic Parkland	North Pacific Maritime Mesic Parkland	North Pacific Maritime Mesic Parkland	Montane non-forested composite	
31	Subalpine Mosaic-W							North Pacific Maritime Mesic Parkland	North Pacific Maritime Mesic Parkland	North Pacific Maritime Mesic Parkland		
32	Montane Mosaic-E		Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest	East Cascades Mesic Montane Mixed Conifer Forest	Northern Interior Spruce-Fir woodland and forest	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland				North Pacific Western Hemlock - Silver fir Forest (SEE NOTE 2.)	North Pacific Maritime Douglas-Fir Western Hemlock Forest (SEE NOTE 1.)	
33	Montane Mosaic-W								North Pacific Mountain Hemlock Forest	North Pacific Western Hemlock - Silver fir Forest (SEE NOTE 2.)	North Pacific Maritime Douglas-Fir Western Hemlock Forest (SEE NOTE 1.)	
34	Montane Herbaceous-E	Montane non-forested composite	Montane non-forested composite	Montane non-forested composite	Montane non-forested composite	Montane non-forested composite	Northern Rocky Mountain Subalpine Dry Parkland	North Pacific Maritime Mesic Parkland	Montane non-forested composite	Montane non-forested composite	Montane non-forested composite	
35	Montane Herbaceous-W						Northern Rocky Mountain Subalpine Dry Parkland	North Pacific Maritime Mesic Parkland	Montane non-forested composite	Montane non-forested composite	Montane non-forested composite	Montane non-forested composite
36	Montane Shrub-E	Montane non-forested composite	Montane non-forested composite	Montane non-forested composite	Montane non-forested composite	Montane non-forested composite	Northern Rocky Mountain Subalpine Dry Parkland	North Pacific Maritime Mesic Parkland	Montane non-forested composite	Montane non-forested composite	Montane non-forested composite	

Cross-tabulation of NCGBE level 2 vs. Veg Zones (Shining Mountains)

								Shining Mountains Veg Zones				
		PONDER-OSA PINE	**INTERIOR DOUGLAS-FIR**	**INTERIOR GRAND FIR**	**MONTANE SPRUCE**	**INTERIOR SUBALPINE FOREST**	**INTERIOR ALPINE**	**COASTAL ALPINE**	**MOUNTAIN HEMLOCK**	**PACIFIC SILVER FIR**	**COASTAL WESTERN HEMLOCK**	**COASTAL DOUGLAS-FIR**
37	Montane Shrub-W					Montane non-forested composite		North Pacific Maritime Mesic Parkland	Montane non-forested composite	Montane non-forested composite	Montane non-forested composite	Montane non-forested composite
38	Lush Shrub (ALSI)-E					Montane non-forested composite	Northern Rocky Mountain Subalpine Dry Parkland	North Pacific Maritime Mesic Parkland	Montane non-forested composite	Montane non-forested composite	Montane non-forested composite	
39	Lush Shrub (ALSI)-W							North Pacific Maritime Mesic Parkland	Montane non-forested composite	Montane non-forested composite	Montane non-forested composite	
40	Lush Low El Herb-E										Montane non-forested composite	
41	Lush Low-El Herb-W										Montane non-forested composite	Montane non-forested composite
42	Lush Low-El Shrub-E											
44	Ripar Decid Forest-E	***riparian***	***riparian***	***riparian***	***riparian***	***riparian***			***riparian***	***riparian***	***riparian***	
45	Ripar Decid Forest-W									***riparian***	***riparian***	***riparian***
46	Upland Decid-E	North Pacific Maritime Douglas-Fir Western Hemlock Forest (SEE NOTE 1.)	East Cascades Mesic Montane Mixed Conifer Forest	East Cascades Mesic Montane Mixed Conifer Forest	Northern Interior Spruce-Fir woodland and forest	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Northern Rocky Mountain Subalpine Dry Parkland	North Pacific Maritime Mesic Parkland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	North Pacific Maritime Douglas-Fir Western Hemlock Forest (SEE NOTE 1.)	

Cross-tabulation of NCGBE level 2 vs. Veg Zones (Shining Mountains)

		PONDEROSA PINE	INTERIOR DOUGLAS-FIR	INTERIOR GRAND FIR	MONTANE SPRUCE	INTERIOR SUBALPINE FOREST	INTERIOR ALPINE	Shining Mountains Veg Zones COASTAL ALPINE	MOUNTAIN HEMLOCK	PACIFIC SILVER FIR	COASTAL WESTERN HEMLOCK	COASTAL DOUGLAS-FIR
47	Upland Decid-W		East Cascades Mesic Montane Mixed Conifer Forest						North Pacific Mountain Hemlock Forest	North Pacific Maritime Douglas-Fir Western Hemlock Forest (SEE NOTE 1.)	North Pacific Maritime Douglas-Fir Western Hemlock Forest (SEE NOTE 1.)	North Pacific Maritime Douglas-Fir Western Hemlock Forest (SEE NOTE 1.)
48	Bare & Rock	North Pacific Montane Cliff, Talus and Massive Bedrock	North Pacific Montane Cliff, Talus and Massive Bedrock		North Pacific Montane Cliff, Talus and Massive Bedrock	North Pacific Montane Cliff, Talus and Massive Bedrock	North Pacific Alpine Bedrock and Scree	North Pacific Alpine Bedrock and Scree	North Pacific Montane Cliff, Talus and Massive Bedrock	North Pacific Montane Cliff, Talus and Massive Bedrock	North Pacific Montane Cliff, Talus and Massive Bedrock	North Pacific Montane Cliff, Talus and Massive Bedrock
49	Snow & Ice					North American Ice Field and Outwash	North American Ice Field and Outwash	North American Ice Field and Outwash	North American Ice Field and Outwash	North American Ice Field and Outwash		
1	Water	water	water	water	water	water	water	water	water	water	water	water
51	Wet Soil & Gravel	wet soil gravel	wet soil gravel	wet soil gravel	wet soil gravel	wet soil gravel	wet soil gravel	wet soil gravel	wet soil gravel	wet soil gravel	wet soil gravel	wet soil gravel
53	Agriculture-Orchard & Crops										agriculture	agriculture
50	Shadow	shadow	shadow	shadow	shadow	shadow	shadow	shadow	shadow	shadow	shadow	shadow
100	Unclassified				unclassified	unclassified	unclassified					

2.4 GIS Decision Matrix 2

Cross-tabulation of NLCD vs. Veg Zones (Shining Mountains)

Shining Mountains Veg Zones

code	NLCD landcover	COASTAL DOUGLAS-FIR	COASTAL WESTERN HEMLOCK	PACIFIC SILVER FIR	MOUNTAIN HEMLOCK	COASTAL ALPINE	INTERIOR GRAND FIR	OCEAN
		4	5	14	9	2	7	12
12	Perennial Ice/Snow				1			
33	Transitional *(clearcuts)*	North Pacific Maritime Douglas-Fir Western Hemlock Forest (SEE NOTE 1.)	North Pacific Maritime Douglas-Fir Western Hemlock Forest (SEE NOTE 1.)	North Pacific Western Hemlock - Silver fir Forest (SEE NOTE 2.)	North Pacific Mountain Hemlock Forest		East Cascades Mesic Montane Mixed Conifer Forest	North Pacific Maritime Douglas-Fir Western Hemlock Forest (SEE NOTE 1.)
41	Deciduous Forest	North Pacific Maritime Douglas-Fir Western Hemlock Forest (SEE NOTE 1.)	North Pacific Maritime Douglas-Fir Western Hemlock Forest (SEE NOTE 1.)	North Pacific Western Hemlock - Silver fir Forest (SEE NOTE 2.)	North Pacific Mountain Hemlock Forest		East Cascades Mesic Montane Mixed Conifer Forest	North Pacific Maritime Douglas-Fir Western Hemlock Forest (SEE NOTE 1.)
42	Evergreen Forest	North Pacific Maritime Douglas-Fir Western Hemlock Forest (SEE NOTE 1.)	North Pacific Maritime Douglas-Fir Western Hemlock Forest (SEE NOTE 1.)	North Pacific Western Hemlock - Silver fir Forest (SEE NOTE 2.)	North Pacific Mountain Hemlock Forest	0	East Cascades Mesic Montane Mixed Conifer Forest	North Pacific Maritime Douglas-Fir Western Hemlock Forest (SEE NOTE 1.)
43	Mixed Forest	North Pacific Maritime Douglas-Fir Western Hemlock Forest (SEE NOTE 1.)	North Pacific Maritime Douglas-Fir Western Hemlock Forest (SEE NOTE 1.)	North Pacific Western Hemlock - Silver fir Forest (SEE NOTE 2.)	North Pacific Mountain Hemlock Forest		1	North Pacific Maritime Douglas-Fir Western Hemlock Forest (SEE NOTE 1.)
51	Shrubland	Montane non-forested composite	Montane non-forested composite	Montane non-forested composite	Montane non-forested composite		Montane non-forested composite	Montane non-forested composite
71	Grasslands/ Herbaceous	Montane non-forested composite	Montane non-forested composite	Montane non-forested composite	Montane non-forested composite		Montane non-forested composite	Montane non-forested composite
91	Woody Wetlands	North Pacific Lowland Riparian Forest and Shrubland	North Pacific Lowland Riparian Forest and Shrubland	North Pacific Montane Riparian Woodland and Shrubland	North Pacific Montane Riparian Woodland and Shrubland		2	North Pacific Lowland Riparian Forest and Shrubland

Cross-tabulation of NLCD vs. Veg Zones (Shining Mountains)

		Shining Mountains Veg Zones						
		COASTAL DOUGLAS-FIR	COASTAL WESTERN HEMLOCK	PACIFIC SILVER FIR	MOUNTAIN HEMLOCK	COASTAL ALPINE	INTERIOR GRAND FIR	OCEAN
92	**Emergent Herbaceous Wetlands**			**0**				
31	**Bare Rock/Sand/ Clay**	North Pacific Montane Cliff, Talus and Massive Bedrock	North Pacific Montane Cliff, Talus and Massive Bedrock	North Pacific Montane Cliff, Talus and Massive Bedrock	North Pacific Montane Cliff, Talus and Massive Bedrock		**1**	North Pacific Montane Cliff, Talus and Massive Bedrock
11	Open Water	water	water	water	water		water	water
21	Low Intensity Residential	urban	urban					urban
22	High Intensity Residential	urban	urban					
23	Commercial/Industrial/Transpor	urban	urban	urban	urban		urban	urban
32	Quarries/Strip Mines/Gravel Pi	mine	mine	mine				
61	Orchards/Vineyards/Other	agriculture	agriculture					
81	Pasture/Hay	agriculture	agriculture	agriculture				
82	Row Crops	agriculture	agriculture					
83	Small Grains	agriculture	agriculture	agriculture				agriculture
84	Fallow	agriculture	agriculture					
85	Urban/Recreational Grasses	urban	urban	urban	urban			

2.5 *GIS Decision Matrix 3*

Crosswalk of BEC-BEU combinations to ecological systems

BEC LABEL	HAB1MOD1	BEU name	BEU modifier	Draft #1 March 31, Rex Crawford WA NHP	Draft #2 April 14, Geoff Cushon BC MoF	Final May 3	area (ha)	comment
CWH dm	CF	Cultivated Field		*agriculture*	*agriculture*	*agriculture*	33,384	
CWH ds 1	CF	Cultivated Field		*agriculture*	*agriculture*	*agriculture*	5,046	
CWH xm 1	CF	Cultivated Field		*agriculture*	*agriculture*	*agriculture*	39,026	
IDF dk 2	DF s	Interior Douglas-fir Forest	steep, warm (southerly) aspect	Northern Interior Dry-Mesic Mixed Conifer Forest and Woodland	East Cascades Mesic Montane Mixed Conifer Forest	East Cascades Mesic Montane Mixed Conifer Forest	1,176	
IDF dk 2	DL	Douglas-fir - Lodgepole Pine		Northern Interior Spruce-Fir woodland and forest	East Cascades Mesic Montane Mixed Conifer Forest	East Cascades Mesic Montane Mixed Conifer Forest	5,402	
IDF dk 2	DL n	Douglas-fir - Lodgepole Pine	cool (northerly) aspect	Northern Interior Spruce-Fir woodland and forest	East Cascades Mesic Montane Mixed Conifer Forest	East Cascades Mesic Montane Mixed Conifer Forest	1,961	
IDF dk 2	EF s	Engelmann Spruce - Sub-alpine Fir Dry Forested	steep, warm (southerly) aspect	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	East Cascades Mesic Montane Mixed Conifer Forest	East Cascades Mesic Montane Mixed Conifer Forest	2	
IDF un	DF s	Interior Douglas-fir Forest	steep, warm (southerly) aspect	Northern Interior Dry-Mesic Mixed Conifer Forest and Woodland	East Cascades Mesic Montane Mixed Conifer Forest	East Cascades Mesic Montane Mixed Conifer Forest	180	
IDF un	DL s	Douglas-fir - Lodgepole Pine	steep, warm (southerly) aspect	Northern Interior Spruce-Fir woodland and forest	East Cascades Mesic Montane Mixed Conifer Forest	East Cascades Mesic Montane Mixed Conifer Forest	136	
IDF ww	DF	Interior Douglas-fir Forest		Northern Interior Dry-Mesic Mixed Conifer Forest and Woodland	East Cascades Mesic Montane Mixed Conifer Forest	East Cascades Mesic Montane Mixed Conifer Forest	2,315	
IDF ww	DF n	Interior Douglas-fir Forest	cool (northerly) aspect	Northern Interior Dry-Mesic Mixed Conifer Forest and Woodland	East Cascades Mesic Montane Mixed Conifer Forest	East Cascades Mesic Montane Mixed Conifer Forest	959	

Crosswalk of BEC-BEU combinations to ecological systems

BEC LABEL	HAB1MOD1	BEU name	BEU modifier	Draft #1 March 31, Rex Crawford WA NHP	Draft #2 April 14, Geoff Cushon BC MoF	Final May 3	area (ha)	comment
IDF ww	DF s	Interior Douglas-fir Forest	steep, warm (southerly) aspect	Northern Interior Dry-Mesic Mixed Conifer Forest and Woodland	East Cascades Mesic Montane Mixed Conifer Forest	East Cascades Mesic Montane Mixed Conifer Forest	11,785	
IDF ww	DL	Douglas-fir - Lodgepole Pine		Northern Interior Spruce-Fir woodland and forest	East Cascades Mesic Montane Mixed Conifer Forest	East Cascades Mesic Montane Mixed Conifer Forest	215	
IDF ww	DL l	Douglas-fir - Lodgepole Pine	shallow (lithic) soils	Northern Interior Spruce-Fir woodland and forest	East Cascades Mesic Montane Mixed Conifer Forest	East Cascades Mesic Montane Mixed Conifer Forest	431	
IDF ww	DL s	Douglas-fir - Lodgepole Pine	steep, warm (southerly) aspect	Northern Interior Spruce-Fir woodland and forest	East Cascades Mesic Montane Mixed Conifer Forest	East Cascades Mesic Montane Mixed Conifer Forest	5,779	
IDF ww	DL t	Douglas-fir - Lodgepole Pine	moderate, warm (southerly) aspect	Northern Interior Spruce-Fir woodland and forest	East Cascades Mesic Montane Mixed Conifer Forest	East Cascades Mesic Montane Mixed Conifer Forest	23	
IDF ww	RD	Western Redcedar - Douglas-fir		East Cascades Mesic Montane Mixed Conifer Forest	East Cascades Mesic Montane Mixed Conifer Forest	East Cascades Mesic Montane Mixed Conifer Forest	18,706	
IDF ww	RD m	Western Redcedar - Douglas-fir	moist soils	East Cascades Mesic Montane Mixed Conifer Forest	East Cascades Mesic Montane Mixed Conifer Forest	East Cascades Mesic Montane Mixed Conifer Forest	6,430	
IDF ww	RD n	Western Redcedar - Douglas-fir	cool (northerly) aspect	East Cascades Mesic Montane Mixed Conifer Forest	East Cascades Mesic Montane Mixed Conifer Forest	East Cascades Mesic Montane Mixed Conifer Forest	13,352	
IDF ww	RD s	Western Redcedar - Douglas-fir	steep, warm (southerly) aspect	East Cascades Mesic Montane Mixed Conifer Forest	East Cascades Mesic Montane Mixed Conifer Forest	East Cascades Mesic Montane Mixed Conifer Forest	275	
CWH dm	GB	Gravel Bar		*fill via nibble*	*fill via nibble*	**riparian**	1,158	
CWH ds 1	GB	Gravel Bar		*fill via nibble*	*fill via nibble*	**riparian**	730	

Crosswalk of BEC-BEU combinations to ecological systems

BEC LABEL	HAB1MOD1	BEU name	BEU modifier	Draft #1 March 31, Rex Crawford WA NHP	Draft #2 April 14, Geoff Cushon BC MoF	Final May 3	area (ha)	comment
CWH vm 1	GB	Gravel Bar		*fill via nibble*	*fill via nibble*	**riparian**	603	
CWH dm	MI	Mine		*mine*	*mine*	*mine*	125	
CWH xm 1	MI	Mine		*mine*	*mine*	*mine*	50	
AT unp	GL	Glacier		North American Ice Field	North American Ice Field	North American Ice Field	210,373	
ESSFmw	GL	Glacier		North American Ice Field	North American Ice Field	North American Ice Field	80	
MH mm 1	GL	Glacier		North American Ice Field	North American Ice Field	North American Ice Field	101	
MH mm 2	GL	Glacier		North American Ice Field	North American Ice Field	North American Ice Field	3,279	
AT unp	AU	Alpine Unvegetated		North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	110,203	
AT unp	AU n	Alpine Unvegetated	cool (northerly) aspect	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	141,144	
AT unp	AU s	Alpine Unvegetated	steep, warm (southerly) aspect	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	145,951	
AT unp	RO	Rock		North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	12,955	
AT unp	RO n	Rock	cool (northerly) aspect	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	574	
AT unp	RO s	Rock	steep, warm (southerly) aspect	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	5,992	
AT unp	UV n	Unvegetated	cool (northerly) aspect	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	513	
AT unp	UV s	Unvegetated	steep, warm (southerly) aspect	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	667	
CWH ms 1	AU	Alpine Unvegetated		North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	109	

Crosswalk of BEC-BEU combinations to ecological systems

BEC LABEL	HAB1MOD1	BEU name	BEU modifier	Draft #1 March 31, Rex Crawford WA NHP	Draft #2 April 14, Geoff Cushon BC MoF	Final May 3	area (ha)	comment
CWH ms 1	AU n	Alpine Unvegetated	cool (northerly) aspect	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	86	
CWH vm 2	AU	Alpine Unvegetated		North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	81	
CWH vm 2	AU s	Alpine Unvegetated	steep, warm (southerly) aspect	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	45	
ESSFdv	AU	Alpine Unvegetated		North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	294	
ESSFdv	AU n	Alpine Unvegetated	cool (northerly) aspect	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	193	
ESSFmw	AU	Alpine Unvegetated		North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	923	
ESSFmw	AU n	Alpine Unvegetated	cool (northerly) aspect	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	1,971	
ESSFmw	AU s	Alpine Unvegetated	steep, warm (southerly) aspect	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	1,756	
MH mm 1	AU	Alpine Unvegetated		North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	2,739	
MH mm 1	AU n	Alpine Unvegetated	cool (northerly) aspect	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	2,813	
MH mm 1	AU s	Alpine Unvegetated	steep, warm (southerly) aspect	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	1,907	
MH mm 1	UV s	Unvegetated	steep, warm (southerly) aspect	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	497	
MH mm 2	AU	Alpine Unvegetated		North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	4,411	

Crosswalk of BEC-BEU combinations to ecological systems

BEC LABEL	HAB1MOD1	BEU name	BEU modifier	Draft #1 March 31, Rex Crawford WA NHP	Draft #2 April 14, Geoff Cushon BC MoF	Final May 3	area (ha)	comment
MH mm 2	AU n	Alpine Unvegetated	cool (northerly) aspect	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	6,309	
MH mm 2	AU s	Alpine Unvegetated	steep, warm (southerly) aspect	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	3,796	
MH mm 2	UV n	Unvegetated	cool (northerly) aspect	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	182	
MH mm 2	UV s	Unvegetated	steep, warm (southerly) aspect	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	North Pacific Alpine & Subalpine Bedrock and Scree	157	
AT unp	AV	Avalanche Track		North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	Alpine composite	539	
AT unp	AV n	Avalanche Track	cool (northerly) aspect	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	Alpine composite	1,811	
AT unp	AV s	Avalanche Track	steep, warm (southerly) aspect	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	Alpine composite	9,909	
CWH ds 1	AV n	Avalanche Track	cool (northerly) aspect	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	404	
CWH ds 1	AV s	Avalanche Track	steep, warm (southerly) aspect	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	259	
CWH ms 1	AV n	Avalanche Track	cool (northerly) aspect	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	4,075	
CWH ms 1	AV s	Avalanche Track	steep, warm (southerly) aspect	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	8,948	
CWH vm 1	AV n	Avalanche Track	cool (northerly) aspect	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	257	
CWH vm 1	AV s	Avalanche Track	steep, warm (southerly) aspect	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	629	
CWH vm 2	AV	Avalanche Track		North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	785	

Crosswalk of BEC-BEU combinations to ecological systems

BEC LABEL	HAB1MOD1	BEU name	BEU modifier	Draft #1 March 31, Rex Crawford WA NHP	Draft #2 April 14, Geoff Cushon BC MoF	Final May 3	area (ha)	comment
CWH vm 2	AV n	Avalanche Track	cool (northerly) aspect	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	777	
CWH vm 2	AV s	Avalanche Track	steep, warm (southerly) aspect	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	2,865	
ESSFdv	AV s	Avalanche Track	steep, warm (southerly) aspect	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	145	
ESSFmw	AV	Avalanche Track		North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	371	
ESSFmw	AV n	Avalanche Track	cool (northerly) aspect	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	901	
ESSFmw	AV s	Avalanche Track	steep, warm (southerly) aspect	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	3,195	
ESSFmwp	AV s	Avalanche Track	steep, warm (southerly) aspect	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	2	
MH mm 1	AV	Avalanche Track		North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	343	
MH mm 1	AV n	Avalanche Track	cool (northerly) aspect	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	659	
MH mm 1	AV s	Avalanche Track	steep, warm (southerly) aspect	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	2,028	
MH mm 2	AV	Avalanche Track		North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	129	
MH mm 2	AV n	Avalanche Track	cool (northerly) aspect	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	3,266	
MH mm 2	AV s	Avalanche Track	steep, warm (southerly) aspect	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	North Pacific Avalanche Chute Shrubland	9,467	

Crosswalk of BEC-BEU combinations to ecological systems

BEC LABEL	HAB1MOD1	BEU name	BEU modifier	Draft #1 March 31, Rex Crawford WA NHP	Draft #2 April 14, Geoff Cushon BC MoF	Final May 3	area (ha)	comment
CWH ms 1	CH l	Coastal Western Hemlock - Western Redcedar	shallow (lithic) soils	North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	1	
CWH ms 1	CW	Coastal Western Hemlock - Douglas-fir		North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	2	
CWH ms 1	DF s	Interior Douglas-fir Forest	steep, warm (southerly) aspect	East Cascades Mesic Montane Mixed Conifer Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	1	
CWH ms 1	DL s	Douglas-fir - Lodgepole Pine	steep, warm (southerly) aspect	Northern Interior Spruce-Fir woodland and forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	4	
CWH ms 1	EF s	Engelmann Spruce - Sub-alpine Fir Dry Forested	steep, warm (southerly) aspect	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	2	
CWH ms 1	EF t	Engelmann Spruce - Sub-alpine Fir Dry Forested	moderate, warm (southerly) aspect	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	16	
CWH ms 1	EW	Subalpine Fir - Mountain Hemlock Wet Forested		North Pacific Mountain Hemlock Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	13	
CWH ms 1	EW l	Subalpine Fir - Mountain Hemlock Wet Forested	shallow (lithic) soils	North Pacific Mountain Hemlock Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	157	
CWH ms 1	EW n	Subalpine Fir - Mountain Hemlock Wet Forested	cool (northerly) aspect	North Pacific Mountain Hemlock Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	14	
CWH ms 1	EW s	Subalpine Fir - Mountain Hemlock Wet Forested	steep, warm (southerly) aspect	North Pacific Mountain Hemlock Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	3	

Crosswalk of BEC-BEU combinations to ecological systems

BEC LABEL	HAB1MOD1	BEU name	BEU modifier	Draft #1 March 31, Rex Crawford WA NHP	Draft #2 April 14, Geoff Cushon BC MoF	Final May 3	area (ha)	comment
CWH ms 1	EW u	Subalpine Fir - Mountain Hemlock Wet Forested	upper elevation, gentle slope	North Pacific Mountain Hemlock Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	64	
CWH ms 1	FR	Amabilis Fir - Western Hemlock		North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	75,026	
CWH ms 1	FR l	Amabilis Fir - Western Hemlock	shallow (lithic) soils	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	9,420	
CWH ms 1	FR m	Amabilis Fir - Western Hemlock	moist soils	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	3,672	
CWH ms 1	FR n	Amabilis Fir - Western Hemlock	cool (northerly) aspect	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	164,625	
CWH ms 1	FR s	Amabilis Fir - Western Hemlock	steep, warm (southerly) aspect	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	143,471	
CWH ms 1	FR t	Amabilis Fir - Western Hemlock	moderate, warm (southerly) aspect	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	10,682	
CWH ms 1	MF	Mountain Hemlock - Amabilis Fir		North Pacific Mountain Hemlock Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	18	
CWH ms 1	MF n	Mountain Hemlock - Amabilis Fir	cool (northerly) aspect	North Pacific Mountain Hemlock Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	14	
CWH ms 1	MF s	Mountain Hemlock - Amabilis Fir	steep, warm (southerly) aspect	North Pacific Mountain Hemlock Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	6	

Crosswalk of BEC-BEU combinations to ecological systems

BEC LABEL	HAB1MOD1	BEU name	BEU modifier	Draft #1 March 31, Rex Crawford WA NHP	Draft #2 April 14, Geoff Cushon BC MoF	Final May 3	area (ha)	comment
CWH ms 1	RS	Western Redcedar Swamp		North Pacific Hardwood-Coniferous Swamp	North Pacific Hardwood-Coniferous Swamp	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	76	wetland - disregard due to scale
CWH ms 1	SM	Subalpine Meadow		North Pacific Maritime Mesic Subalpine Parkland	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	340	
CWH ms 1	WL	wetland		Boreal Fen	Boreal Fen	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	1,130	wetland - disregard due to scale
CDF mm	CD	CD Coastal Douglas-fir		North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest	North Pacific Maritime Dry-Mesic Douglas-Fir Forest	North Pacific Maritime Dry-Mesic Douglas-Fir Forest	6,812	
CDF mm	CG	Coastal Western Redcedar - Grand Fir		North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest	North Pacific Maritime Dry-Mesic Douglas-Fir Forest	North Pacific Maritime Dry-Mesic Douglas-Fir Forest	193	
CDF mm	CW m	Coastal Western Hemlock - Douglas-fir	moist soils	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Maritime Dry-Mesic Douglas-Fir Forest	North Pacific Maritime Dry-Mesic Douglas-Fir Forest	659	
CWH xm 1	CD	CD Coastal Douglas-fir		North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest	North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest	North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest	5,334	
CWH xm 1	CD l	CD Coastal Douglas-fir	shallow (lithic) soils	North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest	North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest	North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest	598	
CWH xm 1	CD s	CD Coastal Douglas-fir	steep, warm (southerly) aspect	North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest	North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest	North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest	4,788	

Crosswalk of BEC-BEU combinations to ecological systems

BEC LABEL	HAB1MOD1	BEU name	BEU modifier	Draft #1 March 31, Rex Crawford WA NHP	Draft #2 April 14, Geoff Cushon BC MoF	Final May 3	area (ha)	comment
CWH xm 1	CD t	CD Coastal Douglas-fir	moderate, warm (southerly) aspect	North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest	North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest	North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest	805	
CWH xm 1	CW	Coastal Western Hemlock - Douglas-fir		North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest	North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest	53,371	
CWH xm 1	CW n	Coastal Western Hemlock - Douglas-fir	cool (northerly) aspect	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest	North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest	341	
AT unp	FR	Amabilis Fir - Western Hemlock		North Pacific Maritime Mesic Subalpine Parkland	North Pacific Maritime Mesic Subalpine Parkland	North Pacific Maritime Mesic Subalpine Parkland	19	follow Rex C. interpretation of BEU b/c AT unp is modelled & least-studied BEC unit (pers. comm. Fred N.)
AT unp	FR n	Amabilis Fir - Western Hemlock	cool (northerly) aspect	North Pacific Maritime Mesic Subalpine Parkland	North Pacific Maritime Mesic Subalpine Parkland	North Pacific Maritime Mesic Subalpine Parkland	759	follow Rex C. interpretation of BEU b/c AT unp is modelled & least-studied BEC unit (pers. comm. Fred N.)
AT unp	HP	Mountain Hemlock Parkland		North Pacific Maritime Mesic Subalpine Parkland	North Pacific Maritime Mesic Subalpine Parkland	North Pacific Maritime Mesic Subalpine Parkland	15,512	follow Rex C. interpretation of BEU b/c AT unp is modelled & least-studied BEC unit (pers. comm. Fred N.)
AT unp	HP l	Mountain Hemlock Parkland	shallow (lithic) soils	North Pacific Maritime Mesic Subalpine Parkland	North Pacific Maritime Mesic Subalpine Parkland	North Pacific Maritime Mesic Subalpine Parkland	2,922	follow Rex C. interpretation of BEU b/c AT unp is modelled & least-studied BEC unit (pers. comm. Fred N.)

Crosswalk of BEC-BEU combinations to ecological systems

BEC LABEL	HAB1MOD1	BEU name	BEU modifier	Draft #1 March 31, Rex Crawford WA NHP	Draft #2 April 14, Geoff Cushon BC MoF	Final May 3	area (ha)	comment
AT unp	HP n	Mountain Hemlock Parkland	cool (northerly) aspect	North Pacific Maritime Mesic Subalpine Parkland	North Pacific Maritime Mesic Subalpine Parkland	North Pacific Maritime Mesic Subalpine Parkland	200	follow Rex C. interpretation of BEU b/c AT unp is modelled & least-studied BEC unit (pers. comm. Fred N.)
AT unp	HP s	Mountain Hemlock Parkland	steep, warm (southerly) aspect	North Pacific Maritime Mesic Subalpine Parkland	North Pacific Maritime Mesic Subalpine Parkland	North Pacific Maritime Mesic Subalpine Parkland	295	follow Rex C. interpretation of BEU b/c AT unp is modelled & least-studied BEC unit (pers. comm. Fred N.)
AT unp	SM	Subalpine Meadow		North Pacific Maritime Mesic Subalpine Parkland	North Pacific Maritime Mesic Subalpine Parkland	North Pacific Maritime Mesic Subalpine Parkland	5,166	follow Rex C. interpretation of BEU b/c AT unp is modelled & least-studied BEC unit (pers. comm. Fred N.)
AT unp	WP	Subalpine fir - Mountain Hemlock Wet Parkland		North Pacific Maritime Mesic Subalpine Parkland	North Pacific Maritime Mesic Subalpine Parkland	North Pacific Maritime Mesic Subalpine Parkland	878	follow Rex C. interpretation of BEU b/c AT unp is modelled & least-studied BEC unit (pers. comm. Fred N.)
AT unp	WP l	Subalpine fir - Mountain Hemlock Wet Parkland	shallow (lithic) soils	North Pacific Maritime Mesic Subalpine Parkland	North Pacific Maritime Mesic Subalpine Parkland	North Pacific Maritime Mesic Subalpine Parkland	2,255	follow Rex C. interpretation of BEU b/c AT unp is modelled & least-studied BEC unit (pers. comm. Fred N.)
AT unp	YS	Yellow-cedar Skunk Cabbage Swamp Forest		North Pacific Hardwood-Coniferous Swamp	North Pacific Maritime Mesic Subalpine Parkland	North Pacific Maritime Mesic Subalpine Parkland	135	wetland - disregard due to scale
MH mm 1	HP	Mountain Hemlock Parkland		North Pacific Maritime Mesic Subalpine Parkland	North Pacific Mountain Hemlock Forest	North Pacific Maritime Mesic Subalpine Parkland	6,926	follow Rex C. interpretation of BEU b/c MH is less-studied BEC unit (pers. comm. Fred N.)

Crosswalk of BEC-BEU combinations to ecological systems

BEC LABEL	HAB1MOD1	BEU name	BEU modifier	Draft #1 March 31, Rex Crawford WA NHP	Draft #2 April 14, Geoff Cushon BC MoF	Final May 3	area (ha)	comment
MH mm 1	HP l	Mountain Hemlock Parkland	shallow (lithic) soils	North Pacific Maritime Mesic Subalpine Parkland	North Pacific Mountain Hemlock Forest	North Pacific Maritime Mesic Subalpine Parkland	2,814	follow Rex C. interpretation of BEU b/c MH is less-studied BEC unit (pers. comm. Fred N.)
MH mm 1	HP n	Mountain Hemlock Parkland	cool (northerly) aspect	North Pacific Maritime Mesic Subalpine Parkland	North Pacific Mountain Hemlock Forest	North Pacific Maritime Mesic Subalpine Parkland	130	follow Rex C. interpretation of BEU b/c MH is less-studied BEC unit (pers. comm. Fred N.)
MH mm 1	HP s	Mountain Hemlock Parkland	steep, warm (southerly) aspect	North Pacific Maritime Mesic Subalpine Parkland	North Pacific Mountain Hemlock Forest	North Pacific Maritime Mesic Subalpine Parkland	79	follow Rex C. interpretation of BEU b/c MH is less-studied BEC unit (pers. comm. Fred N.)
MH mm 1	SM	Subalpine Meadow		North Pacific Maritime Mesic Subalpine Parkland	North Pacific Mountain Hemlock Forest	North Pacific Maritime Mesic Subalpine Parkland	323	follow Rex C. interpretation of BEU b/c MH is less-studied BEC unit (pers. comm. Fred N.)
MH mm 2	HP	Mountain Hemlock Parkland		North Pacific Maritime Mesic Subalpine Parkland	North Pacific Mountain Hemlock Forest	North Pacific Maritime Mesic Subalpine Parkland	3,322	follow Rex C. interpretation of BEU b/c MH is less-studied BEC unit (pers. comm. Fred N.)
MH mm 2	HP l	Mountain Hemlock Parkland	shallow (lithic) soils	North Pacific Maritime Mesic Subalpine Parkland	North Pacific Mountain Hemlock Forest	North Pacific Maritime Mesic Subalpine Parkland	164	follow Rex C. interpretation of BEU b/c MH is less-studied BEC unit (pers. comm. Fred N.)
MH mm 2	HP n	Mountain Hemlock Parkland	cool (northerly) aspect	North Pacific Maritime Mesic Subalpine Parkland	North Pacific Mountain Hemlock Forest	North Pacific Maritime Mesic Subalpine Parkland	59	follow Rex C. interpretation of BEU b/c MH is less-studied BEC unit (pers. comm. Fred N.)
MH mm 2	HP s	Mountain Hemlock Parkland	steep, warm (southerly) aspect	North Pacific Maritime Mesic Subalpine Parkland	North Pacific Mountain Hemlock Forest	North Pacific Maritime Mesic Subalpine Parkland	71	follow Rex C. interpretation of BEU b/c MH is less-studied BEC unit (pers. comm. Fred N.)

Crosswalk of BEC-BEU combinations to ecological systems

BEC LABEL	HAB1MOD1	BEU name	BEU modifier	Draft #1 March 31, Rex Crawford WA NHP	Draft #2 April 14, Geoff Cushon BC MoF	Final May 3	area (ha)	comment
MH mm 2	SM	Subalpine Meadow		North Pacific Maritime Mesic Subalpine Parkland	North Pacific Mountain Hemlock Forest	North Pacific Maritime Mesic Subalpine Parkland	1,701	follow Rex C. interpretation of BEU b/c MH is less-studied BEC unit (pers. comm. Fred N.)
MH mm 2	WP	Subalpine fir - Mountain Hemlock Wet Parkland		North Pacific Maritime Mesic Subalpine Parkland	North Pacific Mountain Hemlock Forest	North Pacific Maritime Mesic Subalpine Parkland	8	follow Rex C. interpretation of BEU b/c MH is less-studied BEC unit (pers. comm. Fred N.)
CWH dm	CD	CD Coastal Douglas-fir		North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	12,704	
CWH dm	CD l	CD Coastal Douglas-fir	shallow (lithic) soils	North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	3,757	
CWH dm	CD s	CD Coastal Douglas-fir	steep, warm (southerly) aspect	North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	48,398	
CWH dm	CD t	CD Coastal Douglas-fir	moderate, warm (southerly) aspect	North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	38,904	
CWH dm	CH s	Coastal Western Hemlock - Western Redcedar	steep, warm (southerly) aspect	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	2	
CWH dm	CW	Coastal Western Hemlock - Douglas-fir		North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	153,306	

Crosswalk of BEC-BEU combinations to ecological systems

BEC LABEL	HAB1MOD1	BEU name	BEU modifier	Draft #1 March 31, Rex Crawford WA NHP	Draft #2 April 14, Geoff Cushon BC MoF	Final May 3	area (ha)	comment
CWH dm	CW n	Coastal Western Hemlock - Douglas-fir	cool (northerly) aspect	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	61,323	
CWH dm	CW s	Coastal Western Hemlock - Douglas-fir	steep, warm (southerly) aspect	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	8,407	
CWH dm	CW t	Coastal Western Hemlock - Douglas-fir	moderate, warm (southerly) aspect	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	453	
CWH dm	ES	Estuary		Temperate Pacific Tidal Salt and Brackish Marsh	Temperate Pacific Tidal Salt and Brackish Marsh	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	135	wetland - disregard due to scale
CWH dm	FR	Amabilis Fir - Western Hemlock		North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	12	
CWH dm	FR n	Amabilis Fir - Western Hemlock	cool (northerly) aspect	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	2	
CWH dm	WL	wetland		Boreal Fen	Boreal Fen	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	3,185	wetland - disregard due to scale
CWH ds 1	CD	CD Coastal Douglas-fir		North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	6,870	

Crosswalk of BEC-BEU combinations to ecological systems

BEC LABEL	HAB1MOD1	BEU name	BEU modifier	Draft #1 March 31, Rex Crawford WA NHP	Draft #2 April 14, Geoff Cushon BC MoF	Final May 3	area (ha)	comment
CWH ds 1	CD l	CD Coastal Douglas-fir	shallow (lithic) soils	North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	4,589	
CWH ds 1	CD n	CD Coastal Douglas-fir	cool (northerly) aspect	North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	3,527	
CWH ds 1	CD s	CD Coastal Douglas-fir	steep, warm (southerly) aspect	North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	45,048	
CWH ds 1	CD t	CD Coastal Douglas-fir	moderate, warm (southerly) aspect	North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	14,301	
CWH ds 1	CW	Coastal Western Hemlock - Douglas-fir		North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	39,195	
CWH ds 1	CW n	Coastal Western Hemlock - Douglas-fir	cool (northerly) aspect	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	46,755	
CWH ds 1	CW s	Coastal Western Hemlock - Douglas-fir	steep, warm (southerly) aspect	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	9,538	
CWH ds 1	FR	Amabilis Fir - Western Hemlock		North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	1	

Crosswalk of BEC-BEU combinations to ecological systems

BEC LABEL	HAB1MOD1	BEU name	BEU modifier	Draft #1 March 31, Rex Crawford WA NHP	Draft #2 April 14, Geoff Cushon BC MoF	Final May 3	area (ha)	comment
CWH ds 1	FR n	Amabilis Fir - Western Hemlock	cool (northerly) aspect	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	48	
CWH ds 1	HS	Western Hemlock - Sitka Spruce		North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	163	
CWH ds 1	WL	wetland		Boreal Fen	Boreal Fen	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	697	wetland - disregard due to scale
CWH vm 1	CH	Coastal Western Hemlock - Western Redcedar		North Pacific Hypermaritime Western Red cedar -Western Hemlock Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	217	
CWH vm 1	CH l	Coastal Western Hemlock - Western Redcedar	shallow (lithic) soils	North Pacific Hypermaritime Western Red cedar -Western Hemlock Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	855	
CWH vm 1	CH s	Coastal Western Hemlock - Western Redcedar	steep, warm (southerly) aspect	North Pacific Hypermaritime Western Red cedar -Western Hemlock Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	46,602	
CWH vm 1	CW	Coastal Western Hemlock - Douglas-fir		North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	3	
CWH vm 1	FR	Amabilis Fir - Western Hemlock		North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	41,436	
CWH vm 1	FR l	Amabilis Fir - Western Hemlock	shallow (lithic) soils	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	340	
CWH vm 1	FR m	Amabilis Fir - Western Hemlock	moist soils	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	362	
CWH vm 1	FR n	Amabilis Fir - Western Hemlock	cool (northerly) aspect	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	64,264	

Crosswalk of BEC-BEU combinations to ecological systems

BEC LABEL	HAB1MOD1	BEU name	BEU modifier	Draft #1 March 31, Rex Crawford WA NHP	Draft #2 April 14, Geoff Cushon BC MoF	Final May 3	area (ha)	comment
CWH vm 1	FR s	Amabilis Fir - Western Hemlock	steep, warm (southerly) aspect	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	4,712	
CWH vm 1	FR t	Amabilis Fir - Western Hemlock	moderate, warm (southerly) aspect	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	1,980	
CWH vm 1	WL	wetland		Boreal Fen	Boreal Fen	North Pacific Mesic Western Hemlock - Silver fir Forest	64	wetland - disregard due to scale
CWH vm 2	CH	Coastal Western Hemlock - Western Redcedar		North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	3,630	
CWH vm 2	CH l	Coastal Western Hemlock - Western Redcedar	shallow (lithic) soils	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	3,482	
CWH vm 2	CH n	Coastal Western Hemlock - Western Redcedar	cool (northerly) aspect	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	303	
CWH vm 2	CH s	Coastal Western Hemlock - Western Redcedar	steep, warm (southerly) aspect	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	108,051	
CWH vm 2	CW s	Coastal Western Hemlock - Douglas-fir	steep, warm (southerly) aspect	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	180	
CWH vm 2	FR	Amabilis Fir - Western Hemlock		North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	52,342	
CWH vm 2	FR l	Amabilis Fir - Western Hemlock	shallow (lithic) soils	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	1,266	
CWH vm 2	FR n	Amabilis Fir - Western Hemlock	cool (northerly) aspect	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	115,514	
CWH vm 2	FR s	Amabilis Fir - Western Hemlock	steep, warm (southerly) aspect	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	14,786	
CWH vm 2	FR t	Amabilis Fir - Western Hemlock	moderate, warm (southerly) aspect	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	197	

Crosswalk of BEC-BEU combinations to ecological systems

BEC LABEL	HAB1MOD1	BEU name	BEU modifier	Draft #1 March 31, Rex Crawford WA NHP	Draft #2 April 14, Geoff Cushon BC MoF	Final May 3	area (ha)	comment
CWH vm 2	HL l	Coastal Western Hemlock - Lodgepole Pine	shallow (lithic) soils	North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	2,113	
CWH vm 2	MF	Mountain Hemlock - Amabilis Fir		North Pacific Mountain Hemlock Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	1	
CWH vm 2	MF n	Mountain Hemlock - Amabilis Fir	cool (northerly) aspect	North Pacific Mountain Hemlock Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	488	
CWH vm 2	MF s	Mountain Hemlock - Amabilis Fir	steep, warm (southerly) aspect	North Pacific Mountain Hemlock Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	7	
MH mm 1	FR	Amabilis Fir - Western Hemlock		North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mountain Hemlock Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	358	follow Rex C. interpretation of BEU b/c MH is less-studied BEC unit (pers. comm. Fred N.)
MH mm 1	FR l	Amabilis Fir - Western Hemlock	shallow (lithic) soils	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mountain Hemlock Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	2	follow Rex C. interpretation of BEU b/c MH is less-studied BEC unit (pers. comm. Fred N.)
MH mm 1	FR n	Amabilis Fir - Western Hemlock	cool (northerly) aspect	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mountain Hemlock Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	740	follow Rex C. interpretation of BEU b/c MH is less-studied BEC unit (pers. comm. Fred N.)
MH mm 2	FR	Amabilis Fir - Western Hemlock		North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mountain Hemlock Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	170	follow Rex C. interpretation of BEU b/c MH is less-studied BEC unit (pers. comm. Fred N.)
MH mm 2	FR n	Amabilis Fir - Western Hemlock	cool (northerly) aspect	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mountain Hemlock Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	1,830	follow Rex C. interpretation of BEU b/c MH is less-studied BEC unit (pers. comm. Fred N.)

Crosswalk of BEC-BEU combinations to ecological systems

BEC LABEL	HAB1MOD1	BEU name	BEU modifier	Draft #1 March 31, Rex Crawford WA NHP	Draft #2 April 14, Geoff Cushon BC MoF	Final May 3	area (ha)	comment
MH mm 2	FR s	Amabilis Fir - Western Hemlock	steep, warm (southerly) aspect	North Pacific Mesic Western Hemlock - Silver fir Forest	North Pacific Mountain Hemlock Forest	North Pacific Mesic Western Hemlock - Silver fir Forest	10	follow Rex C. interpretation of BEU b/c MH is less-studied BEC unit (pers. comm. Fred N.)
CWH dm	RO s	Rock	steep, warm (southerly) aspect	North Pacific Montane Massive Bedrock, Cliff and Talus	North Pacific Montane Massive Bedrock, Cliff and Talus	North Pacific Montane Massive Bedrock, Cliff and Talus	192	
CWH ms 1	RO	Rock		North Pacific Montane Massive Bedrock, Cliff and Talus	North Pacific Montane Massive Bedrock, Cliff and Talus	North Pacific Montane Massive Bedrock, Cliff and Talus	538	
CWH ms 1	RO n	Rock	cool (northerly) aspect	North Pacific Montane Massive Bedrock, Cliff and Talus	North Pacific Montane Massive Bedrock, Cliff and Talus	North Pacific Montane Massive Bedrock, Cliff and Talus	100	
CWH ms 1	RO s	Rock	steep, warm (southerly) aspect	North Pacific Montane Massive Bedrock, Cliff and Talus	North Pacific Montane Massive Bedrock, Cliff and Talus	North Pacific Montane Massive Bedrock, Cliff and Talus	1,507	
CWH vm 2	RO	Rock		North Pacific Montane Massive Bedrock, Cliff and Talus	North Pacific Montane Massive Bedrock, Cliff and Talus	North Pacific Montane Massive Bedrock, Cliff and Talus	304	
CWH vm 2	RO n	Rock	cool (northerly) aspect	North Pacific Montane Massive Bedrock, Cliff and Talus	North Pacific Montane Massive Bedrock, Cliff and Talus	North Pacific Montane Massive Bedrock, Cliff and Talus	365	
CWH vm 2	RO s	Rock	steep, warm (southerly) aspect	North Pacific Montane Massive Bedrock, Cliff and Talus	North Pacific Montane Massive Bedrock, Cliff and Talus	North Pacific Montane Massive Bedrock, Cliff and Talus	320	
ESSFdv	RO s	Rock	steep, warm (southerly) aspect	North Pacific Montane Massive Bedrock, Cliff and Talus	North Pacific Montane Massive Bedrock, Cliff and Talus	North Pacific Montane Massive Bedrock, Cliff and Talus	224	

Crosswalk of BEC-BEU combinations to ecological systems

BEC LABEL	HAB1MOD1	BEU name	BEU modifier	Draft #1 March 31, Rex Crawford WA NHP	Draft #2 April 14, Geoff Cushon BC MoF	Final May 3	area (ha)	comment
ESSFmw	RO	Rock		North Pacific Montane Massive Bedrock, Cliff and Talus	North Pacific Montane Massive Bedrock, Cliff and Talus	North Pacific Montane Massive Bedrock, Cliff and Talus	276	
ESSFmw	RO n	Rock	cool (northerly) aspect	North Pacific Montane Massive Bedrock, Cliff and Talus	North Pacific Montane Massive Bedrock, Cliff and Talus	North Pacific Montane Massive Bedrock, Cliff and Talus	22	
ESSFmw	RO s	Rock	steep, warm (southerly) aspect	North Pacific Montane Massive Bedrock, Cliff and Talus	North Pacific Montane Massive Bedrock, Cliff and Talus	North Pacific Montane Massive Bedrock, Cliff and Talus	1,323	
MH mm 1	RO	Rock		North Pacific Montane Massive Bedrock, Cliff and Talus	North Pacific Montane Massive Bedrock, Cliff and Talus	North Pacific Montane Massive Bedrock, Cliff and Talus	4,201	
MH mm 1	RO n	Rock	cool (northerly) aspect	North Pacific Montane Massive Bedrock, Cliff and Talus	North Pacific Montane Massive Bedrock, Cliff and Talus	North Pacific Montane Massive Bedrock, Cliff and Talus	336	
MH mm 1	RO s	Rock	steep, warm (southerly) aspect	North Pacific Montane Massive Bedrock, Cliff and Talus	North Pacific Montane Massive Bedrock, Cliff and Talus	North Pacific Montane Massive Bedrock, Cliff and Talus	3,273	
MH mm 2	RO	Rock		North Pacific Montane Massive Bedrock, Cliff and Talus	North Pacific Montane Massive Bedrock, Cliff and Talus	North Pacific Montane Massive Bedrock, Cliff and Talus	1,839	
MH mm 2	RO n	Rock	cool (northerly) aspect	North Pacific Montane Massive Bedrock, Cliff and Talus	North Pacific Montane Massive Bedrock, Cliff and Talus	North Pacific Montane Massive Bedrock, Cliff and Talus	285	
MH mm 2	RO s	Rock	steep, warm (southerly) aspect	North Pacific Montane Massive Bedrock, Cliff and Talus	North Pacific Montane Massive Bedrock, Cliff and Talus	North Pacific Montane Massive Bedrock, Cliff and Talus	745	

Crosswalk of BEC-BEU combinations to ecological systems

BEC LABEL	HAB1MOD1	BEU name	BEU modifier	Draft #1 March 31, Rex Crawford WA NHP	Draft #2 April 14, Geoff Cushon BC MoF	Final May 3	area (ha)	comment
AT unp	EW	Subalpine Fir - Mountain Hemlock Wet Forested		North Pacific Mountain Hemlock Forest	North Pacific Maritime Mesic Subalpine Parkland	North Pacific Mountain Hemlock Forest	4,142	follow Rex C. interpretation of BEU b/c AT unp is modelled & least-studied BEC unit (pers. comm. Fred N.)
AT unp	EW l	Subalpine Fir - Mountain Hemlock Wet Forested	shallow (lithic) soils	North Pacific Mountain Hemlock Forest	North Pacific Maritime Mesic Subalpine Parkland	North Pacific Mountain Hemlock Forest	1,238	follow Rex C. interpretation of BEU b/c AT unp is modelled & least-studied BEC unit (pers. comm. Fred N.)
AT unp	EW n	Subalpine Fir - Mountain Hemlock Wet Forested	cool (northerly) aspect	North Pacific Mountain Hemlock Forest	North Pacific Maritime Mesic Subalpine Parkland	North Pacific Mountain Hemlock Forest	26,249	follow Rex C. interpretation of BEU b/c AT unp is modelled & least-studied BEC unit (pers. comm. Fred N.)
AT unp	EW s	Subalpine Fir - Mountain Hemlock Wet Forested	steep, warm (southerly) aspect	North Pacific Mountain Hemlock Forest	North Pacific Maritime Mesic Subalpine Parkland	North Pacific Mountain Hemlock Forest	14,406	follow Rex C. interpretation of BEU b/c AT unp is modelled & least-studied BEC unit (pers. comm. Fred N.)
AT unp	EW u	Subalpine Fir - Mountain Hemlock Wet Forested	upper elevation, gentle slope	North Pacific Mountain Hemlock Forest	North Pacific Maritime Mesic Subalpine Parkland	North Pacific Mountain Hemlock Forest	6,259	follow Rex C. interpretation of BEU b/c AT unp is modelled & least-studied BEC unit (pers. comm. Fred N.)
AT unp	MF	Mountain Hemlock - Amabilis Fir		North Pacific Mountain Hemlock Forest	North Pacific Maritime Mesic Subalpine Parkland	North Pacific Mountain Hemlock Forest	16,413	follow Rex C. interpretation of BEU b/c AT unp is modelled & least-studied BEC unit (pers. comm. Fred N.)

Crosswalk of BEC-BEU combinations to ecological systems

BEC LABEL	HAB1MOD1	BEU name	BEU modifier	Draft #1 March 31, Rex Crawford WA NHP	Draft #2 April 14, Geoff Cushon BC MoF	Final May 3	area (ha)	comment
AT unp	MF l	Mountain Hemlock - Amabilis Fir	shallow (lithic) soils	North Pacific Mountain Hemlock Forest	North Pacific Maritime Mesic Subalpine Parkland	North Pacific Mountain Hemlock Forest	22,415	follow Rex C. interpretation of BEU b/c AT unp is modelled & least-studied BEC unit (pers. comm. Fred N.)
AT unp	MF n	Mountain Hemlock - Amabilis Fir	cool (northerly) aspect	North Pacific Mountain Hemlock Forest	North Pacific Maritime Mesic Subalpine Parkland	North Pacific Mountain Hemlock Forest	55,639	follow Rex C. interpretation of BEU b/c AT unp is modelled & least-studied BEC unit (pers. comm. Fred N.)
AT unp	MF s	Mountain Hemlock - Amabilis Fir	steep, warm (southerly) aspect	North Pacific Mountain Hemlock Forest	North Pacific Maritime Mesic Subalpine Parkland	North Pacific Mountain Hemlock Forest	89,150	follow Rex C. interpretation of BEU b/c AT unp is modelled & least-studied BEC unit (pers. comm. Fred N.)
AT unp	MF t	Mountain Hemlock - Amabilis Fir	moderate, warm (southerly) aspect	North Pacific Mountain Hemlock Forest	North Pacific Maritime Mesic Subalpine Parkland	North Pacific Mountain Hemlock Forest	932	follow Rex C. interpretation of BEU b/c AT unp is modelled & least-studied BEC unit (pers. comm. Fred N.)
AT unp	MF u	Mountain Hemlock - Amabilis Fir	upper elevation, gentle slope	North Pacific Mountain Hemlock Forest	North Pacific Maritime Mesic Subalpine Parkland	North Pacific Mountain Hemlock Forest	14,698	follow Rex C. interpretation of BEU b/c AT unp is modelled & least-studied BEC unit (pers. comm. Fred N.)
MH mm 1	CH s	Coastal Western Hemlock - Western Redcedar	steep, warm (southerly) aspect	North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest	North Pacific Mountain Hemlock Forest	North Pacific Mountain Hemlock Forest	8	BEU = CH is artifact, scattered 7 occs, total area < 9ha
MH mm 1	MF	Mountain Hemlock - Amabilis Fir		North Pacific Mountain Hemlock Forest	North Pacific Mountain Hemlock Forest	North Pacific Mountain Hemlock Forest	70,400	follow Rex C. interpretation of BEU b/c MH is less-studied BEC unit (pers. comm. Fred N.)

Crosswalk of BEC-BEU combinations to ecological systems

BEC LABEL	HAB1MOD1	BEU name	BEU modifier	Draft #1 March 31, Rex Crawford WA NHP	Draft #2 April 14, Geoff Cushon BC MoF	Final May 3	area (ha)	comment
MH mm 1	MF l	Mountain Hemlock - Amabilis Fir	shallow (lithic) soils	North Pacific Mountain Hemlock Forest	North Pacific Mountain Hemlock Forest	North Pacific Mountain Hemlock Forest	16,968	follow Rex C. interpretation of BEU b/c MH is less-studied BEC unit (pers. comm. Fred N.)
MH mm 1	MF n	Mountain Hemlock - Amabilis Fir	cool (northerly) aspect	North Pacific Mountain Hemlock Forest	North Pacific Mountain Hemlock Forest	North Pacific Mountain Hemlock Forest	64,112	follow Rex C. interpretation of BEU b/c MH is less-studied BEC unit (pers. comm. Fred N.)
MH mm 1	MF s	Mountain Hemlock - Amabilis Fir	steep, warm (southerly) aspect	North Pacific Mountain Hemlock Forest	North Pacific Mountain Hemlock Forest	North Pacific Mountain Hemlock Forest	88,644	follow Rex C. interpretation of BEU b/c MH is less-studied BEC unit (pers. comm. Fred N.)
MH mm 1	MF u	Mountain Hemlock - Amabilis Fir	upper elevation, gentle slope	North Pacific Mountain Hemlock Forest	North Pacific Mountain Hemlock Forest	North Pacific Mountain Hemlock Forest	8,503	follow Rex C. interpretation of BEU b/c MH is less-studied BEC unit (pers. comm. Fred N.)
MH mm 2	EW	Subalpine Fir - Mountain Hemlock Wet Forested		North Pacific Mountain Hemlock Forest	North Pacific Mountain Hemlock Forest	North Pacific Mountain Hemlock Forest	29	follow Rex C. interpretation of BEU b/c MH is less-studied BEC unit (pers. comm. Fred N.)
MH mm 2	EW n	Subalpine Fir - Mountain Hemlock Wet Forested	cool (northerly) aspect	North Pacific Mountain Hemlock Forest	North Pacific Mountain Hemlock Forest	North Pacific Mountain Hemlock Forest	6,053	follow Rex C. interpretation of BEU b/c MH is less-studied BEC unit (pers. comm. Fred N.)
MH mm 2	EW s	Subalpine Fir - Mountain Hemlock Wet Forested	steep, warm (southerly) aspect	North Pacific Mountain Hemlock Forest	North Pacific Mountain Hemlock Forest	North Pacific Mountain Hemlock Forest	269	follow Rex C. interpretation of BEU b/c MH is less-studied BEC unit (pers. comm. Fred N.)
MH mm 2	MF	Mountain Hemlock - Amabilis Fir		North Pacific Mountain Hemlock Forest	North Pacific Mountain Hemlock Forest	North Pacific Mountain Hemlock Forest	21,514	follow Rex C. interpretation of BEU b/c MH is less-studied BEC unit (pers. comm. Fred N.)

Crosswalk of BEC-BEU combinations to ecological systems

BEC LABEL	HAB1MOD1	BEU name	BEU modifier	Draft #1 March 31, Rex Crawford WA NHP	Draft #2 April 14, Geoff Cushon BC MoF	Final May 3	area (ha)	comment
MH mm 2	MF l	Mountain Hemlock - Amabilis Fir	shallow (lithic) soils	North Pacific Mountain Hemlock Forest	North Pacific Mountain Hemlock Forest	North Pacific Mountain Hemlock Forest	10,426	follow Rex C. interpretation of BEU b/c MH is less-studied BEC unit (pers. comm. Fred N.)
MH mm 2	MF n	Mountain Hemlock - Amabilis Fir	cool (northerly) aspect	North Pacific Mountain Hemlock Forest	North Pacific Mountain Hemlock Forest	North Pacific Mountain Hemlock Forest	113,708	follow Rex C. interpretation of BEU b/c MH is less-studied BEC unit (pers. comm. Fred N.)
MH mm 2	MF s	Mountain Hemlock - Amabilis Fir	steep, warm (southerly) aspect	North Pacific Mountain Hemlock Forest	North Pacific Mountain Hemlock Forest	North Pacific Mountain Hemlock Forest	94,100	follow Rex C. interpretation of BEU b/c MH is less-studied BEC unit (pers. comm. Fred N.)
MH mm 2	MF t	Mountain Hemlock - Amabilis Fir	moderate, warm (southerly) aspect	North Pacific Mountain Hemlock Forest	North Pacific Mountain Hemlock Forest	North Pacific Mountain Hemlock Forest	2,306	follow Rex C. interpretation of BEU b/c MH is less-studied BEC unit (pers. comm. Fred N.)
MH mm 2	MF u	Mountain Hemlock - Amabilis Fir	upper elevation, gentle slope	North Pacific Mountain Hemlock Forest	North Pacific Mountain Hemlock Forest	North Pacific Mountain Hemlock Forest	28,776	follow Rex C. interpretation of BEU b/c MH is less-studied BEC unit (pers. comm. Fred N.)
MH mm 2	WL	wetland		Boreal Fen	Boreal Fen	North Pacific Mountain Hemlock Forest	287	wetland - disregard due to scale
MH mm 2	YS	Yellow-cedar Skunk Cabbage Swamp Forest		North Pacific Hardwood-Coniferous Swamp	North Pacific Hardwood-Coniferous Swamp	North Pacific Mountain Hemlock Forest	101	wetland - disregard due to scale
MS dc 1	DL s	Douglas-fir - Lodgepole Pine	steep, warm (southerly) aspect	Northern Interior Spruce-Fir woodland and forest	Northern Interior Spruce-Fir woodland and forest	Northern Interior Spruce-Fir woodland and forest	503	
MS dc 1	EF n	Engelmann Spruce - Sub-alpine Fir Dry Forested	cool (northerly) aspect	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Northern Interior Spruce-Fir woodland and forest	Northern Interior Spruce-Fir woodland and forest	2	
MS dc 1	SF	White Spruce - Subalpine Fir		Northern Interior Spruce-Fir woodland and forest	Northern Interior Spruce-Fir woodland and forest	Northern Interior Spruce-Fir woodland and forest	383	

Crosswalk of BEC-BEU combinations to ecological systems

BEC LABEL	HAB1MOD1	BEU name	BEU modifier	Draft #1 March 31, Rex Crawford WA NHP	Draft #2 April 14, Geoff Cushon BC MoF	Final May 3	area (ha)	comment
MS dc 1	SF n	White Spruce - Subalpine Fir	cool (northerly) aspect	Northern Interior Spruce-Fir woodland and forest	Northern Interior Spruce-Fir woodland and forest	Northern Interior Spruce-Fir woodland and forest	331	
MS dm 2	DL	Douglas-fir - Lodgepole Pine		Northern Interior Spruce-Fir woodland and forest	Northern Interior Spruce-Fir woodland and forest	Northern Interior Spruce-Fir woodland and forest	2,094	
MS dm 2	DL t	Douglas-fir - Lodgepole Pine	moderate, warm (southerly) aspect	Northern Interior Spruce-Fir woodland and forest	Northern Interior Spruce-Fir woodland and forest	Northern Interior Spruce-Fir woodland and forest	859	
MS dm 2	EF	Engelmann Spruce - Sub-alpine Fir Dry Forested		Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Northern Interior Spruce-Fir woodland and forest	Northern Interior Spruce-Fir woodland and forest	65	
MS dm 2	FP	Engelmann Spruce - Subalpine Fir Parkland		Northern Rocky Mountain Subalpine Dry Parkland	Northern Interior Spruce-Fir woodland and forest	Northern Interior Spruce-Fir woodland and forest	3	
MS dm 2	SF	White Spruce - Subalpine Fir		Northern Interior Spruce-Fir woodland and forest	Northern Interior Spruce-Fir woodland and forest	Northern Interior Spruce-Fir woodland and forest	3,925	
MS dm 2	SF t	White Spruce - Subalpine Fir	moderate, warm (southerly) aspect	Northern Interior Spruce-Fir woodland and forest	Northern Interior Spruce-Fir woodland and forest	Northern Interior Spruce-Fir woodland and forest	78	
MS un	DF s	Interior Douglas-fir Forest	steep, warm (southerly) aspect	Northern Interior Spruce-Fir woodland and forest	Northern Interior Spruce-Fir woodland and forest	Northern Interior Spruce-Fir woodland and forest	2	
MS un	DL s	Douglas-fir - Lodgepole Pine	steep, warm (southerly) aspect	Northern Interior Spruce-Fir woodland and forest	Northern Interior Spruce-Fir woodland and forest	Northern Interior Spruce-Fir woodland and forest	1,381	
MS un	EW n	Subalpine Fir - Mountain Hemlock Wet Forested	cool (northerly) aspect	North Pacific Mountain Hemlock Forest	Northern Interior Spruce-Fir woodland and forest	Northern Interior Spruce-Fir woodland and forest	3	
MS un	EW s	Subalpine Fir - Mountain Hemlock Wet Forested	steep, warm (southerly) aspect	North Pacific Mountain Hemlock Forest	Northern Interior Spruce-Fir woodland and forest	Northern Interior Spruce-Fir woodland and forest	2	
MS un	FR n	Amabilis Fir - Western Hemlock	cool (northerly) aspect	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	Northern Interior Spruce-Fir woodland and forest	Northern Interior Spruce-Fir woodland and forest	4	
MS un	SF	White Spruce - Subalpine Fir		Northern Interior Spruce-Fir woodland and forest	Northern Interior Spruce-Fir woodland and forest	Northern Interior Spruce-Fir woodland and forest	8,703	

Crosswalk of BEC-BEU combinations to ecological systems

BEC LABEL	HAB1MOD1	BEU name	BEU modifier	Draft #1 March 31, Rex Crawford WA NHP	Draft #2 April 14, Geoff Cushon BC MoF	Final May 3	area (ha)	comment
MS un	SF n	White Spruce - Subalpine Fir	cool (northerly) aspect	Northern Interior Spruce-Fir woodland and forest	Northern Interior Spruce-Fir woodland and forest	Northern Interior Spruce-Fir woodland and forest	481	
AT unp	EF	Engelmann Spruce - Sub-alpine Fir Dry Forested		Northern Rocky Mountain Subalpine Dry Parkland	Northern Rocky Mountain Subalpine Dry Parkland	Northern Rocky Mountain Subalpine Dry Parkland	24	
AT unp	EF n	Engelmann Spruce - Sub-alpine Fir Dry Forested	cool (northerly) aspect	Northern Rocky Mountain Subalpine Dry Parkland	Northern Rocky Mountain Subalpine Dry Parkland	Northern Rocky Mountain Subalpine Dry Parkland	3,914	
AT unp	EF s	Engelmann Spruce - Sub-alpine Fir Dry Forested	steep, warm (southerly) aspect	Northern Rocky Mountain Subalpine Dry Parkland	Northern Rocky Mountain Subalpine Dry Parkland	Northern Rocky Mountain Subalpine Dry Parkland	13,482	
AT unp	EF t	Engelmann Spruce - Sub-alpine Fir Dry Forested	moderate, warm (southerly) aspect	Northern Rocky Mountain Subalpine Dry Parkland	Northern Rocky Mountain Subalpine Dry Parkland	Northern Rocky Mountain Subalpine Dry Parkland	804	
AT unp	EF u	Engelmann Spruce - Sub-alpine Fir Dry Forested	upper elevation, gentle slope	Northern Rocky Mountain Subalpine Dry Parkland	Northern Rocky Mountain Subalpine Dry Parkland	Northern Rocky Mountain Subalpine Dry Parkland	4,753	
AT unp	FP	Engelmann Spruce - Subalpine Fir Parkland		Northern Rocky Mountain Subalpine Dry Parkland	Northern Rocky Mountain Subalpine Dry Parkland	Northern Rocky Mountain Subalpine Dry Parkland	586	
AT unp	AM	Alpine Meadow		NP Alpine composite	NP Alpine composite	Alpine composite	85	
AT unp	AM s	Alpine Meadow	steep, warm (southerly) aspect	NP Alpine composite	NP Alpine composite	Alpine composite	392	
AT unp	AT	Alpine Tundra		NP Alpine composite	NP Alpine composite	Alpine composite	6,432	
AT unp	AT s	Alpine Tundra	steep, warm (southerly) aspect	NP Alpine composite	NP Alpine composite	Alpine composite	1,012	
ESSFmw	AT	Alpine Tundra		NP Alpine composite	NP Alpine composite	Alpine composite	64	
ESSFmw	AT s	Alpine Tundra	steep, warm (southerly) aspect	NP Alpine composite	NP Alpine composite	Alpine composite	41	
MH mm 1	AT	Alpine Tundra		NP Alpine composite	NP Alpine composite	Alpine composite	463	
MH mm 2	AM s	Alpine Meadow	steep, warm (southerly) aspect	NP Alpine composite	NP Alpine composite	Alpine composite	25	
MH mm 2	AT	Alpine Tundra		NP Alpine composite	NP Alpine composite	Alpine composite	43	
MH mm 2	AT s	Alpine Tundra	steep, warm (southerly) aspect	NP Alpine composite	NP Alpine composite	Alpine composite	42	

Crosswalk of BEC-BEU combinations to ecological systems

BEC LABEL	HAB1MOD1	BEU name	BEU modifier	Draft #1 March 31, Rex Crawford WA NHP	Draft #2 April 14, Geoff Cushon BC MoF	Final May 3	area (ha)	comment
CWH dm	SR	Sitka Spruce - Black Cottonwood Riparian		North Pacific Lowland Riparian Forest and Shrubland	North Pacific Lowland Riparian Forest and Shrubland	**riparian**	10,095	map as 'riparian', assign system by BEC zone
CWH ds 1	SR	Sitka Spruce - Black Cottonwood Riparian		North Pacific Lowland Riparian Forest and Shrubland	North Pacific Lowland Riparian Forest and Shrubland	**riparian**	9,104	map as 'riparian', assign system by BEC zone
CWH xm 1	CR	Black Cottonwood Riparian Habitat Class		**North Pacific Montane Riparian Woodland and Shrubland**	**North Pacific Montane Riparian Woodland and Shrubland**	**riparian**	247	this occurrence is not montane; map as 'riparian', assign system by BEC zone
IDF ww	RR	Western Redcedar - Black Cottonwood Riparian		North Pacific Lowland Riparian Forest and Shrubland	North Pacific Lowland Riparian Forest and Shrubland	**riparian**	788	map as 'riparian', assign system by BEC zone
ESSFdc 2	EF	Engelmann Spruce - Sub-alpine Fir Dry Forested		Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	9,672	
ESSFdc 2	EF u	Engelmann Spruce - Sub-alpine Fir Dry Forested	upper elevation, gentle slope	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	3,867	
ESSFdc 2	FP	Engelmann Spruce - Subalpine Fir Parkland		Northern Rocky Mountain Subalpine Dry Parkland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	462	
ESSFdc 2	SM	Subalpine Meadow		North Pacific Maritime Mesic Subalpine Parkland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	116	
ESSFdcp	EF	Engelmann Spruce - Sub-alpine Fir Dry Forested		Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	610	
ESSFdcp	FP	Engelmann Spruce - Subalpine Fir Parkland		Northern Rocky Mountain Subalpine Dry Parkland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	339	

Crosswalk of BEC-BEU combinations to ecological systems

BEC LABEL	HAB1MOD1	BEU name	BEU modifier	Draft #1 March 31, Rex Crawford WA NHP	Draft #2 April 14, Geoff Cushon BC MoF	Final May 3	area (ha)	comment
ESSFdcp	SM	Subalpine Meadow		North Pacific Maritime Mesic Subalpine Parkland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	398	
ESSFdv	DF s	Interior Douglas-fir Forest	steep, warm (southerly) aspect	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	1	
ESSFdv	DL s	Douglas-fir - Lodgepole Pine	steep, warm (southerly) aspect	Northern Interior Spruce-Fir woodland and forest	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	2	
ESSFdv	EF	Engelmann Spruce - Sub-alpine Fir Dry Forested		Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	1,886	
ESSFdv	EF n	Engelmann Spruce - Sub-alpine Fir Dry Forested	cool (northerly) aspect	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	4,215	
ESSFdv	EF s	Engelmann Spruce - Sub-alpine Fir Dry Forested	steep, warm (southerly) aspect	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	3,270	
ESSFdv	EW n	Subalpine Fir - Mountain Hemlock Wet Forested	cool (northerly) aspect	North Pacific Mountain Hemlock Forest	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	28	
ESSFdv	EW s	Subalpine Fir - Mountain Hemlock Wet Forested	steep, warm (southerly) aspect	North Pacific Mountain Hemlock Forest	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	16	
ESSFdv	SF n	White Spruce - Subalpine Fir	cool (northerly) aspect	Northern Interior Spruce-Fir woodland and forest	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	2	

Crosswalk of BEC-BEU combinations to ecological systems

BEC LABEL	HAB1MOD1	BEU name	BEU modifier	Draft #1 March 31, Rex Crawford WA NHP	Draft #2 April 14, Geoff Cushon BC MoF	Final May 3	area (ha)	comment
ESSFmw	DL s	Douglas-fir - Lodgepole Pine	steep, warm (southerly) aspect	Northern Interior Spruce-Fir woodland and forest	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	1	
ESSFmw	EF l	Engelmann Spruce - Sub-alpine Fir Dry Forested	shallow (lithic) soils	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	181	
ESSFmw	EF s	Engelmann Spruce - Sub-alpine Fir Dry Forested	steep, warm (southerly) aspect	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	28,677	
ESSFmw	EF t	Engelmann Spruce - Sub-alpine Fir Dry Forested	moderate, warm (southerly) aspect	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	3,341	
ESSFmw	EF u	Engelmann Spruce - Sub-alpine Fir Dry Forested	upper elevation, gentle slope	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	12,841	
ESSFmw	EW	Subalpine Fir - Mountain Hemlock Wet Forested		North Pacific Mountain Hemlock Forest	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	38,366	
ESSFmw	EW l	Subalpine Fir - Mountain Hemlock Wet Forested	shallow (lithic) soils	North Pacific Mountain Hemlock Forest	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	493	
ESSFmw	EW n	Subalpine Fir - Mountain Hemlock Wet Forested	cool (northerly) aspect	North Pacific Mountain Hemlock Forest	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	52,117	
ESSFmw	EW s	Subalpine Fir - Mountain Hemlock Wet Forested	steep, warm (southerly) aspect	North Pacific Mountain Hemlock Forest	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	32,611	
ESSFmw	EW u	Subalpine Fir - Mountain Hemlock Wet Forested	upper elevation, gentle slope	North Pacific Mountain Hemlock Forest	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	43,688	

Crosswalk of BEC-BEU combinations to ecological systems

BEC LABEL	HAB1MOD1	BEU name	BEU modifier	Draft #1 March 31, Rex Crawford WA NHP	Draft #2 April 14, Geoff Cushon BC MoF	Final May 3	area (ha)	comment
ESSFmw	FR	Amabilis Fir - Western Hemlock		North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	54	
ESSFmw	FR n	Amabilis Fir - Western Hemlock	cool (northerly) aspect	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	7	
ESSFmw	FR s	Amabilis Fir - Western Hemlock	steep, warm (southerly) aspect	North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	19	
ESSFmw	MF	Mountain Hemlock - Amabilis Fir		North Pacific Mountain Hemlock Forest	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	16	
ESSFmw	MF l	Mountain Hemlock - Amabilis Fir	shallow (lithic) soils	North Pacific Mountain Hemlock Forest	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	1,177	
ESSFmw	MF n	Mountain Hemlock - Amabilis Fir	cool (northerly) aspect	North Pacific Mountain Hemlock Forest	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	352	
ESSFmw	MF s	Mountain Hemlock - Amabilis Fir	steep, warm (southerly) aspect	North Pacific Mountain Hemlock Forest	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	4,260	
ESSFmw	MF u	Mountain Hemlock - Amabilis Fir	upper elevation, gentle slope	North Pacific Mountain Hemlock Forest	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	105	
ESSFmw	SF	White Spruce - Subalpine Fir		Northern Interior Spruce-Fir woodland and forest	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	1	
ESSFmw	SM	Subalpine Meadow		North Pacific Maritime Mesic Subalpine Parkland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	69	

Crosswalk of BEC-BEU combinations to ecological systems

BEC LABEL	HAB1MOD1	BEU name	BEU modifier	Draft #1 March 31, Rex Crawford WA NHP	Draft #2 April 14, Geoff Cushon BC MoF	Final May 3	area (ha)	comment
ESSFmw	WP	Subalpine fir - Mountain Hemlock Wet Parkland		North Pacific Maritime Mesic Subalpine Parkland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	882	
ESSFmw	WP l	Subalpine fir - Mountain Hemlock Wet Parkland	shallow (lithic) soils	North Pacific Maritime Mesic Subalpine Parkland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	397	
ESSFmw	WP s	Subalpine fir - Mountain Hemlock Wet Parkland	steep, warm (southerly) aspect	North Pacific Maritime Mesic Subalpine Parkland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	727	
ESSFmwp	EF s	Engelmann Spruce - Sub-alpine Fir Dry Forested	steep, warm (southerly) aspect	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	1,824	
ESSFmwp	EF t	Engelmann Spruce - Sub-alpine Fir Dry Forested	moderate, warm (southerly) aspect	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	274	
ESSFmwp	EW	Subalpine Fir - Mountain Hemlock Wet Forested		North Pacific Mountain Hemlock Forest	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	987	
ESSFmwp	EW u	Subalpine Fir - Mountain Hemlock Wet Forested	upper elevation, gentle slope	North Pacific Mountain Hemlock Forest	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	992	
ESSFmwp	WP	Subalpine fir - Mountain Hemlock Wet Parkland		North Pacific Maritime Mesic Subalpine Parkland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	429	
ESSFmwp	WP s	Subalpine fir - Mountain Hemlock Wet Parkland	steep, warm (southerly) aspect	North Pacific Maritime Mesic Subalpine Parkland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	290	
CDF mm	UR	Urban		*urban*	*urban*	*urban*	1,260	
CWH dm	UR	Urban		*urban*	*urban*	*urban*	31,305	

Crosswalk of BEC-BEU combinations to ecological systems

BEC LABEL	HAB1MOD1	BEU name	BEU modifier	Draft #1 March 31, Rex Crawford WA NHP	Draft #2 April 14, Geoff Cushon BC MoF	Final May 3	area (ha)	comment
CWH ds 1	UR	Urban		*urban*	*urban*	*urban*	1,226	
CWH vm 1	UR	Urban		*urban*	*urban*	*urban*	217	
CWH xm 1	UR	Urban		*urban*	*urban*	*urban*	10,963	
AT unp	LS	Small Lake		*water*	*water*	*water*	189	
CDF mm	LL	Large Lake		*water*	*water*	*water*	11	
CDF mm	ST	Subtidal Marine		*water*	*water*	*water*	49,065	
CWH dm	LL	Large Lake		*water*	*water*	*water*	35,568	
CWH dm	LS	Small Lake		*water*	*water*	*water*	1,174	
CWH dm	RE	Reservoir		*water*	*water*	*water*	5,372	
CWH dm	SP	Slow Perennial Stream		*water*	*water*	*water*	5,819	
CWH dm	ST	Subtidal Marine		*water*	*water*	*water*	77,537	
CWH ds 1	LL	Large Lake		*water*	*water*	*water*	9,287	
CWH ds 1	LS	Small Lake		*water*	*water*	*water*	853	
CWH ms 1	LL	Large Lake		*water*	*water*	*water*	986	
CWH ms 1	LS	Small Lake		*water*	*water*	*water*	684	
CWH vm 1	LL	Large Lake		*water*	*water*	*water*	3,395	
CWH vm 1	LS	Small Lake		*water*	*water*	*water*	565	
CWH vm 1	RE	Reservoir		*water*	*water*	*water*	4,181	
CWH vm 1	ST	Subtidal Marine		*water*	*water*	*water*	2,567	
CWH vm 1	UV	Unvegetated		*water*	*water*	*water*	419	
CWH vm 1	UV s	Unvegetated	steep, warm (southerly) aspect	*water*	*water*	*water*	221	
CWH vm 2	LS	Small Lake		*water*	*water*	*water*	1,050	
CWH xm 1	LL	Large Lake		*water*	*water*	*water*	1,582	
CWH xm 1	LS	Small Lake		*water*	*water*	*water*	312	
CWH xm 1	ST	Subtidal Marine		*water*	*water*	*water*	89,580	

Crosswalk of BEC-BEU combinations to ecological systems

BEC LABEL	HAB1MOD1	BEU name	BEU modifier	Draft #1 March 31, Rex Crawford WA NHP	Draft #2 April 14, Geoff Cushon BC MoF	Final May 3	area (ha)	comment
ESSFmw	LS	Small Lake		*water*	*water*	*water*	82	
IDF dk 2	LL	Large Lake		*water*	*water*	*water*	290	
IDF ww	LL	Large Lake		*water*	*water*	*water*	2,784	
IDF ww	LS	Small Lake		*water*	*water*	*water*	220	
MH mm 1	LS	Small Lake		*water*	*water*	*water*	729	
MH mm 2	LL	Large Lake		*water*	*water*	*water*	984	

3.0 Freshwater Methodology

3.1 Freshwater Coarse-filter Methods

Freshwater coarse-filter targets are freshwater ecosystems that consist of a group of strongly interacting freshwater and riparian / near-shore communities held together by shared physical habitat, environmental regimes, energy exchanges, and nutrient dynamics. They vary in their spatial extent, have indistinct boundaries, and can be hierarchically nested within one another depending on spatial scale (e.g., headwater lakes and streams are nested within larger coastal river systems). Perhaps the most distinguishing features of freshwater ecosystems from terrestrial ecosystems are their variability in form and their dynamic nature. They are extremely dynamic in that they often change where they exist (e.g., a migrating river channel) and when they exist (e.g., seasonal ponds) in a time frame that we can experience. Freshwater ecosystems are nearly always found connected to and dependant upon one another, and as such they form drainage networks that constitute even larger ecological systems. They exist in many different forms, depending upon their underlying climate, geology, vegetation, and other features of the watersheds in which they occur. In very general terms, however, freshwater ecosystems fall into three major groups: standing-water ecosystems (e.g., lakes and ponds); flowing-water ecosystems (e.g., rivers and streams); and freshwater dependent ecosystems that interface with the terrestrial ecosystems (e.g., wetlands and riparian areas).

Freshwater ecosystems support an exceptional concentration of biodiversity. Species richness is greater relative to habitat extent in freshwater ecosystems than in either marine or terrestrial ecosystems. They contain approximately 12% of all species, with almost 25% of all vertebrate species concentrated within these freshwater habitats (Stiassny 1996). The richness of freshwater species includes a wide variety of plants, fishes, mussels, crayfish, snails, reptiles, amphibians, insects, micro-organisms, birds, and mammals that live beneath the water or spend much of their time in or on the water. Many of these species depend upon the physical, chemical, and hydrologic processes and biological interactions found within freshwater ecosystems to trigger their various life cycle stages (e.g., spawning behavior of a specific fish species might need to be triggered by adequate flooding at the right time of the year, for a sufficient duration, and within the right temperature range, etc.; seed germination of a particular plant might require a different combination of variables).

Freshwater ecosystems support almost all terrestrial animal species since these species depend on freshwater ecosystems for water, food and various aspects of their life cycles. In addition, freshwater ecosystems provide environmental services such as electricity, drinking water, waste removal, crop irrigation and landscaping, transportation, manufacturing, food source, recreation, religion and sense of place, that form the basis of our economies and social values.

Classification of freshwater ecosystems

The classification of freshwater ecosystems is a relatively new pursuit. This classification model builds off of the BC freshwater ecosystem classifications completed for the Coast Information Teams' ecosystem spatial assessment (Rumsey et al. 2004) and the Muskwa Kechika's Conservation Area Design (Heinemeyer et al. 2004). For classification purposes, freshwater ecosystems are defined as networks of streams, lakes and wetlands that are distinct in geomorphological patterns, tied together by similar environmental processes (e.g., hydrologic and nutrient regimes, access to floodplains) and gradients (e.g., temperature, chemical and habitat volume), occur in the same part of the drainage network, and form a distinguishable drainage unit on a hydrography map. Freshwater ecosystems are spatially nested within major river drainages and ecological drainage units (EDUs), and are spatially represented as watershed units (specifically BC Watershed Atlas third order watersheds and WA USGS HUC 6). They are defined at a spatial scale that is practical for regional planning. Freshwater ecosystems provide a means to generalize about large-scale patterns in networks of streams and lakes, and the ecological processes that link them together as opposed to fine-scale freshwater systems which capture a detailed and often quite complex picture of physical diversity at the stream reach and lake level.

Methods

The types and distributions of freshwater ecosystems are characterized based on abiotic factors that have been shown to influence the distribution of species and the spatial extent of freshwater community types. This method aims to capture the range of variability of freshwater system types by characterizing different combinations of physical habitat and environmental regimes that potentially result in unique freshwater ecosystem and community types. It is virtually impossible to build a freshwater ecosystem classification founded on biological data given that freshwater communities have not been identified in most places, and there is generally a lack of adequate survey data for freshwater species. Given that freshwater ecosystems are themselves important targets for conservation because they provide a coarse-filter target and environmental context for species and communities, a classification approach that identifies and maps the diversity and distribution of these systems is a critical tool for comprehensive conservation and resource management planning. An additional advantage of such an approach is that data on physical and geographic features (hydrography, land use and soil types, roads and dams, topographic relief, precipitation, etc.), which influence the formation and current condition of freshwater ecosystems, is widely and consistently available.

The proposed freshwater ecosystem classification framework is based to a large extent on The Nature Conservancy's classification framework for aquatic ecosystems (Higgins et al. 2003). The framework classifies environmental features of freshwater landscapes at two spatial scales. It loosely follows the hierarchical model of Tonn (1990) and Maxwell et al. (1995). It includes ecological drainage units that take into account regional drainage (zoogeography, climatic, and physiographic) patterns, and mesoscale units (coarse-scale freshwater systems) that take into account dominant environmental and ecological processes occurring within a watershed.

Nine abiotic variables were used to delineate freshwater ecosystem types that capture the major abiotic drivers of freshwater systems: drainage area, underlying biogeoclimatic zone and geology, stream gradient, accumulative precipitation yield, lake and wetland influence, glacial connectivity, and Melton's R. Table 1 describes each variables and identifies its data source. These variables are widely accepted in the literature as being the dominant variables shaping coarse scale freshwater systems and their associated communities and also strongly co-varying with many other important physical processes (i.e., Vannote et al. 1980; Mathews 1998; Poff and Ward 1989; Poff and Alan 1995; Lyons 1989; Hart and Finelli 1999; Lewis and Magnuson 1999; Newall and Magnuson 1999; Brown et al. 2003).

Table 1. Summary of data used in freshwater ecosystem classification

VARIABLE	DESCRIPTION	SOURCE
Accumulative precipitation yield	Accumulative precipitation yield per upstream drainage	ClimateSource
Drainage Area	Accumulative drainage area per upstream drainage	BC Watershed Atlas; USGS HUC calculated watersheds
Percentage of lake area to watershed polygon area	Percentage of lake area in each watershed polygon	BC Watershed Atlas; NHD dataset
Percentage of wetland area to watershed polygon area	Percentage of wetland area in each watershed polygon	BC Watershed Atlas; NHD dataset
Percent glacial influence	Percentage of accumulative upstream drainage area that is currently glaciated	BC Watershed Atlas; NHD dataset
Biogeoclimatic Zone / Shining Mountains Zone	Percentage of each watershed polygon within each of the 14 biogeoclimatic zones	BC Ministry of Forests (2004) Qbei_bc coverage from ARCWHSE
Geology	Percentage of accumulative upstream drainage in each of the 5 geology classes	BC Ministry of Energy and Mines at 1:250,000; WA DNR 1:100,000
Mainstem and Tributary Stream Gradient	Percentage of mainstem and tributary reaches of each watershed polygon in each of 6 gradient classes	BC Watershed Atlas, and BC 25m DEM; USGS HUC

Statistics

Descriptive statistics (mean, standard deviation, skewness, and variance) were calculated for each variable. Variables that were highly skewed (skewness values >=2) were log 10 transformed to help meet the assumptions of normality for parametric statistics. Variability in categorical variables such as gradient classes, biogeoclimatic zones, geology classes was reduced into two continuous axes using nonmetric multidimensional scaling. All variables were normalized for proportional comparisons between variables. Cluster analysis was performed on all normalized variables (agglomerative hierarchical clustering (Sorensen, flexible beta of –0.25)), and 46 freshwater system types were selected (Map 9).

Results and Discussion

Okanagan, Middle Fraser, and Thompson EDUs collectively consist of 3,927 freshwater systems that were classified into 46 freshwater system types. Table 2 summarizes the characteristics of each system type. Table 3 summarizes the classification of these freshwater ecosystems into system types within each of the EDUs. Map 9 spatially summarizes the abundance and distribution of these freshwater system types within each of the EDUs.

Freshwater Aquatic Assessment Units – BC Portion: Vertical Stacking

One of the components required when using automated optimized site selection programs such as MARXAN is a boundary file (*bound.dat*). The purpose of the boundary file is to allow the program to attempt to select contiguous assessment units in an effort to better represent or capture landscape scale priority conservation areas (Schindel, 2004). This method generally works well when dealing with terrestrial assessment units, but has the potential to work poorly when dealing with freshwater aquatic assessment units (AAUs) – such as third order watersheds, which were used as AAUs for the North Cascades and Pacific Ranges ecoregional assessment[12]. The potential problem in traditional horizontal grouping of adjacent assessment units, it that while watersheds may be adjacent, this does not necessarily indicate hydrological connectivity. For example, two neighbouring watersheds may meet at a ridgeline with each watershed draining into a separate drainage basin. So, while the two watersheds are adjacent, they do not have hydrological connectivity (Schindel, 2004).

Vertical Stacking is a method that was developed by Michael Schindel (TNC Oregon) designed to accommodate for these types of relationships, where adjacency between assessment units does not necessarily mean connectivity. Vertical stacking was used to generate the *bound.dat* input file for the freshwater MARXAN analysis portion of the North Cascades and Pacific Ranges ERA. In this case, the basic assessment units, third order watersheds, were nested within mainstem watersheds. A table containing all possible relationships between the third order watersheds and mainstems was generated by using a GIS to overlay the two layers. The resulting *bound.dat* file was used in MARXAN to ensure that the resulting portfolio would more accurately represent hydrological connectivity, than if a traditional horizontal boundary file was used. For more detailed information about Vertical Stacking, please refer to Schindel (2004), or Vander Schaaf et al. (2006).

Results and Discussion

Lower Fraser and Southern Coastal Streams ecological drainage units (EDUs) collectively consist of 829 freshwater systems that were classified into 17 freshwater system types. Table 15 summarizes the characteristics of each system type. The Lower Fraser EDU consisted of 251 watersheds that were grouped into 16 different aquatic ecological systems types. The Southern Coastal Streams EDU consisted of 578 watersheds that were grouped

[12] Only the British Columbia portion of the EDUs that fall wholly or partially within the North Cascades ecosection were analyzed as part of this ERA.

into 17 different aquatic ecological systems types. Map 9 spatially summarizes the abundance and distribution of these freshwater system types within each of the EDUs.

Based on the TNC/NatureServe recommendations (Comer 2001, 2003; Appendix 19), a conservation goal of 30% was set for each freshwater coarse-filter system target type which was then stratified by EDU to ensure representation across EDUs. Freshwater ecosystem types derived from this assessment have value beyond supporting priority setting for biodiversity conservation. Freshwater ecosystem types can be used for evaluating and monitoring ecological potential and condition, predicting impacts from disturbance, and defining desirable future conditions. In addition, they can be used to inform sampling programs for biodiversity assessment and water quality monitoring, which requires an ecological framework in addition to a spatial framework to stratify sampling locations (Higgins et al. 2003).

We realize that this classification framework is a series of hypotheses that need to be tested and refined through additional data and expert review. We recommend that concurrently, data be gathered to refine/test the classification to bring the scientific rigor needed to further its development and use by conservation partners and agencies.

Table 5. Summary of coarse-filter freshwater ecosystem types in the North Cascades Ecoregion

Drainage Area (km)	Accumulative Precipitation Yield	Hydrologic Regime	Water Temp.	Glacial Influ-ence	Lake and Wetland Influence	Mainstem Gradient	Tribu-tary Gradient	Under-lying Geology
very large	very high	rain on snow	cool	low	low	shallow	moderate	intrusive / metamorphic
small	moderate	rain and glacial melt	cold	high	low	steep	moderate	intrusive / metamorphic
small	high	rain and glacial melt	cold	high	low	moderate	steep	volcanic
small	moderate	rain and glacial melt	cold	high	low	steep	steep	intrusive / metamorphic
small	high	rain on snow	warm	low	moderate	moderate	moderate	intrusive / metamorphic
very small	moderate	rain and glacial melt	cold	high	low	steep	steep	intrusive / metamorphic
small	high	rain	cool	moderat e	low	steep	moderate	intrusive / metamorphic
small	high	rain and glacial melt	cold	moderat e	low	steep	moderate	intrusive / metamorphic
very small	high	rain on snow	cool	low	low	steep	moderate	intrusive / metamorphic
very small	high	snow melt	warm	none	moderate	shallow	shallow	hard sedimentary rock
very small	moderate	rain and glacial melt	cold	high	low	steep	moderate	intrusive / metamorphic
very small	moderate	rain	cool	low	low	steep	steep	intrusive / metamorphic
very small	moderate	snow melt	cool	none	low	moderate	moderate	intrusive / metamorphic
very small	low	rain and glacial melt	cold	moderat e	low	steep	steep	intrusive / metamorphic
very small	moderate	rain	cool	low	low	steep	moderate	intrusive / metamorphic
very	moderate	rain on	cool	none	low	steep	steep	intrusive /

small		snow						metamorphic
very small	moderate	rain on snow	cool	none	low	steep	moderate	intrusive / metamorphic

Table 6. Categories developed for quantitative data used in North Cascades freshwater ecosystem classification

Variable	Categories
Drainage Area (km^2)	Low =10-100; Moderate = 100-1,000, High = 1,000-10,000; Very High = 10,000-100,000, >100000
Accumulative Precipitation Yield	Low = >100,000,000; Moderate = 100,000,000-1,000,000,000; High = 1,000,000,000-10,000,000,000; Very High = >100,000,000,000
Mainstem Gradient	Shallow = <2%; Moderate = 2 - 16%; Steep = >16%
Tributary Gradient	Shallow = <2%; Moderate = 2 - 16%; Steep = >16%
Lake Influence	Low = <1% of watershed unit area; Moderate = 1 - 10%; High = 10 - 100%
Wetland Influence	Low = <1% of watershed unit area; Moderate = 1 - 10%; High = 10 - 100%
Glacial Influence	None; Low = <1.0 % of upstream drainage; Moderate = 1.0 - 5.0%; High = >5.0%

3.2 Freshwater Fine-filter Methods

Introduction to Freshwater Fine-filter Methods and Technical Team

Conservation *targets* are entities that are selected for their importance to biodiversity conservation and include freshwater ecological systems and freshwater species of concern. While coarse-filter targets capture ecological systems and their functions, fine-filter targets represent rare or vulnerable populations of species or habitats that may not be adequately represented within coarse-filter targets. The analysis of freshwater systems and species are completed separately—this document only describes the fine-filter species portion of the methods used for identifying important freshwater conservation areas. Our approach is to establish conservation goals for all targets and to identify a suite of conservation areas that meet goals for all targets. In theory, effective conservation of all conservation areas identified will sustain freshwater biodiversity.

The freshwater animals technical team adhered to a similar assessment process and principles as the terrestrial and marine teams, but the freshwater analysis was not confined to the North Cascades ecoregion boundary. Instead, the freshwater analysis used a type of boundary more suited to freshwater ecosystems called an ecological drainage unit (EDU). Three EDUs intersect the ecoregion and extend beyond the ecoregion boundary (Southern Coastal Streams, Lower Fraser, and Puget Sound EDU). Because the Puget EDU had recently been completed for another ecoregional assessment, and each EDU is treated as a stand-alone assessment, it was not necessary to reassess the Lower Fraser EDU here. Therefore, this assessment only considers the Southern Coastal Streams and Lower Fraser EDUs. It should be noted, however, that the Lower Fraser EDU was also previously completed (during the Okanagan ecoregional assessment), but is being revisited due to extensive new data availability and the Lower Fraser EDU's substantial influence on the North Cascades ecoregion (it was a periphery EDU for the Okanagan assessment). Two species (Pink and Chum Salmon) were analyzed according to a different boundary than the

EDUs; they were instead stratified by salmon ecoregion (XAN[13]) zones, which are more applicable to the biogeography of these salmonid species.

Overview of Steps

There were six primary steps involved in analyzing the freshwater fine-filter contribution to setting priority conservation areas in the North Cascades ecoregion. The steps were as follows:

1. Identify fine-filter freshwater targets;
2. Assemble data on location of targets and document metadata;
3. Represent occurrences;
4. Set goals for each fine-filter freshwater target;
5. Determine data gaps and considerations for next iteration;
6. Expert review of portfolio sites.

Identify Fine-filter Freshwater Targets

Methods used to identify fine-filter animal targets are described in this section and are based largely on Groves et al. (2000 and 2002) and Higgins et al. (1998). Conservation targets were selected at multiple spatial scales and levels of biological organization. This ecosystem-level approach to conservation is particularly important for freshwater biodiversity, since region-wide data exist for few non-game species. As discussed in the introduction, targets and target goals were only determined for two of the three EDUs intersecting the ecoregion (Southern Coastal Streams and the Lower Fraser).

The freshwater animal team's goal was to develop a list of target species that require special attention, and when considered collectively, their locational data will be used to help identify priority areas for conservation. Freshwater fine-filter targets are generally defined as those species that are currently imperiled, threatened, endangered, of special concern due to endemic, disjunct, vulnerable, keystone, or wide-ranging status, or species aggregations or groups. Target selection criteria and spatial representation information can be found in Table 1.1.

Table 1.1 Target Selection Criteria

Select all viable imperiled, threatened, and endangered species as targets.	• Imperiled species have a global rank of G1-G3 or T1-T3 by NatureServe or the Conservation Data Center in British Columbia (see www.natureserve.org for explanation of ranking system). National and Provincial Rankings were also included (N1-N3 and S1-S3). • For international programs, the IUCN Red List was used as a guide to select species in the critically endangered, endangered, or vulnerable categories. • Endangered and threatened species are those federally listed or proposed for listing as Threatened or Endangered under the ESA or COSEWIC. In British Columbia, "red-listed" species correspond to endangered or threatened.

[13] Refer to Appendix 1 - Glossary

	• Identified Wildlife refers to those Species at Risk and Regionally Important Wildlife that the Minister of Environment designates as requiring special management attention under the *Forest and Range Practices Act.*
Species of special concern include declining, endemic, disjunct, vulnerable, keystone, or wide-ranging species. For many species, it may be necessary to target only one aspect of a species life history such as breeding range, wintering range, or a migratory location. If applicable, planners should note what aspect of a species life history is the target of conservation efforts.	• Declining species: Declining species exhibit significant, long-term declines in habitat and/or numbers, are subject to a high degree of threat, or may have unique habitat or behavioral requirements that expose them to great risk. • Endemic species: Endemic species are restricted to an ecoregion (or a small geographic area within an ecoregion), depend entirely on a single area for survival, and therefore are often more vulnerable. • Disjunct species have populations that are geographically isolated from populations in other ecoregions • Vulnerable species are usually abundant, may not be declining, but some aspect of their life history makes them especially vulnerable, such as habitats needed for migratory stopovers or winter range. • Keystone species are those whose impact on a community or ecological system is disproportionately large for their abundance. They contribute to ecosystem function in a unique and significant manner through their activities. Their removal causes major changes in community composition. • Wide-ranging species depend on vast areas. These species include top-level predators such as the gray wolf and northern goshawk. Wide-ranging species can be especially useful in examining linkages among conservation areas in a true conservation network.
Species aggregations, species groups, and hot spots of richness are unique, irreplaceable examples for the species that use them, or are critical to the conservation of a certain species or suite of species.	• Globally significant examples of species aggregations (i.e., critical migratory stopover sites that contain significant numbers of migratory individuals of many species). For example, significant migratory stopovers for shorebirds have been formally designated through the Western Hemi-sphere Shorebird Reserve Network. • Major groups of species share common ecological processes and patterns, and/or have similar conservation requirements and threats (e.g., freshwater mussels, forest-interior birds). It is often more practical in ecoregional plans to target such groups as opposed to each individual species of concern. • Biodiversity hotspots contain large numbers of endemic species and usually face significant threat.

The target list for the Southern Coastal Streams EDU and the Lower Fraser EDU was compiled through online querying of NatureServe Explorer for native fish, mollusks, crustaceans, and four families of insects (stoneflies, mayflies, dragonflies, caddisflies) at risk in British Columbia. The CDC species explorer was also queried for red and blue-listed species and identified wildlife species for forest districts within the ecoregion (the Sunshine Coast, Squamish, Port McNeill, Mid-Coast, Chilliwack, Campbell River, Lillooet, Merritt, and Chilcotin forest districts). Added to the NatureServe and CDC lists were additional species from the CDC, which were obtained through a data request for all species at risk within the North Cascades EDU boundaries.

After compiling the target list from the above sources, it was sorted by scientific name to remove duplication of species that were listed with both organizations. Marine species were removed from this list and transferred to the marine team for analysis, and plant targets were removed from the target list as it was understood that the plant team was to analyze freshwater and terrestrial plants. Due to miscommunication between the plants team and the freshwater fine-filter teams, freshwater plants were not evaluated for the North Cascades ecoregion. Birds, mammals, and amphibians were temporarily removed from the master target list as well since the terrestrial animals team was to analyze those taxonomic groups. Birds, mammals, and amphibians that have some portion of their life history dependent upon freshwater systems were later added back in to the freshwater animals analysis once data had been obtained and cleaned. The final target list included information for each target, such as NatureServe ranks, federal and provincial status in Canada, distribution, and other reasons for selection.

Since it was not possible through NatureServe or the CDC Explorer to compile data based solely on the North Cascades EDU boundaries, the list was created for species at risk throughout B.C. This meant the target list was far too long, as it incorporated species at risk without current distributions within the North Cascades ecoregion EDUs. The technical team felt that although this approach was more time consuming, it was the more inclusive approach as we would have otherwise been limited to listing only those species with available data within the ecoregion, and may have missed listing several species of concern. The initial list was later drastically pared down through receiving expert input.

To receive expert input on the draft list, it was distributed along with the criteria selection to regional experts and taxanomic experts for review and recommendations. The recommendations were compiled and then discussed with other members of the technical team to finalize the target list. If an expert said that a target was "peripheral at best", the target was left in since it could be located at the far end of its range, and thus it could still be important habitat to conserve due to climate change effects or other similar factors that would necessitate a larger range.

After expert review, we had a final freshwater animal target list for the Southern Coastal Streams EDU consisting of 26 targets—19 fish (8 of which were salmonids), 1 mammal, 1 amphibians, 1 bird, 3 dragonflies, and 1 stonefly. The final freshwater animal target list for the Lower Fraser EDU consisted of 41 targets—24 fish (8 of which were salmonids), 1 mammal, 4 amphibians, 0 birds, 7 dragonflies, and 5 stoneflies. Table 1.2 and 1.3 lists all of the freshwater fine-filter animal targets for the Southern Coastal Streams and Lower Fraser EDUs respectively. Note: the initial target lists were the same for both EDUs, as we did not obtain the level of detail from experts that would signify if a target was found in only one or in both of the EDUs. Tables 1.2 and 1.3 are split out according to the data we have to represent target distribution per EDU.

Two additional targets for each EDU were assigned retro status because they were surveyed or modeled habitat rather than observational data (see Table 1.4). Retrospective evaluation has the benefit of simplifying the analysis by reducing the amount of data being input, and by reducing the influence of a large quantity of data or the influence of a species with a very high goal associated with its data. A large amount of habitat or modeled data can significantly influence the result of the site selection analysis. Rather than let one species dominate the result, we used these two datasets retrospectively to evaluate the portfolio as defined by the goals and data of other targets. If the goals do not capture enough of these retro targets in the portfolio, then the goals will be adjusted appropriately to incorporate more of that species.

Note: Different seasonal runs for a salmonid species were treated as separate targets. This affects Chinook (*Oncorhynchus tshawytscha*), Chum (*Oncorhynchus keta*), Pink (*Oncorhynchus gorbuscha*), and Steelhead (*Oncorhynchus mykiss*) salmon.

See Appendix 5 for species that were removed from the master target list due to 1) not having current distribution in the North Cascades or British Columbia, 2) not likely having current distribution in the North Cascades and a significant lack of distribution information, 3) extinct status, and 4) marine species rather than freshwater status.

Table 1.2 Freshwater fine-filter targets for the Southern Coastal Stream EDU

TAXANOMIC GROUP	COMMON NAME	SCIENTIFIC NAME	EDU	XAN	G RANK ROUNDED	CAD NATIONAL RANK	S RANK BC	BC LISTED	DISTRIBUTION
Amphibians	Coastal tailed frog	*Ascaphus truei*	SCS & LF	N/A	G4		S3S4		Widespread
Birds	Western grebe	*Aechmophorus occidentalis*	SCS	N/A	G5		S1B, S3N		Peripheral
Freshwater Fish	Green Sturgeon	*Acipenser medirostris*	SCS & LF	N/A	G3	N3N	S3N	RED	Limited
Freshwater Fish	Threespine stickleback	*Gasterosteus aculeatus*	SCS & LF	N/A	G5	N5	S5	RED	Endemic
Freshwater Fish	Western Brook Lamprey	*Lampetra richardsoni*	SCS & LF	N/A	G5	N4N5	S4	BLUE	Endemic/ Limited
Freshwater Fish	Coastal Cutthroat Trout, Clarki Subspecies	*Oncorhynchus clarki clarki*	SCS & LF	N/A	T4	NNR	S3S4		Limited
Freshwater Fish	Coastal Cutthroat Trout, Clarki Subspecies (anadromous)	*Oncorhynchus clarki clarki*	SCS & LF	N/A	T4	NNR	S3S4		Widespread
Freshwater Fish	Bull Trout	*Salvelinus confluentus*	SCS & LF	N/A	G3	N3	S3	RED	Endemic
Freshwater Fish	Dolly Varden	*Salvelinus malma*	SCS & LF	N/A	G5	N4	S3S4	BLUE	Endemic
Freshwater Fish	Dolly Varden (anadromous)	*Salvelinus malma*	SCS	N/A	G5	N4	S3S4	BLUE	Widespread
Freshwater Fish	Kokanee	*Oncorhynchus nerka*	SCS & LF	N/A	G5	N5	S4	RED	Limited
Freshwater Fish	Sockeye Salmon (Sakinaw Lake)	*Oncorhynchus nerka*	SCS	N/A	G5	N5	S4	RED	Endemic
Freshwater Fish	Eulachon	*Thaleichthys pacificus*	SCS & LF	N/A	G5	N5	S2S3	BLUE	Endemic
Insects-Odonata	Western Pondhawk	*Erythemis collocata*	SCS & LF	N/A	G5	N3	S3	BLUE	Limited
Insects-Odonata	Blue Dasher	*Pachydiplax longipennis*	SCS & LF	N/A	G5	N4	S3S4	BLUE	Limited
Insects-Odonata	Black Petaltail	*Tanypteryx hageni*	SCS	N/A	G4	N3	S3	BLUE	Endemic
Insects-Plecoptera	A Stonefly	*Bolshecapnia gregsoni*	SCS	N/A	G2	N2	SNR		Endemic

TAXANOMIC GROUP	COMMON NAME	SCIENTIFIC NAME	EDU	XAN	G RANK ROUNDED	CAD NATIONAL RANK	S RANK BC	BC LISTED	DISTRIBUTION
Mammals	Pacific water Shrew	*Sorex bendirii*	SCS & LF	N/A	G4		S1S2		Widespread/ Peripheral
Anadromous Salmonids	Sockeye Salmon	*Oncorhynchus nerka*	SCS & LF	N/A	G5	N5	S4	RED	Widespread
Anadromous Salmonids	Chum Salmon	*Oncorhynchus keta*	N/A	PSGB & FR XANS					Widespread
Anadromous Salmonids	Coho Salmon	*Oncorhynchus kisutch*	SCS & LF	N/A					Widespread
Anadromous Salmonids	Coho Salmon	*Oncorhynchus kisutch*	SCS & LF	N/A					Widespread
Anadromous Salmonids	Chinook Salmon (NO RUN INFO.)	*Oncorhynchus tshawytscha*	SCS & LF	N/A					Widespread
Anadromous Salmonids	Pink Salmon (NO RUN INFO.)	*Oncorhynchus gorbuscha*	N/A	PSGB & FR XANS					Widespread
Anadromous Salmonids	Steelhead Salmon—winter	*Oncorhynchus mykiss*	SCS & LF	N/A					Widespread
Anadromous Salmonids	Steelhead Salmon—summer	*Oncorhynchus mykiss*	SCS & LF	N/A					Widespread
Anadromous Salmonids	Steelhead Salmon—general	*Oncorhynchus mykiss*	SCS & LF	N/A					Widespread

Table 1.3 Freshwater fine-filter targets for the Lower Fraser EDU

TAXANOMIC GROUP	COMMON NAME	SCIENTIFIC NAME	EDU	XAN	G RANK ROUNDED	CAD NATIONAL RANK	S RANK BC	BC LISTED	DISTRIBUTION
Amphibians	Coastal tailed frog	*Ascaphus truei*	SCS & LF	N/A	G4		S3S4		Widespread
Amphibians	Western toad	*Bufo boreas*	LF	N/A	G4	S4			Widespread
Amphibians	Red-legged frog	*Rana aurora*	LF	N/A	G4	S3S4			Widespread/ Limited
Amphibians	Pacific Giant Salamander	*Dicamptodon tenebrosus*	LF	N/A					Widespread
Freshwater Fish	Green Sturgeon	*Acipenser medirostris*	SCS & LF	N/A	G3	N3N	S3N	RED	Limited

TAXANOMIC GROUP	COMMON NAME	SCIENTIFIC NAME	EDU	XAN	G RANK ROUNDED	CAD NATIONAL RANK	S RANK BC	BC LISTED	DISTRIBUTION
Freshwater Fish	White Sturgeon (Lower Fraser River Population)	*Acipenser transmontanus pop. 4*	LF	N/A	T2	N3	S2	RED	Endemic
Freshwater Fish	Mountain Sucker	*Catostomus platyrhynchus*	LF	N/A	G5	N4	S3?	BLUE	Widespread
Freshwater Fish	Salish Sucker	*Catostomus sp. 4*	LF	N/A	G1	N1	S1	RED	Endemic
Freshwater Fish	Threespine stickleback	*Gasterosteus aculeatus*	SCS & LF	N/A	G5	N5	S5	RED	Endemic
Freshwater Fish	Western Brook Lamprey	*Lampetra richardsoni*	SCS & LF	N/A	G5	N4N5	S4	BLUE	Endemic/ Limited
Freshwater Fish	Coastal Cutthroat Trout, Clarki Subspecies	*Oncorhynchus clarki clarki*	SCS & LF	N/A	T4	NNR	S3S4		Limited
Freshwater Fish	Coastal Cutthroat Trout, Clarki Subspecies (anadromous)	*Oncorhynchus clarki clarki*	SCS & LF	N/A	T4	NNR	S3S4		Widespread
Freshwater Fish	Nooksack Dace	*Rhinichthys sp. 4*	LF	N/A	G3	N1	S1	RED	
Freshwater Fish	Bull Trout	*Salvelinus confluentus*	SCS & LF	N/A	G3	N3	S3	RED	Endemic
Freshwater Fish	Dolly Varden	*Salvelinus malma*	SCS & LF	N/A	G5	N4	S3S4	BLUE	Endemic
Freshwater Fish	Kokanee	*Oncorhynchus nerka*	SCS & LF	N/A	G5	N5	S4	RED	Limited
Freshwater Fish	Sockeye Salmon (Cultus Lake)	*Oncorhynchus nerka*	LF	N/A	G5	N5	S4	RED	Endemic
Freshwater Fish	Pygmy Longfin Smelt/Harrison/Pitt Lake Smelt	*Spirinchus sp. 1*	LF	N/A	G1	N4	S1	RED	Endemic
Freshwater Fish	Eulachon	*Thaleichthys pacificus*	SCS & LF	N/A	G5	N5	S2S3	BLUE	Endemic
Freshwater Fish	Cultus Lake Sculpin	*Cottus sp. 2*	LF	N/A					Endemic
	Emma's Dancer	*Argia emma*	LF	N/A	G5	N3N4	S3S4	BLUE	

Insects-Odonata	(nez Perce)								Limited
TAXONOMIC GROUP	**COMMON NAME**	**SCIENTIFIC NAME**	**EDU**	**XAN**	**G RANK ROUNDED**	**CAD NATIONAL RANK**	**S RANK BC**	**BC LISTED**	**DISTRIBUTION**
Insects-Odonata	Vivid Dancer	*Argia vivida*	LF	N/A	G5	N3	S2	RED	Limited
Insects-Odonata	Beaverpond Baskettail	*Epitheca canis*	LF	N/A	G5	N5	S3	BLUE	Limited
Insects-Odonata	Western Pondhawk	*Erythemis collocata*	SCS & LF	N/A	G5	N3	S3	BLUE	Limited
Insects-Odonata	Grappletail	*Octogomphus specularis*	LF	N/A	G4	N2	S2	RED	Limited
Insects-Odonata	Blue Dasher	*Pachydiplax longipennis*	SCS & LF	N/A	G5	N4	S3S4	BLUE	Limited
Insects-Odonata	Autumn Meadowhawk	*Sympetrum vicinum*	LF	N/A	G5	N5	S3S4	BLUE	Limited
Insects-Plecoptera	A Stonefly	*Bolshecapnia sasquatchi*	LF	N/A	G3	N3	SNR		Limited
Insects-Plecoptera	A Spring Stonefly	*Cascadoperla trictura*	LF	N/A	G3	N2	SNR		Limited
Insects-Plecoptera	A Stonefly	*Isocapnia fraserii*	LF	N/A	G1	N1	SNR		Endemic
Insects-Plecoptera	A Stonefly	*Setvena tibilalis*	LF	N/A	G4	N2	SNR		Limited
Insects-Plecoptera	A Stonefly	*Isocapnia vedderensif*	LF	N/A					Limited
Mammals	Pacific water Shrew	*Sorex bendirii*	SCS & LF	N/A	G4		S1S2		Widespread/ Peripheral
Anadromous Salmonids	Sockeye Salmon	*Oncorhynchus nerka*	SCS & LF	N/A	G5	N5	S4	RED	Widespread
Anadromous Salmonids	Chum Salmon	*Oncorhynchus keta*	N/A	PSGB & FR XANS					Widespread
Anadromous Salmonids	Coho Salmon	*Oncorhynchus kisutch*	SCS & LF	N/A					Widespread
Anadromous Salmonids	Chinook Salmon (NO RUN INFO.)	*Oncorhynchus tshawytscha*	SCS & LF	N/A					Widespread

TAXANOMIC GROUP	COMMON NAME	SCIENTIFIC NAME	EDU	XAN	G RANK ROUNDED	CAD NATIONAL RANK	S RANK BC	BC LISTED	DISTRIBUTION
Anadromous Salmonids	Pink Salmon (NO RUN INFO.)	*Oncorhynchus gorbuscha*	N/A	PSGB & FR XANS					Widespread
Anadromous Salmonids	Steelhead Salmon—winter	*Oncorhynchus mykiss*	SCS & LF	N/A					Widespread
Anadromous Salmonids	Steelhead Salmon—summer	*Oncorhynchus mykiss*	SCS & LF	N/A					Widespread
Anadromous Salmonids	Steelhead Salmon—general	*Oncorhynchus mykiss*	SCS & LF	N/A					Widespread

Table 1.4 Retro Targets for Southern Coastal Streams and Lower Fraser EDUs

TAXANOMIC GROUP	COMMON NAME	SCIENTIFIC NAME	EDU	XAN	G RANK ROUNDED	CAD NATIONAL RANK	S RANK BC	BC LISTED	DISTRIBUTION
Amphibians	Coastal tailed frog—habitat	*Ascaphus truei*	SCS & LF	N/A	G5		S3S5		Widespread
Anadromous Salmonids	Steelhead Salmon—modeled habitat	*Oncorhynchus mykiss*	SCS & LF	N/A					

We sought review from experts across the ecoregion at many steps in the process, from identifying targets through to the final portfolio assembly. In gathering the freshwater animals target list and obtaining data, the freshwater animals team received expert input from individuals at The Nature Conservancy (TNC), Nature Conservancy of Canada (NCC), Washington Department of Fish and Wildlife (WDFW), the Washington Natural Heritage Program (WNHP), Ministry of Environment (MEnv), Royal BC Museum, University of British Columbia, University of Puget Sound, Conservation Data Center of British Columbia (CDC), and several private individuals/consultants (See Table 1.4 for a comprehensive list of experts who provided input). These experts were asked for two kinds of input: 1) to review draft target criteria and target lists and provide recommendations for additions and deletions, and 2) to provide occurrence data (or leads to data) for species on the target list.

Table 1.5 Experts Consulted

NAME AND ORGANIZATION	PRIMARY EXPERTISE	EMAIL	PHONE
Sue Pollard (Ministry of Environment)	Fishes	sue.pollard@gems7.gov.bc.ca	(250) 387-9586
Joanne Schuett-Hames (Washington Department of Fish & Wildlife)	Fishes	schuejps@dfw.wa.gov	(360) 902-2695
Don McPhail (University of British Columbia)	Fishes	mcphail@zoology.ubc.ca	(604) 822-3388
Tom Burke (Private)	Mollusks	burketc@earthlink.net	(360) 455-4418
Terry Frest (Deixis Consulting)	Mollusks	tjfrest@earthlink.net	(206) 527-6764
Bill Leonard (Private)	Mollusks	mollusca1@comcast.net	(360) 357-5030
Jacquie Lee (Private)	Mollusks	jacqlee@telus.net	(604) 294-6199
Kristiina Ovaska (Private)	Mollusks	kovaska@jdmicro.com	(250) 727-9708
Jennifer Heron (Ministry of Environment)	Insects	JMHeron@Victoria1.gov.bc.ca	(604) 222-6759
Geoff Scudder (University of British Columbia)	Insects	scudder@zoology.ubc.ca	(604) 822-3682
Rob Cannings (Royal BC Museum)	Odonata	Rcannings@royalbcmuseum.bc.ca	(250) 356-8242
Dennis Paulson (Univ. of Puget Sound)	Odonata	dpaulson@ups.edu, nettasmith@comcast.net	(253) 879-3798
Leah Ramsay (Conservation Data Centre)	Odonata & Fishes	Leah.Ramsay@gems4.gov.bc.ca	(250) 387-9524
Sue Salter (Private)	Ephemeroptera	suesalter@shaw.ca	(250) 494-7560
John Fleckenstein (Washington Natural Heritage Program)	Generalist	john.fluckenstein@wadnr.gov	(360) 902-1674
Laura Friis, (Ministry of Environment)	Amphibians, Mammals	Laura.Friis@gov.bc.ca,	(250) 387-9755
Glenn Sutherland, J. Richardson, L. Dupuis, T. Wabe (Private)	Amphibians		

Assemble Data on Location of Targets and Document Metadata

Initial data collection began with contacting likely data sources such as the Conservation Data Centre, Royal BC Museum, and provincial/regional biologists. Experts who had given input on the target list were also asked for any pertinent data. Thirty-three individuals/organizations were contacted in the search for pertinent data (listed in Table 2.1).

Table 2.1 Individual/Organizations We Requested Data From

TYPE OF DATA	INDIVIDUAL/ORGANIZATION
Mollusks	Terry Frest (Deixis Consulting)
Mollusks	Kristiina Ovaska (Private)
Mollusks	Jacquie Lee (Private)
Mollusks	Marta Donovan (Conservation Data Centre)
Mollusks	Kelly Sendall (Royal BC Museum)
Mollusks	George Holm (Private)
Mollusks	Robert Forsyth (Private)
Mollusks	Bamfield Marine Sciences Centre
Mollusks	Canadian Museum of Nature—Ottawa
Insects	Sue Pollard (Ministry of Environment)
Insects	Sue Salter (Private)
Insects	John Fleckenstein (Washington Natural Heritage Program)
Insects	Rob Cannings (Royal BC Museum)
Insects	Agriculture Canada, Experimental Farms
Insects	Leah Ramsay (Conservation Data Centre)
Insects	Geoff Scudder (University of British Columbia)
Insects	Jennifer Heron (Ministry of Environment)
Insects	Karen Needham (University of British Columbia Spencer Entomology)
Insects	Pacific Forestry Centre
Insects	Corvalis Entomology Museum
Fish	Joanne Schuett-Hames (Washington Department of Fish & Wildlife)
Fish	Don McPhail (University of British Columbia)
Fish	David Tesch (Ministry of Environment)
Fish	Marta Donovan (Conservation Data Centre)
Fish	Kelly Sendall (Royal BC Museum)
Fish	Mike Pearson (Pearson Ecological)
Fish	Eric Parkinson (University of British Columbia)
Fish	Nicolas Mandrak (Department of Fisheries and Oceans)
Amphibians, Mammals	Laura Friis (Ministry of Environment)
Amphibians	G. Sutherland, J. Richarson, L. Dupuis, T. Wabe (Private)

Spatial data used to map occurrences of each target were collected from seven of the above sources, plus additional datasets supplied by the terrestrial animals team. Metadata for each dataset can be found in Appendix 4. Datasets used for the analysis are listed below:

- Ministry of Environment—Modeled Distribution of Steelhead Stocks
- Pearson Ecological—Salish Sucker and Nooksack Dace
- Royal British Columbia Museum—Fish and Mollusks
- Royal British Columbia Museum—Dragonflies

- University of British Columbia—Plecoptera and Tricoptera
- Ministry of Environment—Fish
- British Columbia Conservation Data Centre—Fish and Dragonflies
- Data collected by Washington Department of Fish and Wildlife from Ministry of Environment and Private Researchers/Consultants—Amphibians, Birds, Mammals

Represent Occurrences

Each set of source data varied considerably in how target distribution and abundance were represented, and in their spatial data types and scale accuracy. In the source data, species observations were represented as points, arcs, and/or polygons in a GIS, while modeled habitat data were represented as arcs or polygons. The data had to be reconciled and merged to produce a data layer of value, and so considerable time was spent reconciling these formats.

For species with small ranges and low mobility, such as non-anadromous fish, dragonflies, and stoneflies, target occurrences may represent the location of a population or subpopulation. For example, a GIS database for dragonfly locations may contain multiple points for Vivid Dancer (A*rgia vivida)* along a first order stream. Each point is not a separate target occurrence. Instead, the set of points is assumed to represent the location of a population or sub-population, thus creating a single occurrence. The grouping process results in a reduction of data records and an improvement in data quality. Only within the CDC data were observations grouped into target occurrences.

For all riparian species that were not grouped into occurrences by the CDC, data points were grouped into occurrences by the technical team based on a species-specific separation distance. Aquatic species (fish) were not grouped into occurrences, but were instead attributed to stream reaches. Due to the paucity of available data for some species, a single observation sometimes corresponded to one target occurrence.

All of the freshwater fine-filter data went through the following cleaning methods:

1. Reprojection into BC Albers projection;
2. Initially clipped to a 5-kilometer buffer of the North Cascades ecoregion, combined with the Southern Coastal Stream Ecological Drainage Unit—later it was decided that we would rerun the Lower Fraser EDU as well as the Southern Coastal Streams, and so all data had to be clipped again, this time to the boundary between the 5-kilometer buffer of the North Cascades ecoregion and the Lower Fraser EDU. These newly clipped data were cleaned separately from the first set of clipped data, and then the two sets of clipped data were combined after they were both cleaned;
3. All non-target species were removed from the datasets;
4. Data was filtered for currency and accuracy and data records were eliminated if they were:

    a. dated before 1985;
    b. known to be extirpated;
    c. too imprecisely located, an unverified sighting, or from non-credible sources;

   d. lacking basic information of species name and precise location.

5. Datasets were cross-walked to determine which attributes were similar across datasets despite different naming conventions. Attributes were then reformatted (in terms of naming and type of field) in order to facilitate merging of spatially similar datasets; this included adding a source for each record and a species ID for each target;

6. Element Occurrences (EOs) were created through the following process:

   a. Riparian species were separated into their own files and then buffered with the appropriate species-specific separation distance. Any set of points representing one certain species whose buffers overlapped were assigned the same occurrence id and an amount of the occurrence they made up (1/2 or 1/3 of the total occurrence etc.)

   b. Note: data from the CDC already had element occurrences assigned, and so buffers of one species that overlapped with any CDC polygon occurrences of the same species were assigned to the EO ID of the CDC data, and amounts were adjusted accordingly in both datasets to represent the full EO. For example, if there was 1 CDC polygon occurrence and 3 other data points of the same species overlapping with that CDC occurrence—then each record got assigned .25 for the amount.

   c. Individual point files of each species were merged back together into one riparian species file per spatial format (1 riparian points, arcs, and polygons file).

   d. CDC riparian polygon data were turned into point data so that they could be merged with the point data from other datasets, resulting in one final riparian species point file—now with EOs and amounts.

7. All fish point datasets were merged together (from the Known Fish Observations and Royal BC Museum) to create one fish point dataset. Initially, we chose not to attribute the fish points to arcs because it would only distort the source data and make assumptions of life history movement patterns—by leaving as a point, we would acknowledge our ignorance of the specific movement pattern of the target. (Later, when it came to working out the goals, we realized we had to attribute the fish data to stream reaches because we realized that when the data was attributed directly to the watershed units, MARXAN could not take the 30% of watersheds to meet its goal if there were only one or two watersheds that had a certain species. Instead, it was choosing the whole watershed and substantially overshooting its goals.) Fish arc datasets were merged together (from the Washington Department of Fish and Wildlife, Mike Pearson's data, and the points that had been attributed to arcs), and duplication was removed. Polygon data did not need to be merged since it was only from the CDC.

   a. Note: any target represented in more than one type of spatial data (for example, as points and also as arcs) had to be adjusted to remove duplication across datasets. Arc data took priority over the point data.

b. Note: after attributing points to arcs, three fish species were represented as both polygons and as arcs; therefore each representation of the same species were given separate target id's for MARXAN.

8. Modeled data was kept separate since it was treated as a retro target.

For the purposes of freshwater portfolio assembly using MARXAN, fish data were attributed to the nearest stream reach, and then attributed to the underlying watersheds. All non-fish data were attributed directly to the underlying watersheds.

Set Goals for Fine-filter Freshwater Targets

Initial conservation goals were set based on TNC/NatureServe recommendations (Comer 2001, 2003; Appendix 19) and further discussion with experts. Conservation goals for riparian species targets with occurrence information were determined following "moderate risk" occurrence or population guidelines (Comer, 2003) and were based largely on current distribution of the species (See Table 4.1).

Table 4.1 Goal Setting

DISTRIBUTION RELATIVE TO ECOREGION	SPATIAL PATTERN OF OCCURRENCE		
	FINE-FILTER TARGET SPECIES		
	DEFAULT NUMBER OF OCCURRENCES		
	"HIGHER RISK" SCENARIO	"MODERATE RISK" SCENARIO (DEFAULT)	"LOWER RISK SCENARIO"
Endemic	25	**50**	75
Limited	13	**25**	38
Widespread/Disjunct	7	**13**	20
Peripheral	4	**7**	11

SPATIAL DISTRIBUTION	DEFINITION
Endemic	>90% of global distribution in EDU
Limited	<90% of global distribution in EDU, limited to 2-3 EDUs
Disjunct	Genetically distinct from other populations and substantially separated from other populations
Widespread	Global distribution >3 EDUs
Peripheral	<10% of distribution is within EDU

To set the final applied goal, it was necessary first to determine how many occurrences were located in each EDU. To do this, the GIS team intersected the data files with the planning units (watersheds) in order to determine how much of each target is located in each EDU (in terms of area, length of stream habitat, or number of occurrences). Once this information was determined, goals were adjusted accordingly. A summary of the applied goals is listed in Table 4.2 and 4.3.

Of the 7 targets with occurrence data in the Southern Coastal Streams EDU, only 14% of those met their default goals (the target that did meet its goal was an amphibian). The other 86% of the targets had too few occurrences to meet the default goals. Of the 17 targets with occurrence data in the Lower Fraser EDU, only 24% of those met their default goals (all targets that did meet their goal were amphibians). The other 76% of the targets had too few occurrences to meet the default goals. In cases where the default goals were not met, the site selection analysis sought to capture every occurrence. It was assumed that by including all known occurrences in the goal, we would ensure some representation of poorly documented species in the portfolio.

Conservation goals for freshwater fine-filter data that consisted of distribution data in lines and polygons rather than populations were set according to percentages of distribution rather than number of populations. For all fish other than salmon, an initial distributional goal of 30% was used. Salmonid targets were defined differently from other freshwater species due to their complex and wide-ranging life history and their special consideration under COSEWIC and the Endangered Species Act. For the majority of salmon targets, a conservation goal was set at 50% of distribution. For two sockeye salmon (*Oncorhynchus nerka)* populations (Cultus Lake and Sakinaw Lake), the conservation goal was set at 100% since those populations are specifically listed as endangered in BC. Conservation goals for steelhead (*Oncorhynchus mykiss*) runs were also set at 100% because of the severe lack of distributional data for this target in the North Cascades EDUs. In the absence of any clear guidance for bull trout (*Salvelinus confluentus*) targets, we applied the same 50% of distribution goal based on the assumption that they exhibit similar life history and distribution to salmon targets.

It is important to note that the 30% or 50% value should not be construed as something that has been substantiated or otherwise condoned, but rather as a mid-way point between two extremes in light of the fact that there is no available science that suggests any other appropriate and defensible goal. It would have been preferred to set salmonid goals of 50% of spawning and rearing habitat, but since the data did not support this zonal information; we set goals at 50% of observed distribution instead.

Conservation goals for modeled Coastal Tailed Frog (*Ascaphus truei*) and Steelhead (*Oncorhynchus mykiss*) habitat data were set at 0% as we are treating them as retro targets whose goals can reevaluated if the portfolio does not pick up an adequate amount of their habitat through meeting the goals of other targets. Due to the large-scale spatial distribution of this data, there was the risk that they would drive the site selection portfolio.

Table 4.2 Applied Goals for the Southern Coastal Streams EDU

TAXONOMIC GROUP	TARGET SPECIES	SCIENTIFIC NAME	APPLIED GOAL	STRATIFIED BY
Amphibian	Coastal Tailed Frog	*Ascaphus truei*	13 EOs	EDU
Bird	Western Grebe	*Aechmorphorus occidental*	1 EO	EDU
Mammal	Pacific Water Shrew	*Sorex bendirii*	1 EO	EDU
Freshwater Fish—Anadromous Salmonid	Sockeye Salmon	*Oncorhynchus nerka*	50% of distribution	EDU
Freshwater Fish—Anadromous Salmonid	Chum Salmon	*Oncorhynchus keta*	50% of distribution	XAN
Freshwater Fish—Anadromous Salmonid	Coho Salmon	*Oncorhynchus kisutch*	50% of distribution	EDU
Freshwater Fish—Anadromous Salmonid	Chinook Salmon	*Oncorhynchus tshawytscha*	50% of distribution	EDU
Freshwater Fish—Anadromous Salmonid	Pink Salmon	*Oncorhynchus gorbuscha*	50% of distribution	XAN
Freshwater Fish—Anadromous Salmonid	Steelhead	*Oncorhynchus mykiss*	50% of distribution	EDU
Freshwater Fish—Anadromous Salmonid	Steelhead (Winter-run)	*Oncorhynchus mykiss*	100% of distribution	EDU
Freshwater Fish—Anadromous Salmonid	Steelhead (Summer-run)	*Oncorhynchus mykiss*	100% of distribution	EDU
Freshwater Fish	Kokanee	*Oncorhynchus nerka*	50% of distribution	EDU
Freshwater Fish	Sockeye Salmon (Sakinaw Lake)	*Oncorhynchus nerka*	100% of distribution	EDU
Insects—Plecoptera	A Stonefly	*Bolshecapnia gregsoni*	2 EOs	EDU
Insects—Odonata	Western Pondhawk	*Erythemis collocata*	2 EOs	EDU
Insects—Odonata	Blue Dasher	*Pachydiplax longipennis*	6 EOs	EDU
Insects—Odonata	Black Petaltail	*Tanypteryx hageni*	1 EOs	EDU
Freshwater Fish	Green Sturgeon	*Acipenser medirostris*	30% of distribution	EDU
Freshwater Fish	Threespine Stickleback	*Gasterosteus aculeatus*	30% of distribution	EDU
Freshwater Fish	Western Brook Lamprey	*Lampetra richardsoni*	30% of distribution	EDU
Freshwater Fish	Coastal Cutthroat Trout	*Oncorhynchus clarki clar*	30% of distribution	EDU
Freshwater Fish	Bull Trout	*Salvelinus confluentus*	50% of distribution	EDU
Freshwater Fish	Dolly Varden	*Salvelinus malma*	30% of distribution	EDU
Freshwater Fish	Eulachon	*Thaleichthys pacificus*	30% of distribution	EDU
Freshwater Fish	Cutthroat Trout (Anadromous)	*Oncorhynchus clarki clarki*	30% of distribution	EDU
Freshwater Fish	Dolly Varden (Anadromous)	*Salvelinus malma*	30% of distribution	EDU
	RETRO TARGETS			
Amphibian	Coastal Tailed Frog (modeled)	*Ascaphus truei*	RETRO Target = 0%	EDU
Freshwater Fish—Anadromous Salmonid	Steelhead (modeled)	*Oncorhynchus mykiss*	RETRO Target = 0%	EDU

Table 4.3 Applied Goals for the Lower Fraser EDU

TAXONOMIC GROUP	TARGET SPECIES	SCIENTIFIC NAME	APPLIED GOAL	STRATIFIED BY
Amphibian	Coastal Tailed Frog	*Ascaphus truei*	13 EOs	EDU
Mammal	Pacific Water Shrew	*Sorex bendirii*	10 EOs	EDU
Amphibian	Western Toad	*Bufo boreas*	11 EOs	EDU
Amphibian	Red-legged Frog	*Rana aurora*	19 EOs	EDU
Amphibian	Pacific Giant Salamander	*Dicamptodon tenebrosus*	13 EOs	EDU
Freshwater Fish—Anadromous Salmonid	Sockeye Salmon	*Oncorhynchus nerka*	50% of distribution	EDU
Freshwater Fish—Anadromous Salmonid	Chum Salmon	*Oncorhynchus keta*	50% of distribution	XAN
Freshwater Fish—Anadromous Salmonid	Coho Salmon	*Oncorhynchus kisutch*	50% of distribution	EDU
Freshwater Fish—Anadromous Salmonid	Chinook Salmon	*Oncorhynchus tshawytscha*	50% of distribution	EDU
Freshwater Fish—Anadromous Salmonid	Pink Salmon	*Oncorhynchus gorbuscha*	50% of distribution	XAN
Freshwater Fish—Anadromous Salmonid	Steelhead	*Oncorhynchus mykiss*	50% of distribution	EDU
Freshwater Fish—Anadromous Salmonid	Steelhead (Winter-run)	*Oncorhynchus mykiss*	100% of distribution	EDU
Freshwater Fish—Anadromous Salmonid	Steelhead (Summer-run)	*Oncorhynchus mykiss*	100% of distribution	EDU
Freshwater Fish	Kokanee	*Oncorhynchus nerka*	50% of distribution	EDU
Freshwater Fish	Sockeye Salmon (Cultus Lake)	*Oncorhynchus nerka*	100% of distribution	EDU
Insects—Plecoptera	A Stonefly	*Bolshecapnia sasquatch*	1 EOs	EDU
Insects—Plecoptera	A Spring Stonefly	*Cascadoperla trictura*	2 EOs	EDU
Insects—Plecoptera	A Stonefly	*Isocapnia fraseri*	1 EOs	EDU
Insects—Plecoptera	A Stonefly	*Setvena tibialis*	1 EOs	EDU
Insects—Plecoptera	A Stonefly	*Isocapnia vedderensis*	3 EOs	EDU
Insects—Odonata	Emma's Dancer	*Argia emma*	5 EOs	EDU
Insects—Odonata	Vivid Dancer	*Argia vivida*	2 EOs	EDU
Insects—Odonata	Beaverpond Baskettail	*Epitheca canis*	5 EOs	EDU
Insects—Odonata	Western Pondhawk	*Erythemis collocata*	1 EOs	EDU
Insects—Odonata	Grappletail	*Octogomphus specularis*	4 EOs	EDU
Insects—Odonata	Blue Dasher	*Pachydiplax longipennis*	2 EOs	EDU
Insects—Odonata	Autumn Meadowhawk	*Sympetrum vicinum*	8 EOs	EDU
Freshwater Fish	Green Sturgeon	*Acipenser medirostris*	30% of distribution	EDU
Freshwater Fish	White Sturgeon (Lower Fraser)—arc data	*Acipenser transmontanus*	30% of distribution	EDU
Freshwater Fish	White Sturgeon (Lower Fraser)—polygon data	*Acipenser transmontanus*	30% of distribution	EDU
Freshwater Fish	Mountain Sucker—arc data	*Catostomus platyrhynchus*	30% of distribution	EDU

Freshwater Fish	Mountain Sucker—polygon data	*Catostomus platyrhynchus*	30% of distribution	EDU
TAXONOMIC GROUP	**TARGET SPECIES**	**SCIENTIFIC NAME**	**APPLIED GOAL**	**STRATIFIED BY**
Freshwater Fish	Salish Sucker—arc data	*Catostomus sp. 4*	30% of distribution	EDU
Freshwater Fish	Salish Sucker—polygon data	*Catostomus sp. 4*	30% of distribution	EDU
Freshwater Fish	Threespine Stickleback	*Gasterosteus aculeatus*	30% of distribution	EDU
Freshwater Fish	Western Brook Lamprey	*Lampetra richardsoni*	30% of distribution	EDU
Freshwater Fish	Coastal Cutthroat Trout	*Oncorhynchus clarki clar*	30% of distribution	EDU
Freshwater Fish	Nooksack Dace	*Rhinichthys cataractae*	30% of distribution	EDU
Freshwater Fish	Bull Trout	*Salvelinus confluentus*	50% of distribution	EDU
Freshwater Fish	Dolly Varden	*Salvelinus malma*	30% of distribution	EDU
Freshwater Fish	Pygmy Longfin Smelt	*Spirinchus sp. 1*	30% of distribution	EDU
Freshwater Fish	Eulachon	*Thaleichthys pacificus*	30% of distribution	EDU
Freshwater Fish	Cultus Lake Sculpin	*Cottus sp. 2*	30% of distribution	EDU
Freshwater Fish	Cutthroat Trout (Anadromous)	*Oncorhynchus clarki clarki*	30% of distribution	EDU
	RETRO TARGETS			
Amphibian	Coastal Tailed Frog (modeled)	*Ascaphus truei*	RETRO Target = 0%	EDU
Freshwater Fish—Anadromous Salmonid	Steelhead (modeled)	*Oncorhynchus mykiss*	RETRO Target = 0%	EDU

Determine Data Gaps and Considerations for Next Iteration

The analysis was somewhat limited in precision, comprehensiveness, and reliability due to a number of data gaps within the freshwater analysis that should be addressed in subsequent analyses of this assessment. (1) No occurrence or satisfactory habitat data were available for 95 of the 143 target animal species (66%) (see Table 5.1). Over 90% of the species without pertinent data were invertebrates. This reflects our extremely poor understanding of invertebrate species diversity, geographic distribution, and habitat requirements. Eighteen of the species we did have data for had fewer than 10 known occurrences in the ecoregion (75%). Lack of data is likely a function of low survey effort or inconsistent data collection methods. (2) Freshwater plants were not included in this iteration. (3) The target list should be reevaluated for each EDU to determine if there are any species that should be targets for only one EDU rather than both EDUs (as the separation is currently based on data distribution rather than breaking out targets per EDU during target list creation).

Table 5.1 Freshwater animals for which no recent or valid data exists within the Southern Coastal Streams or Lower Fraser EDUs

TAXON GROUP	COMMON NAME	SCIENTIFIC NAME	G RANK ROUNDED	CAD NATIONAL RANK	S RANK BC	BC LISTED
Birds	Barrow's goldeneye	*Bucephala islandica*	G5		S4B	
Birds	American dipper	*Cinclus mexicanus*	G5		S5B,S4N	
Birds	Band-tailed pigeon	*Columba fasciata*	G4		S3S4B	
Birds	Bald eagle	*Haliaeetus leucocephalus*	G4		S4	
Birds	Harlequin duck	*Histrionicus histrionicus*	G4		S4B, S3N	
Birds	Double-crested cormorant	*Phalacrocorax auritus*	G5		S2B, SZN	
Crustacean	A crayfish	*Pacifastacus leniusculus trowbridgii*	T3	N3	S3	
Freshwater Fish	White Sturgeon	*Acipenser transmontanus*	G4	N2	S2	BLUE
Insects-Ephemeroptera	A Mayfly	*Ameletus pritchardi*	G3	N2N4		
Insects-Ephemeroptera	A Mayfly	*Ameletus shepherdi*	G3	N2	SNR	
Insects-Ephemeroptera	A Mayfly	*Ameletus sparsatus*	G3	N3	SNR	
Insects-Ephemeroptera	A Mayfly	*Ameletus suffusus*	G3	N2	SNR	
Insects-Ephemeroptera	A Mayfly	*Ameletus vancouverensis*	G3	N1	SNR	
Insects-Ephemeroptera	A Mayfly	*Ameletus vernalls*	G3	N2	SNR	
Insects-Ephemeroptera	A Mayfly	*Baetis parallelus*	G2	N1	SNR	
Insects-Ephemeroptera	A Mayfly	*Baetis persecutor*	G2	N1N3	SNR	
Insects-Ephemeroptera	A Mayfly	*Caudatella jacobi*	G3	N2N4	SNR	
Insects-Ephemeroptera	A Mayfly	*Cinygma lyriforme*	G5	N1	SNR	
Insects-Ephemeroptera	A Mayfly	*Cinygmula gartrelli*	G3	N2	SNR	
Insects-Ephemeroptera	A Mayfly	*Cinygmula kootenai*	G2	N1	SNR	
Insects-Ephemeroptera	A Mayfly	*Cinygmula mimus*	G5	N2N	SNR	
Insects-Ephemeroptera	A Mayfly	*Cinygmula par*	G4	N2	SNR	
Insects-Ephemeroptera	A Mayfly	*Cinygmula ramaleyi*	G4	N3	SNR	
Insects-Ephemeroptera	A Mayfly	*Cinygmula reticulata*	G4	N2N4	SNR	
Insects-Ephemeroptera	A Mayfly	*Cinygmula uniformis*	G3	N3	SNR	
Insects-Ephemeroptera	A Mayfly	*Drunella pelosa*	G5	N2	SNR	
Insects-Ephemeroptera	A Mayfly	*Epeorus dulciana*	G2	N1	SNR	
Insects-Ephemeroptera	A Mayfly	*Epeorus permagnus*	G3	N2	SNR	
Insects-Ephemeroptera	A Mayfly	*Eurylophella lodi*	G4	N1	SNR	

TAXON GROUP	COMMON NAME	SCIENTIFIC NAME	G RANK ROUNDED	CAD NATIONAL RANK	S RANK BC	BC LISTED
Insects-Ephemeroptera	A Mayfly	*Ironodes arctus*	G2	N1N	SNR	
Insects-Ephemeroptera	A Mayfly	*Ironodes flavipennis*	G2	N1	SNR	
Insects-Ephemeroptera	A Mayfly	*Paraleptophlebia brunneipennis*	GH	NH	SH	
Insects-Ephemeroptera	A Mayfly	*Paraleptophlebia columbiae*	G2	N1	SNR	
Insects-Ephemeroptera	A Mayfly	*Paraleptophlebia gregalis*	G3	N2	SNR	
Insects-Ephemeroptera	A Mayfly	*Paraleptophlebia rufivenosa*	GH	NH	NH	
Insects-Ephemeroptera	A Mayfly	*Paraleptophlebia temporalis*	G4	N1	SNR	
Insects-Ephemeroptera	A Mayfly	*Paraleptophlebia vaciva*	G3	N1	SNR	
Insects-Ephemeroptera	A Mayfly	*Procloeon quaestium*	G3	N3	SNR	
Insects-Ephemeroptera	A Mayfly	*Rhithrogena futilis*	G4	N3	SNR	
Insects-Ephemeroptera	A Mayfly	*Rhithrogena virilis*	G3	N3	SNR	
Insects-Ephemeroptera	A Mayfly	*Serratella teresa*	G4	N1	SNR	
Insects-Ephemeroptera	A Mayfly	*Siphlonurus authumnalis*	G3	N1	SNR	
Insects-Ephemeroptera	A Mayfly	*Siphlonurus phyllis*	G3	N3N4	SNR	
Insects-Odonata	Western River Cruiser	*Macromia magnifica*	G5	N3	S3	BLUE
Insects-Plecoptera	A Stonefly	*Bolshecapnia milami*	G3	N3	SNR	
Insects-Plecoptera	A Stonefly	*Bolshecapnia rogozera*	G1	N1	SNR	
Insects-Plecoptera	A Stonefly	*Bolshecapnia spenceri*	G3	N3	SNR	
Insects-Plecoptera	A Stonefly	*Capnia sextuberculata*	G4	N3	SNR	
Insects-Plecoptera	A Stonefly	*Doroneuria baumanni*	G4	N3	SNR	
Insects-Plecoptera	A Stonefly	*Frisonia picticeps*	G3	N3	SNR	
Insects-Plecoptera	A Stonefly	*Isocapnia agassizi*	G3	N2	SNR	
Insects-Plecoptera	A Stonefly	*Isoperla sordida*	G3	N3	SNR	
Insects-Plecoptera	A Stonefly	*Megaleuctra stigmata*	G2	N2	SNR	
Insects-Plecoptera	A Stonefly	*Megarcys irregularis*	G3	N3	SNR	
Insects-Plecoptera	A Stonefly	*Osobenus yakimae*	G3	N2	SNR	
Insects-Plecoptera	A Stonefly	*Perlomyia collaris*	G3	N3	SNR	
Insects-Plecoptera	A Stonefly	*Perlomyia utahensis*	G3	N3	SNR	
Insects-Plecoptera	A Stonefly	*Setvena bradleyi*	G3	N3	SNR	
Insects-Tricoptera	Vertrees's Ceraclean Caddisfly	*Ceraclea vertreesi*	G3	NNR	SNR	
Insects-Tricoptera	Mt Hood Primitive Brachycentid	*Eobrachycentrus gelidae*	G3	NNR	SNR	

TAXON GROUP	COMMON NAME	SCIENTIFIC NAME	G RANK ROUNDED	CAD NATIONAL RANK	S RANK BC	BC LISTED
	Caddisfly					
Insects-Tricoptera	Tombstone Prairie Oligophiebodes Caddisfly	*Oligophlebodes mostbento*	G3	NNR	SNR	
Insects-Tricoptera	A Caddisfly	*Rhyacophila ebria*	G1	NN1	SNR	
Insects-Tricoptera	A Rhyacophilian Caddisfly	*Rhyacophila glacieri*	G1	NNR	SNR	
Mammals	Northern bog lemming	*Synaptomis borealis*	G4		S4	
Mammals	Grizzly bear	*Ursus arctos*	G4		S3	
Freshwater Mollusks	Rocky Mountain Capshell	*Acroloxus coloradensis*	G3	N3	S3	RED
Freshwater Mollusks	Winged Floater	*Andonta nuttalliana*	G3	N3	SNR	
Freshwater Mollusks	California Floater	*Anodonta californiensis*	G3	N3	S3S4	
Freshwater Mollusks	Western floater	*Anodonta kennerlyi*	G4			
Freshwater Mollusks	Oregon floater	*Anodonta oregonensis*	G5		na	
Freshwater Mollusks	Prairie Fossaria	*Fossaria bulimoides*	G5	N3	S4	
Freshwater Mollusks	Dusky Fossaria	*Fossaria dalli*	G5	N3	SNR	
Freshwater Mollusks	Pygmy Fossaria	*Fossaria parva*	G5	N5	S3?	
Freshwater Mollusks		*Fossaria perplexa*				
Freshwater Mollusks	Attenuate Fossaria	*Fossaria truncatula*	G3	N3	S3	
Freshwater Mollusks	A Freshwater Snail	*Fossaria vancouverensis*	GH	NH	SH	
Freshwater Mollusks	Western Ridged Mussel	*Gonidea angulata*	G3	N1N3	S1S3	
Freshwater Mollusks	Star gyro	*Gyraulus crista*				
Freshwater Mollusks	Pleated Juga	*Juga plicifera*				
Freshwater Mollusks	Frigid Lymnaea	*Lymnaea atkaensis*	G3	N3N4	S3S4	
Freshwater Mollusks	Western pearlshell	*Margaritifera falcata*				
Freshwater Mollusks	Cloaked Physa	*Physa megalochlamys*	G3	N3	S3?	
Freshwater Mollusks	Frigid Physa	*Physa sibirica*	G4	N4N5	S2S3	
Freshwater Mollusks	Grain Physa	*Physella hordacea*	G1	N1	S1?	
Freshwater Mollusks	Hotwater Physa	*Physella wrighti*	G1	N1	S1	
Freshwater Mollusks	Coarse Rams-horn	*Planorbella binneyi*	G4	N1	SNR	
Freshwater Mollusks	Fine-lined rams-horn	*Planorbella occidentalis*				
Freshwater Mollusks	Meadow Rams-horn	*Planorbula campestris*	G3	N2	SNR	
Freshwater Mollusks	A hydrobiid snail	*Pristinicola hemphilli*				

Freshwater Mollusks	Umbilicate Sprite	*Promenetus umbilicatellus*	G4	N2	SNR	
Freshwater Mollusks	Glossy Valvvata	*Valvata humeralis*	G5	N2N4	SH	
TAXON GROUP	**COMMON NAME**	**SCIENTIFIC NAME**	**G RANK ROUNDED**	**CAD NATIONAL RANK**	**S RANK BC**	**BC LISTED**
Freshwater Mollusks	Rams-horn Valvata	*Valvata mergella*	G2	N2	SNR	
Freshwater Mollusks	Threeridge Valvata	*Valvata tricarinata*	G5	N5	SH	

Expert Review of Portfolio Sites

The preliminary portfolio that was produced using Marxan was revised based on expert knowledge of local site conditions and biodiversity. This was solicited through workshops and individual meetings with biologists from a variety of federal agencies, local organizations, universities, and other researchers.

4.0 Freshwater—Data Description and Location

- **Original source data can be found on the Nature Conservancy of Canada's BC office:**

GIS DRIVE:\Data\Ecoregions\North_Casc\Data\AquaticData_AsOfJuly122005\Data_Source

- **Milestone data are located on the Nature Conservancy of Canada's BC office:**

GIS DRIVE:\Data\AquaticData_AsOfJuly122005\Data_Analysis. The organization within this directory is as follows:

- Ecoregion_Wide
    - This folder contains the Odonata data and Terrestrial Mollusks data, compiled into one full dataset for the entire range of EDUs
- Fraser_Only
    - This folder contains the initial cleaning and final datasets for data within the Fraser EDU and 5K buffered ecoregion boundary only.
- SCS_Only
    - This folder contains the initial cleaning and final datasets for data that falls within the SCS EDU, but outside of the ecoregion boundary.
- Fr_SCS_Combined
    - This folder contains all of the data that was cleaned for both EDUs, and the final seven datasets that were attributed to the EDUs. It also contains the spec.dat table with adjusted goals

5.0 Species ID Designations

A six-digit code was developed for each target, corresponding to its unit of stratification, its system type, and its individual species ID. The 1st two digits of the 6 digit full species ID correspond to the stratification unit it is located in:

CODE	STRATIFICATION UNIT
15	EDU—Southern Coastal Streams
16	EDU—Lower Fraser
19	XAN—Puget Sound/Georgia Basin
20	XAN—Fraser River

The 3rd digit of the full species ID is a “6” for all records, which denotes that it is part of the freshwater fine-filter target analysis.

The final three digits of the full species ID corresponds to each particular species target:

TAXONOMIC GROUP	TARGET SPECIES	SCIENTIFIC NAME	SPP ID
Amphibian	Coastal Tailed Frog	*Ascaphus truei*	101
Bird	Western Grebe	*Aechmorphorus occidental*	102
Mammal	Pacific Water Shrew	*Sorex bendirii*	103
Amphibian	Western Toad	*Bufo boreas*	104
Amphibian	Red-legged Frog	*Rana aurora*	105
Amphibian	Pacific Giant Salamander	*Dicamptodon tenebrosus*	115
Freshwater Fish—Anadromous Salmonid	Sockeye Salmon	*Oncorhynchus nerka*	201
Freshwater Fish—Anadromous Salmonid	Chum Salmon	*Oncorhynchus keta*	202
Freshwater Fish—Anadromous Salmonid	Coho Salmon	*Oncorhynchus kisutch*	203
Freshwater Fish—Anadromous Salmonid	Chinook Salmon	*Oncorhynchus tshawytscha*	204
Freshwater Fish—Anadromous Salmonid	Pink Salmon	*Oncorhynchus gorbuscha*	205
Freshwater Fish—Anadromous Salmonid	Steelhead	*Oncorhynchus mykiss*	206
Freshwater Fish—Anadromous Salmonid	Steelhead (Winter-run)	*Oncorhynchus mykiss*	207
Freshwater Fish—Anadromous Salmonid	Steelhead (Summer-run)	*Oncorhynchus mykiss*	208
Freshwater Fish	Kokanee	*Oncorhynchus nerka*	210
Freshwater Fish	Sockeye Salmon (Cultus Lake)	*Oncorhynchus nerka*	211
Freshwater Fish	Sockeye Salmon (Sakinaw Lake)	*Oncorhynchus nerka*	212
Insects—Plecoptera	A Stonefly	*Bolshecapnia gregsoni*	501
Insects—Plecoptera	A Stonefly	*Bolshecapnia sasquatch*	504
Insects—Plecoptera	A Spring Stonefly	*Cascadoperla trictura*	507
Insects—Plecoptera	A Stonefly	*Isocapnia fraseri*	511
Insects—Plecoptera	A Stonefly	*Setvena tibialis*	519
Insects—Plecoptera	A Stonefly	*Isocapnia vedderensis*	520
Insects—Odonata	Emma's Dancer	*Argia emma*	601
Insects—Odonata	Vivid Dancer	*Argia vivida*	602
Insects—Odonata	Beaverpond Baskettail	*Epitheca canis*	603
Insects—Odonata	Western Pondhawk	*Erythemis collocata*	604
Insects—Odonata	Grappletail	*Octogomphus specularis*	606
Insects—Odonata	Blue Dasher	*Pachydiplax longipennis*	607
Insects—Odonata	Autumn Meadowhawk	*Sympetrum vicinum*	608
Insects—Odonata	Black Petaltail	*Tanypteryx hageni*	609
Freshwater Fish	Green Sturgeon	*Acipenser medirostris*	801
Freshwater Fish	White Sturgeon (Lower Fraser)—arc data	*Acipenser transmontanus*	803
Freshwater Fish	White Sturgeon (Lower Fraser)—polygon data	*Acipenser transmontanus*	833
Freshwater Fish	Mountain Sucker—arc data	*Catostomus platyrhynchus*	804
Freshwater Fish	Mountain Sucker—polygon data	*Catostomus platyrhynchus*	844
Freshwater Fish	Salish Sucker—arc data	*Catostomus sp. 4*	805
Freshwater Fish	Salish Sucker—polygon data	*Catostomus sp. 4*	855
Freshwater Fish	Threespine Stickleback	*Gasterosteus aculeatus*	806

Freshwater Fish	Western Brook Lamprey	*Lampetra richardsoni*	807
Freshwater Fish	Coastal Cutthroat Trout	*Oncorhynchus clarki clarki*	808
TAXONOMIC GROUP	**TARGET SPECIES**	**SCIENTIFIC NAME**	**SPP ID**
Freshwater Fish	Nooksack Dace	*Rhinichthys cataractae*	809
Freshwater Fish	Bull Trout	*Salvelinus confluentus*	810
Freshwater Fish	Dolly Varden	*Salvelinus malma*	811
Freshwater Fish	Pygmy Longfin Smelt	*Spirinchus sp. 1*	812
Freshwater Fish	Eulachon	*Thaleichthys pacificus*	813
Freshwater Fish	Cultus Lake Sculpin	*Cottus sp. 2*	814
Freshwater Fish	Cutthroat Trout (Anadromous)	*Oncorhynchus clarki clar*	816
Freshwater Fish	Dolly Varden (Anadromous)	*Salvelinus malma*	818
	RETRO TARGETS		
Amphibian	Coastal Tailed Frog--habitat	*Ascaphus truei*	100
Freshwater Fish—Anadromous Salmonid	Steelhead--modeled habitat	*Oncorhynchus mykiss*	209

6.0 Data Description

Ministry of Environment—Modeled Distribution of Steelhead Stocks

Comments: This is a work in progress, a modeled distribution of which streams have steelhead. All polygons have watershed codes, which can be associated with streams. SRM is the metadata keepers. The distribution is defined by stocks—a report will be out soon.

Contact: Eric Parkinson, eric.parkinson@gov.bc.ca, (604) 222-6761

Pearson Ecological—Salish Sucker and Nooksack Dace

Comments: Very accurate, placed points/arcs on orthophotos.

Contact: Mike Pearson, mike@pearsonecological.com, (250) 387-1343

Source File Projection: UTM NAD 83, zone 10

Processing Steps: Removed those records which did not fall within the ecoregion boundary and merged the rest into one dataset

Royal British Columbia Museum—Fish

Comments: Many of the coordinates have 00's in the decimals place, which means the spatial precision is fairly low and lower than what was used in the Okanagan (1 km). The data was assumed to be NAD 27 due to the age of the records. David Tesch recommended not using this fish data due to a low confidence in the data. Alternatively, we could use those that fall within the province and wipe out the rest.

Contact: Kelly Sendall, ksendall@royalbcmuseum.bc.ca, (250) 387-2932

Source File Projection: None, was an excel database, and was converted from degrees minutes seconds to decimal degrees, and then was converted to points

Processing Steps: Clipped to the EDU buffer, pulled out only species of interest (including marine to pass off), removed data that does not specify seconds. Note: Spirinchus species pop. 1 = Harrison Lake Pygmy Longfin Smelt, Salmon clarki = coastal cutthroat trout, and rhinichthys cataractae / longnose dace = nooksack dace.

Royal British Columbia Museum—Dragonflies

Comments: Very thorough dataset.

Contact: Rob Cannings, rcannings@royalbcmuseum.bc.ca, (250) 356-8242

Source File Projection: None, was an excel database and was converted to points

Processing Steps: Clipped to the EDU buffer, pulled out only species of interest

Royal British Columbia Museum—Ephemeroptera, Tricoptera, Plecoptera

Contact: Claudia Copley, ccopley@royalbcmuseum.bc.ca, (250) 952-0696

Source File Projection: None, was an excel database and was converted to points

Processing Steps: Clipped to the EDU buffer, pulled out only species of interest

University of British Columbia—Plecoptera and Tricoptera

Contact: Launi Lucas & Geoff Scudder, lucas@zoology.ubc.ca, (604) 822-3682

Ministry of Environment—Fish

Comments: This Known Fish Observations is a point dataset that is a combination of the most recent FISS and field consolidated waterbody survey components (CWBS) (they are linked/updated to sources and so data was updated as of date obtained). It will later also incorporate UBC museum datasets and others. And further down the road, CWBS will roll into FISS as well—and there will be one stem dataset. This observational/capture data focuses on distribution, but is of limited analysis for statistical use because there is some duplication. It includes over 170,000 points and includes records where an expert said there were fish, even if none were specifically observed, but are identified as waterbody based rather than observation based. Don McPhail (UBC) said that the data quality in FISS tends to go down after 1965/1970 due to increased contractors. Points are about 95% plausible, the other 5% stick out like sore thumbs. Locality tends to be more accurate in recent dates due to GIS. The locational accuracy is highly dependent upon the source.

Contact: David Tesch, david.tesch@gov.bc.ca, (250) 356-5450

Date of File: September, 2004

Source file projection: Albers Conical Equal Area, NAD 83

Processing Steps: Clipped to EDU buffer, pulled out all target species of concern. Note: removed Columbia and upper Fraser white sturgeon since not in North Cascades, removed westslope cutthroat trout since was not = clarki clarki, removed pygmy whitefish since not in North Cascades, left in Puget Coho while cleaning data since will pass that target off to the marine team, northern mountain sucker = mountain sucker, cutthroat trout= coastal cutthroat trout (spoke with Eric Parkinson, who said the natural range of westslope does not cut into NC, though there is some debate near Cathedral Lakes and down into Washington about whether or not they are stocked or natural pops (use the Columbia drainage as the divide, so all west of the Columbia drainage should be coastal rather than westslope). Removed “All Salmon” & “Salmon (General)” records due to lack of specific species name.

Use Constraints:

1. There is some duplication of data points where FISS may already contain a summarized reference for raw data being pulled from another data source. Currently there is no easy way to detect this duplication. As such the coverage is suitable for occurrence information, but it is not suitable for counts or statistics about the number of observations etc.
2. This coverage is not a definitive reference for where fish do not occur. That is absence of a fish observation for a particular location does not imply fish absence.
3. Data points in the coverage come from a variety sources, spatial resolutions and inventory methodologies. The data for a given point may not have been gathered with a rigor suitable for stream classification.

British Columbia Conservation Data Centre—Fish and Dragonflies

Comments: Accurate according to polygon size.

Contact: Marta Donovan, marta.donovan@gov.bc.ca, (250) 387-9523

Processing Steps: Clipped to the EDU buffer, pulled out target species of concern

Data collected by Washington Department of Fish and Wildlife—Amphibians, Birds, Mammals

Contact: Jeff Lewis, lewisjcl@dfw.wa.gov, (360) 902-2374

7.0 Targets Omitted By Experts

TAXANOMIC GROUP	REASON FOR REMOVAL	SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK ROUNDED	CAD FEDERAL STATUS	BC RANK
Crustaceans	Not in North Cascades	*Paramoera carlottensis*		G1	NNR	S1
Crustaceans	Not in North Cascades	*Ramellogammarus vancouverensis*		G1	NNR	S1
Crustaceans	Marine	*Pollicipes polymerus*	Goose Barnacle	GNR	NNR	
Crustaceans	Marine	*Hapalogaster grebnitzkii*	A Marine Decapod	GNR	NNR	
Crustaceans	Marine	*Lebbeus polaris*	A Marine Decapod	GNR	NNR	
Crustaceans	Marine	*Emerita analoga*	Pacific sand crab	GNR	NNR	
Insects	No longer listed	*Aeshna tuberculifera*	Black-tipped Darner	G4	N4	S3
Insects	Not listed in BC	*Ischnura perparva*	Western Forktail	G5	N1N2	S5
Insects	Not in North Cascades	*Aeshna constricta*	Lance-tipped Darner	G5	N5	S2S3
Insects	Not in North Cascades	*Calopteryx aequabilis*	River Jewelring	G5	N5	S1
Insects	Not in North Cascades	*Enallagma civile*	Familiar Bluet	G5	N5	S1
Insects	Not in North Cascades	*Enallagma hageni*	Hagen's Bluet	G5	N5	S3S4
Insects	Not in North Cascades	*Leucorrhinia patricia*	Canada Whiteface	G4	N4	S3
Insects	Not in North Cascades	*Libellula pulchella*	Twelve-spotted Skimmer	G5	N5	S3
Insects	Not in North Cascades	*Somatochlora brevicincta*	Quebec Emerald	G3	N2N3	S2S3
Insects	Not in North Cascades	*Somatochlora forcipata*	Forcipate Emerald	G5	N5	S2
Insects	Not in North Cascades	*Somatochlora kennedyi*	Kennedy's Emerald	G5	N5	S1S2
Insects	Not in North Cascades	*Somatochlora septentrionalis*	Muskeg Emerald	G5	N5	
Insects	Not in North Cascades	*Styurus olivaceus*	Olive Clubtail	G4	N2	S2
Insects	Not in North Cascades	*Ischnura damula*	Plains Forktail	G5	N2N3	S1
Insects	Not in North Cascades	*Gomphus graslinellus*	Pronghorn Clubtail	G5	N3	S2S3
Insects	Not in North Cascades	*Tramea lacerata*	black Saddlebags	G5	N3N4	SNA
Fishes	Marine	*Oncorhynchus kisutch pop. 5*	Coho Salmon-Puget Sound/strait of Georgia	T3	NNR	
Fishes	Marine	*Sebastes paucispinis*	Bocaccio	G4	N2	

Fishes	Not in BC	*Cottus baridi bendirei*	Malheur Mottled Sculpin	T4	NNR	S2
TAXANOMIC GROUP	**REASON FOR REMOVAL**	**SCIENTIFIC NAME**	**COMMON NAME**	**GLOBAL RANK ROUNDED**	**CAD FEDERAL STATUS**	**BC RANK**
Fishes	EXTINCT- Not in North Cascades	*Coregonus sp. 1*	Dragon Lake Whitefish	GX	NX	SX
Fishes	Not in North Cascades	*Acipenser transmontanus pop.1*	White Sturgeon-Kootenai River	T1	N1	S1
Fishes	Not in North Cascades	*Acipenser transmontanus pop. 2*	White Sturgeon-Columbia River	T3	N1	S1
Fishes	Not in North Cascades	*Acipenser transmontanus pop.3*	White Sturgeon-Kootenai River	T1	N1	S1
Fishes	Not in North Cascades	*Acipenser transmontanus pop. 5*	White Sturgeon-Upper Fraser River Pop.	T1	N1	SNR
Fishes	Not in North Cascades	*Acrocheilus alutaceus*	Chiselmouth	G5	N3	S3
Fishes	Not in North Cascades	*Coregonus artedi*	Cisco or Lake Herring	G5	N5	S2
Fishes	Not in North Cascades	*Coregonus autumnalis*	Arctic Cisco	G5	N3?	S2
Fishes	Not in North Cascades	*Coregonus nasus*	Broad Whitefish	G5	N4	S2
Fishes	Not in North Cascades	*Coregonus sardinella*	Least Cisco	G5	N4	S2S3
Fishes	Not in North Cascades	*Cottus bairdi*	Mottled Sculpin	G5	N5	S3
Fishes	Not in North Cascades	*Cottus bairdi hubbsi*	Columbia Mottled Sculpin, Hubbsi Subspecies	T4	NNR	S3
Fishes	Not in North Cascades	*Cottus bairdi punctulatus*	Mountain Scuplin	TNR	NNR	S2
Fishes	Not in North Cascades	*Cottus confuses*	Shorthead Sculpin	G5	N3	S2S3
Fishes	Not in North Cascades	*Cottus sp. 2*	Cultus Lake Sculpin	G1	N1	S1
Fishes	Not in North Cascades	*Gasterosteus sp. 1*	Giant Black Stickleback	G5	N1	S1
Fishes	Not in North Cascades	*Gasterosteus sp. 4*	Paxton Lake Limnetic Stickleback	G1	N1	S1
Fishes	Not in North Cascades	*Gasterosteus sp. 5*	Paxton Lake Benthic Stickleback	G1	N1	S1
Fishes	Not in North Cascades	*Gasterosteus sp. 12*	Hadley Lake Limnetic Stickleback	GX	NX	SX
Fishes	Not in North Cascades	*Gasterosteus sp. 13*	Hadley Lake Benthic Stickleback	GX	NX	SX
Fishes	Not in North Cascades	*Gasterosteus sp. 16*	Vananda Creek Limnetic Stickleback	G1	N1	S1

Fishes	Not in North Cascades	*Gasterosteus sp. 17*	Vananda Creek Benthic Stickleback	G1	N1	S1
TAXANOMIC GROUP	**REASON FOR REMOVAL**	**SCIENTIFIC NAME**	**COMMON NAME**	**GLOBAL RANK ROUNDED**	**CAD FEDERAL STATUS**	**BC RANK**
Fishes	Not in North Cascades	*Gasterosteus sp. 18*	Misty Lake "Lake" Stickleback			S1
Fishes	Not in North Cascades	*Gasterosteus sp. 19*	Misty Lake "Stream" Stickleback			S1
Fishes	Not in North Cascades	*Hiodon alosoides*	Goldeye	G5	N5	S3S4
Fishes	Not in North Cascades	*Hybognathus hankinsoni*	Brassy Minnow	G5	N5	S3S4
Fishes	Not in North Cascades	*Lampetra macrostoma*	Vancouver Lamprey	G1	N1	S1
Fishes	Not in North Cascades	*Lampetra richardsoni pop. 1*	Morrison Creek Brook Lamprey (Morrison Creek Population)	T1	N1	S1
Fishes	Not in North Cascades	*Lota lota pop. 1*	Burbot - Lower Kootenai River	T1	N1	SNR
Fishes	Not in North Cascades	*Margariscus margarita*	Pearl Dace	G5	N5	S3
Fishes	Not in North Cascades	*Notropis atherinoides*	Emerald Shiner	G5	N5	S1
Fishes	Not in North Cascades	*Notropis hudsonius*	Spottail Shiner	G5	N5	S1S2
Fishes	Not in North Cascades	*Oncorhynchus clarki lewisi*	Cutthroat Trout, Lewisi Subspecies	T3	NNR	S3
Fishes	Not in North Cascades	*Oncorhynchus kisutch pop. 1*	Coho Salmon-Lower Columbia River/SW Washington Coast	T2	NNR	SNR
Fishes	Not in North Cascades	*Oncorhynchus nerka pop.1*	Sockeye Salmon-Snake River	T1	NNR	SNR
Fishes	Not in North Cascades	*Oncrohynchus kisutch pop. 6*	Coho Salmon-Olympic Penninsula	T3	NNR	SNR
Fishes	Not in North Cascades	*Prosopium sp. 2*	McCleese/Mclure Lake Pygmy Whitefish	G1	N1	S1
Fishes	Not in North Cascades	*Pungitius pungitius*	Ninespine Stickleback	G5	N5	S1
Fishes	Not in North Cascades	*Rhinichthys osculus*	Speckled Dace	G5	N1N2	S2
Fishes	Not in North Cascades	*Rhinichthys umatilla*	Umatilla Dace	G4	N2	S2
Fishes	Not in North Cascades	*Stenodus leucichthys*	Inconnu	G5	N5	S3
Fishes	Not in North Cascades	*Thymallus arcticus pop. 1*	Arctic Grayling-Williston watershed	T1	N1	S1

Mollusks	Most likely not in North Cascades, missing adequate information	*Cryptomastix mullani*	Coeur d'Alene Oregonian	G3	N3N4	SNR
TAXANOMIC GROUP	**REASON FOR REMOVAL**	**SCIENTIFIC NAME**	**COMMON NAME**	**GLOBAL RANK ROUNDED**	**CAD FEDERAL STATUS**	**BC RANK**
Mollusks	Most likely not in North Cascades, missing adequate information	*Discus shimekii*	Striate Disc	G5	N3N4	SNR
Mollusks	Most likely not in North Cascades, missing adequate information	*Fisherola nuttalli*	Shortface Lanx	G2	N1	SH
Mollusks	Most likely not in North Cascades, missing adequate information	*Fluminicola fuscus*	Ashy Pebblesnail	G3	NX	SH
Mollusks	Most likely not in North Cascades, missing adequate information	*Gastrocopta holzingeri*	Lambda Snaggletooth	G5	N2N3	SNR
Mollusks	Most likely not in North Cascades, missing adequate information	*Hemphillia camelus*	Pale Jumping-Slug	G3	N3N4	S3
Mollusks	Most likely not in North Cascades, missing adequate information	*Hemphillia malonei*	Malone Jumping-Slug	G1	N1	SNR
Mollusks	Most likely not in North Cascades, missing adequate information	*Magnipelta mycophaga*	Magnum Mantleslug	G3	N2N3	SNR
Mollusks	Most likely not in North Cascades, missing adequate information	*Oreohelix strigosa*	Rocky Mountainsnail	G5	N3	SNR
Mollusks	Most likely not in North Cascades, missing adequate information	*Oreohelix subrudis*	Subalpine Mountainsnail	G5	N3N4	SNR
Mollusks	Most likely not in North Cascades, missing adequate information	*Oxyloma groenlandicum*	Ruddy Ambersnail	G3	N3	SNR
Mollusks	Most likely not in North Cascades, missing adequate information	*Oxyloma hawkinsi*	Boundary Ambersnail	G3	N2N3	SNR
Mollusks	Most likely not in North Cascades, missing adequate information	*Oxyloma nuttallianum*	Oblique Ambersnail	G3	N2N4	SNR
Mollusks	Most likely not in North Cascades, missing adequate information	*Physella virginea*	Sunset Physa	G4	N2	S4
Mollusks	Most likely not in North Cascades, missing adequate information	*Planorbella columbiensis*	Caribou Rams-horn	G1	N1N2	S1S2

Mollusks	Most likely not in North Cascades, missing adequate information	*Pupilla hebes*	Crestless Column	G5	N1N2	SNR
TAXANOMIC GROUP	**REASON FOR REMOVAL**	**SCIENTIFIC NAME**	**COMMON NAME**	**GLOBAL RANK ROUNDED**	**CAD FEDERAL STATUS**	**BC RANK**
Mollusks	Most likely not in North Cascades, missing adequate information	*Stagnicola apicina*	Abbreviate Pondsnail	G5	N4	S2S3
Mollusks	Most likely not in North Cascades, missing adequate information	*Succinea oregonensis*	Oregon Ambersnail	G3	N4	SNR
Mollusks	Most likely not in North Cascades, missing adequate information	*Succinea rusticana*	Rustic Ambersnail	G2	N1	SNR
Mollusks	Most likely not in North Cascades, missing adequate information	*Vallonia albula*	Indecisive Vallonia	G3	N3N4	SNR
Mollusks	Most likely not in North Cascades, missing adequate information	*Vallonia cyclophorella*	Silky Vallonia	G5	N3	SNR
Mollusks	Most likely not in North Cascades, missing adequate information	*Vallonia gracilicosta*	Multirib Vallonia	G5	N4	S3S4
Mollusks	Most likely not in North Cascades, missing adequate information	*Vertigo andursiana*	Pacific Vertigo	G2	N1N2	S1S2
Mollusks	Most likely not in North Cascades, missing adequate information	*Vertigo arthuri*		G3	N3	S3
Mollusks	Most likely not in North Cascades, missing adequate information	*Vertigo binneyana*	Cylindrical Vertigo	GH	NH	SNR
Mollusks	Most likely not in North Cascades, missing adequate information	*Vertigo elatior*	Tapered Vertigo	G5	N3	SNR
Mollusks	Marine	*Calliostoma bernardi*	A topsnail	GNR	NNR	
Mollusks	Marine	*Calliostoma platinum*	A topsnail	GNR	NNR	
Mollusks	Marine	*Haliotis kamtschatkana*	Pinto Abalone	GNR	NNR	
Mollusks	Marine	*Hanleyella oldroydi*	A Chilton	GNR	NNR	
Mollusks	Marine	*Ostrea conchaphila*	Olympia Oyster	G5	N5	
Mollusks	Marine	*Okenia vancouverensis*	A Nudibranch	GNR	NNR	

Mollusks	Marine	*Rhamphidonta retifera*	Netted Kelleyclam	GNR	NNR	
Mollusks	Marine	*Serripes groenlandicus*	Greenland Cockle	G5	N5	

APPENDIX 10 – PUGET SOUND EDU: METHODS AND RESULTS

Appendix 10 – Puget Sound EDU: Methods and Results

A general freshwater systems classification framework and methodology was developed by The Nature Conservancy and is well documented and substantiated in other documents (Higgins et al. 1998, 2005). The classification system for each ecological drainage unit (EDU) varies within this framework to account for differences in environmental gradients and the biota within that landscape. The following describes the classification system developed for stream and lake macrohabitats and freshwater systems for the Puget Sound EDU as well as the methods applied to develop freshwater system types. The specific classification attributes and classes within these attributes were developed by The Nature Conservancy's Freshwater Initiative as part of an early (2003) classification effort for western Washington, and were established through research of available literature, analyses of environmental data, and with the guidance of regional and national experts.

The Puget Sound EDU was first assessed in 2003 as part of the Willamette Valley-Puget Trough-Georgia Basin Ecoregional Assessment (Floberg et al. 2004). This subsequent second iteration was conducted in 2005 in order to:

- re-evaluate targets and goals in light of a revised EDU boundary (2004 revision to EDU boundaries),
- address data gaps and other new information,
- include salmon as targets, which were not included in the first iteration,
- apply assessment methods that are more consistent with those applied to other EDUs in the region, and
- facilitate integration with terrestrial and marine assessments by using HUCs as analysis units.

Macrohabitat Classification

Macrohabitats are units of streams and lakes that are relatively homogeneous with respect to size and thermal, chemical, and hydrological regimes. Each macrohabitat type represents a different physical setting thought to correlate with patterns in freshwater biodiversity. Macrohabitats form the basis for creating freshwater ecological systems, the coarse-filter targets used in ecoregional assessments.

Attributes selected for macrohabitat classification are primary drivers determining aquatic habitat structure, the processes that influence habitat, and aquatic community composition. Attributes were also selected for pragmatic reasons. Only attributes that can be represented comprehensively across the EDU with available data were used. While this precluded the application of strictly biological data, which are sparse and inconsistent, it did not limit the classification system in physical attributes selected. Justification for and limitations of each data set are described with each respective attribute below.

Stream macrohabitat classification attributes include 1) watershed area, 2) geology, 3) elevation, and 4) gradient. Attributes are summarized with a Table of Attribute Codes (Table 7) which includes a brief definition and justification of each attribute and its classes.

Data Source for Stream Macrohabitat Reaches

Stream macrohabitat reaches are defined spatially as stream reaches derived from the USGS National Hydrography Dataset (NHD) 1:100,000 hydrography, downloaded from http://nhd.usgs.gov.data.html. These data were supplemented with Washington Department of Fish and Wildlife 1:100,000 data to improve connectivity of stream reaches. Processing in a GIS of these reaches for further classification was accomplished using GIS tools ("NHD-prep.aml") developed by TNC's Freshwater Initiative (Fitzhugh 2002). Detailed documentation of data processing and a catalogue of file names were prepared by Tracy Horsman July 24, 2003 and are archived with the data.

Watershed Area

Contributing watershed area is considered a primary determinant of or driver for hydrologic regime, stream size, and network position (citations to be provided in future roll-up document). Stream size and hydrologic regime are critical factors for determining biological assemblages (Vannote et al. 1980, Mathews 1998, Poff and Ward, 1989, Poff and Alan 1995, and Lyons 1989). Network position has also been shown to correspond to patterns in freshwater community structure (Vannote et al. 1980, Mathews 1998, Lewis and Magnuson 1999, Newall and Magnuson 1999).

Classes

The correlation of watershed area to other stream characteristics often has a relatively linear relationship without distinct breaks. Changes in nutrient cycling, ecosystem energy balance, and community structure increase in scale in a downstream direction (Vannote et al. 1980). Consequently, classes have been selected at progressive orders of magnitude, with the smallest unit roughly corresponding to most 12-digit HUCs (USGS hydrologic unit code watershed boundaries). These classes also show some correlation with stream orders (Bryer 2004). There is also a pragmatic justification for use of these classes - The Nature Conservancy has applied these classes across many freshwater systems classifications. Watershed area classes are:

- Class 1 - headwaters, creeks < 10,000 hectares
- Class 2 - small rivers 10,000 – 100,000 hectares
- Class 3 - medium rivers 100,000 – 1,000,000 hectares
- Class 4 - large rivers > 1,000,000 hectares

Data Source

Watershed area is calculated using a 30-meter DEM (USGS 1999) and GIS tools developed by The Nature Conservancy's Freshwater (Fitzhugh 2002).

Limitations

While contributing watershed area is an important determinant of stream and habitat character within a region, the classes established are relatively arbitrary, representing orders of magnitude differences that are not substantiated or necessarily justified ecologically. Furthermore, due to climatic differences among and within regions, each watershed size class will likely have varying expression and characteristics across EDUs and potentially regions within an EDU. For example, a 100,000 ha catchment in eastern

Washington may produce only a “creek”, whereas an equal catchment area on the west side of the Cascades may produce a “medium river.” However, within the Puget EDU, similar size basins will generally correlate to similar size streams.

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Table 7. Attribute codes.

ATTRIBUTE	CLASSES	CODE	JUSTIFICATION
Size – area of catchment, or watershed area contributing to reach	Class 1 <10,000 ha (headwaters, creeks) Class 2 < 100,000 ha (small rivers) Class 3 <1,000,000 ha (medium rivers) Class 4 > 1,000,000 ha (large rivers)	1 2 3 4	Catchment is a determinant of hydrologic regime, stream size, and network position - critical factors for determining biological assemblages and patterns in freshwater community structure
Geology – dominant lithology of the reach catchment where classes are selected to represent common classes of rock chemistry, texture/erodibility, and permeability	granitic-silicic basalt-mafic sandstone ultramafic-serpentine siltstone coarse outwash carbonate-limestone erodable volcanics alluvium-colluvium glacial drift peat Ice (covered by glacier or permanent snow)	1 2 3 4 5 6 7 8 9 10 11 12	Geologic character of a contributing basin controls or influences water chemistry, hydrologic regime (groundwater:surface water interaction), channel form and channel substrate
Elevation – average elevation of the reach	<100m 100-300m 300-1000m >1000m	1 2 3 4	Elevation influences water temperature, vegetation patterns, and hydrologic regime.
Gradient – slope of the reach, an dimensionless ratio of difference in elevation to length of the reach	<0.005 0.005 – 0.02 0.02 – 0.04 0.04 – 0.10 0.10 – 0.20 > 0.20	1 2 3 4 5 6	Gradient is a principal factor in determining stream velocity and stream power, channel form and habitat. Stream gradient correlates with distribution of aquatic organisms and community structure.

Geology

Geologic character of a contributing basin controls or influences water chemistry, hydrologic regime (groundwater:surface water interaction), channel form and channel substrate. Classes reflect geologic elements that are common to many EDUs.

Classes

The classes chosen were based on an integration of geological types from three separate data sources, and were selected using guidelines from Quigley et al. (1997). The listed classes (Table 1) and subclasses are aggregates of numerous geologic types.

Data Source

A number of different geologic maps were used, each with its own rock type naming protocol. This required stitching together separate maps and cross-walking data sources across the EDU to establish consistent classes. Data sources included the following:

- Harris and Schuster, 2000. Digital Geology of Washington State, Washington DNR, Scale 1:100,000.

Limitations

Spatial geologic data are typically extrapolated from point observations. Thus, the scale at which they are reported can greatly influence their accuracy. The scale of geologic map data applied to this analysis is appropriate for determining basin-scale dominant rock types, but will not necessarily be accurate for reach scale channel classification. Furthermore, data included "unclassified" areas and some rock classes consisted of strata of multiple rock types. These latter were attributed to the dominant or most influential characteristic of the mixed strata. Considering these caveats, geologic attributes should not be construed to be accurate for representing reach-scale habitat, but rather they influence trends in reach-scale channel and water chemistry characteristics from basin to basin.

Elevation

Elevation influences water temperature, vegetation patterns, and hydrologic regime (citations to be provided in future roll-up document). The hydrologic regime is determined by total precipitation, temporal and spatial precipitation patterns, whether precipitation comes in the form of snow or rain, and how long the snow persists. Elevation is the dominant control of most of these factors and has been described as the dominant factor accounting for distribution of biota (Brown, et al. 2003).

Classes

Classes are based roughly on level 4 ecoregions from Pater et al. (1998). Classes were further corroborated with expert input from the USGS staff (Konrad 2003).

Elevation classes are:

1	<100m
2	100 – 300m
3	300 – 1000m
4	>1000m

Data Source

Elevation data were derived from U.S. Geological Survey (USGS), EROS Data Center, 1999, National Elevation Database (NED), 30 meter resolution DEM.

Limitations

Elevation influences vary with both longitude and latitude, yet a single set of classes is applied to this EDU. Slope aspect (orientation relative to the sun) has similar influences to changes in elevation on snow accumulation and melt, soil moisture and vegetation patterns and probably creates greater within-class variation than latitudinal variation within the EDU.

Gradient

Gradient is the slope of each macrohabitat reach measured as the change in elevation divided by the length of the reach. Stream gradient is a principal factor in determining stream velocity and stream power, as well as channel form and related habitat. Stream gradient has been shown to strongly correlate with distribution of aquatic organisms and community structure (Lyons 1989, Hart and Finelli, 1999; Montgomery et al. 1999). Stream gradient classes were based primarily on the work of Montgomery et al (1999), Ian Waite at USGS (pers. comm.), and Tony Cheong at BC MELP (pers. comm.). These classes were corroborated with input from numerous biologists, and agree with trends in the physical and geomorphic literature.

Classes

Gradient classes for macrohabitats are:

- < 0.005 sand bed, dune bed
- 0.005 – 0.02 riffle pool
- 0.02 – 0.04 plane bed and braided
- 0.04 – 0.10 step pools
- 0.10 – 0.20 cascades
- > 0.20 unsuitable for fish

Data Source

Stream reaches were derived from USGS National Hydrography Dataset (NHD) 1:100,000 hydrography, downloaded from http://nhd.usgs.gov.data.html. Elevation data were derived from U.S. Geological Survey (USGS), EROS Data Center, 1999, National Elevation Database (NED), 30 meter resolution DEM.

Limitations

Definition of gradient classes, particularly at low gradient, is limited by the resolution of the base data. 1:100,000 scale hydrography and 30m DEM were used to calculate gradient. Analysis and expert input (J. Davies, NMFS, 2004) suggest that defining classes at a resolution finer than 0.5% (0.005) is impractical. While WDFW has stream gradient data at 1:24,000 scale, the complexities of relating this data set and uncertainties in the data set itself did not warrant use of these data.

Other Attributes considered in stream macrohabitat classification

Other attributes were considered by the advisory group but not selected for macrohabitat classification and are listed below.

- *Stream connectivity* – Connectivity has been used in other classification schemes conducted by the Conservancy and refers to the type of adjoining water features (stream, lake, glacier, coast). The Freshwater Advisory Group and other experts consulted (Naiman, pers. comm., 2003) suggested that while connectivity is an essential ecological component of community and habitat, it cannot be adequately captured with available data and within this classification framework.

- *Lakes* – Lakes were not explicitly included in the classification of macrohabitats or systems. While there are many natural lakes in the Puget Sound EDU, there are no known data sets available to accurately determine whether lakes are natural or non-natural (including natural lakes that have been altered by dams controlling outflow and lake stage). Additionally, those characteristics deemed most appropriate to classify lakes are not represented in available data sets, making meaningful lake classification difficult. Rather than explicitly classify lakes or include them in the classification of systems, the assumption was made that the same variables that determine stream macrohabitats are also important in determining lake character and biota. As such, lakes within systems have been de facto classified and represented in the classification of watersheds. Additionally, expert review will be used to supplement the representation of lakes in the assessment.

Freshwater Systems Classification

Freshwater systems are nested watershed polygons classified according to their component stream macrohabitat attributes. The nesting size classes are the same as those for macrohabitat reaches. All watersheds of a given type or class have a similar combination of reaches representing macrohabitat components. As such, freshwater ecological systems in the Puget Sound EDU represent watersheds of defined size classes with similar physical gradients and characteristics that influence freshwater habitat and communities.

The Nature Conservancy's Freshwater Initiative staff performed the classification of freshwater ecological systems in the Puget Sound EDU (2003). System classification used a clustering algorithm in the PC-ORD software package (McCune and Mefford 1999) and methods recommended in Analysis of Ecological Communities (McCune and Grace, 2002). The GIS tools used to create these watersheds rely on a combination of DEM and stream networks and were developed by The Nature Conservancy's Freshwater Initiative. Where terrain is flat and no stream data exists, watersheds could not be created.

Clustering of Macrohabitats into Systems

Clustering is the process of creating groups of similar suites of variables. In this context, it is the process of comparing the stream reach macrohabitat variables of all watersheds of a given size class and creating groups of watersheds whose reach-scale classification attributes are similar. Ecological systems types in the Puget Sound EDU were defined using multivariate analysis to group neighboring macrohabitats that share similar patterns. Macrohabitats lengths were measured relative to watershed area and normalized to discount differences in watershed size within class. These normalized totals for each watershed were used as inputs to the PC-ORD clustering algorithm. Each size class of watershed was classified separately. PC-ORD allows selection from a variety of distance measures and linkage methods. For the Puget Sound EDU classification, Euclidean distance measure and Ward's group linkage method were selected. The final clusters for each EDU were determined with manual editing and review, comparison with other ecoregional units (e.g., Pater et al. 1998), and expert review with individuals from Washington Department of Fish and Wildlife, Washington Department of Natural Resources, US Army Corps of Engineers, US Fish and Wildlife Service, US Forest Service, British Columbia Ministry of Sustainable Resource Management, University of British Columbia, and Canadian Department of Fisheries and Oceans.

Selecting the number of systems

The clustering process requires the selection and input of a desired number of watershed "groups", or freshwater system types, that it will derive from the total pool of watersheds. This number of groups is then revised manually by combining algorithm-defined systems (two or more separate groups into a single group), or splitting of individual groups into two or more groups. The initial decision of how many system types to apply is a subjective decision. In this case a number of groups was selected that would be small enough to allow us to evaluate the spatial distribution and conservation relevance of environmental gradients across the EDU, but large enough to differentiate among distinct watershed types. Some manual grouping and splitting of algorithm output groups was conducted until the final grouping resulted in systems whose member watersheds (system occurrences) could consistently be described as having the same suite of physical classification attributes and as distinct from another group.

Experts Consulted

The general classification framework, which consists of nested and hierarchical macrohabitats and freshwater systems classified using abiotic attributes, was developed by The Nature Conservancy's Freshwater Initiative with assistance and review from outside experts and is detailed in other documents (Lammert et al., 1997). The classification system was further refined with the assistance of and review by regional experts from a variety of state and federal agencies and research institutions.

Site Selection Algorithm

Targets and Goals

Conservation *targets* are entities that are selected for their importance to biodiversity conservation and include freshwater ecological systems and aquatic species of concern. Our approach is to establish conservation goals for all targets and to identify a suite of conservation areas that meet goals for all targets. In theory, effective conservation of all conservation areas identified will sustain freshwater biodiversity.

Freshwater ecological systems targets are defined using the classification approach detailed above. Conservation goals for these targets have been set as 30% of all targets occurrence, where occurrences represent watersheds. 30% has been used regularly as a standard "moderate-risk" scenario in ecoregional assessments. Justification and further discussion of alternative goal scenarios are provided in Comer 2003. A complete list of ecological systems, numbers of occurrences, and goals for each is provided in Appendix 5 and Volume 1-Report, Chapter 3.3.

Freshwater species of concern are generally defined as those species which are currently threatened, endangered, endemic, or otherwise vulnerable species, and keystone species that greatly influence natural ecological processes. A statewide list of species targets was first developed, and from this, those with historic distributions within the EDU were selected. A list of species targets, numbers of occurrences and goals for each is provided in Appendix 5 and Volume 1-Report, Chapter 3.3.

Conservation goals for species targets were determined following "moderate risk" guidelines proposed by Comer (2003) and based largely on current distribution of the species for spatially limited species. Goals are established for number of "occurrences", or populations, for spatially limited species, and as a percentage of available reproductive and rearing habitat for mobile and wide-ranging species. In all cases where available target data were expressed as point data, points were assumed to be populations. Wide-ranging species, primarily salmon, were represented by distributions rather than spatially distinct occurrences. Goals for species targets were set based on their global distribution across EDUs according to the following guidelines (Comer 2003):

Spatial Distribution	EDU Conservation Goal	Definition
Endemic	50 occurrences	>90% of global distribution in EDU
Limited	25 occurrences	<90% of global distribution in EDU, limited to 2-3 EDUs
Disjunct	13 occurrences	Genetically distinct from other populations and substantially separated from other populations
Widespread	13 occurrences	Global distribution >3 EDUs
Peripheral	7 occurrences	<10% of distribution is within EDU

Salmon species targets and occurrence were defined differently from other species due to their complex and wide-ranging life-history and their special consideration under the Endangered Species Act. Salmon and steelhead species targets were defined as seasonal runs of Evolutionary Significant Units (ESUs, as defined by NOAA Fisheries). Thus each seasonal run of each ESU was defined as a distinct target even though they may be of the same species. For the majority of salmon targets, a conservation goal was set as 50% of available spawning and rearing habitat. For other salmon targets, a conservation goal of 50% of the product of length of spawning habitat and a habitat-quality rank (derived from EDT) was used. Further description of the methods applied to rank salmon habitat using EDT, and a list of ESUs for which EDT data were used are provided in Appendix 10.2.

50% was selected as a commonly accepted value by a suite of experts interviewed. However, the 50% value should not be construed as something that has been substantiated or otherwise condoned, but rather as a mid-way point between two extremes in light of the fact that there is no available science that suggests any other appropriate and defensible goal. While the intent was to establish goals for salmon targets that approximate recovery goals, recovery goals are typically defined in the context of numbers of fish, rather than amount of habitat, and at the time of this assessment, had not been defined for most ESUs.

Suitability Index

The site selection algorithm considers the "suitability" of the landscape for conservation in its selection of conservation areas. An index has been developed which estimates the condition of the landscape and the relative opportunity for conservation as a "cost", the opposite of suitability. A cost value is derived for each analysis unit (HUC 6 analysis units) as well as for each Class 2 and Class 3 watershed. The algorithm gives preference to more suitable analysis units – those with a lower cost value. A detailed explanation of the derivation of the suitability index is provided in Appendix C.

The cost value is derived from the following equation:

Cost value = 1000*(0.33*A + 0.33*B + 0.33*C), where:

A = % non-natural land use
B = % normalized dam density (number of dams/hectare)
C = % normalized road density (total road length /total stream length)

The base cost values for all analysis units within the Puget Sound EDU range from 0 to 516. However, MARXAN produces a more efficient footprint when base values are not near zero. Values near zero imply "no cost", and so the model may include these areas simply because they are "free", resulting in analysis units included in the portfolio when they may have little or no value. To address this, a value of 500 was added to the base costs value of all analysis units such that the minimum value was 500 and the maximum was 1016. This approach addresses the fact that all analysis units do in fact have a cost associated with doing conservation work within them.

Algorithm Operation

The MARXAN site selection algorithm selects an efficient suite of analysis units (AUs) that meet goals for all targets in the most suitable landscapes possible. HUC6s were selected as AUs because they roughly coincide with watershed boundaries in headwaters and tributary streams, they are common management units to many agencies and are widely understood, and they have also been used extensively by ecoregional assessment teams for terrestrial and integrated analysis units. In the Puget Sound EDU, a few AUs were created by aggregating or splitting HUC6s. In one HUC (HUC Number 171100190002), the size of the HUC6 unit exceeded its associated Class 2 watershed system area and was an abnormally large and encompassing analysis unit. This caused early iterations of the MARXAN run to select this AU because it could meet so many goals in a single AU. This HUC was subdivided into three separate AUs to alleviate this problem. In other instances, primarily on the eastern slope of the Olympic Peninsula, many HUCs were smaller than Class 1 watershed systems. In these instances, multiple HUC6s were combined until they equaled or exceeded their component class 1 watershed in size.

Each AU was attributed with its constituent target occurrences (occurrences of Class 1 watershed system types and species target occurrences) and a suitability score for the AU. MARXAN selects the most efficient suite of AUs that meet target goals in the most suitable AUs possible. Thus, in an ideal scenario, all target goals will be met within AUs that have low cost scores (high suitability) and which in total represent a relatively efficient (smallest footprint) portfolio.

Class 2 and 3 freshwater ecological systems targets, however, are generally larger than the AUs and may span many AUs. These target occurrences, or rivers, are added to the final MARXAN solution in addition to the AUs selected for Class 1 system and species targets. The suitability of each Class 2 and 3 system is determined for the entire contributing area of its watershed, rather than by the AUs. Thus, land use and ownership throughout the mainstem river's contributing watershed influence whether it is selected by MARXAN.

Stream connectivity is an important consideration for effective biodiversity conservation. MARXAN can give preference to AUs that are adjacent (share a boundary) over those that are separated through its boundary modifier function. However, *adjacent* AUs are not necessarily connected hydrologically. The boundary modifier function can be inappropriate for freshwater site selection because it may select adjacent AUs in unconnected basins and thereby promote hydrologically disconnected sites rather than connected sites. To remedy this, the boundary modifier is used in a "vertical stacking" technique (M. Schindel, personal correspondence 2005), where preference in AU selection is given to AUs that coincide with Class 2 or Class 3 systems "vertically." In other words, it gives preference to AUs and Class 2 and 3 rivers that are part of the same river system. The algorithm can therefore differentiate between otherwise equivalent AUs (having same targets within them and same suitability score) by considering other layers of data – namely Class 2 and 3 watersheds. The vertical boundary modifier is revised through a number of iterations to balance the benefits gained from connectivity to the loss of efficiency (more AUs needed) and the suitability of AUs selected until a final solution represents reasonable connectivity with little or no loss in efficiency or suitability.

Expert Review of Portfolio

The first iteration of the algorithm-derived Puget Sound EDU portfolio (2003 FWI edition) was reviewed extensively by experts. Expert comments collected during review of the first iteration were subsequently classified into 3 categories by Conservancy staff for the second iteration portfolio (2005 edition), as defined below. In some cases, expert input provided sufficient justification for ensuring that certain analysis units were included in the final portfolio. (These are categorized below as "Include.") Following expert review, the portfolio was modified to reflect this input by "locking in" certain analysis units, and running the algorithm again with these in place. Thus, the final algorithm portfolios reflect expert input.

1. *No action* – This category includes expert input that provides specific information that may be of value to future site conservation planning, but which should not influence the site selection process. In some instances, expert input was not specific or certain, or was in direct conflict with other input, and so should not be used to influence the selection process.

2. *Include* – This category includes areas that have been nominated by an expert as being of high value when the expert opinion is consistent with other factors that show the area as important. Typically, this includes areas that had high sum solution scores, were nominated by multiple experts, or had been otherwise identified as important. Areas that were "included" were locked into the site selection algorithm to ensure that they stay in the final iteration of the portfolio.

3. *Exclude* – This category includes areas that have been described by experts as having little value and being unsuitable for conservation. Typically, the Marxan algorithm is very efficient at excluding such areas, and few if any expert comments result in exclusion. Areas were excluded if recommended by experts *and* they also received very low sum solution scores or had otherwise been identified as poor sites.

4. *Gap to address* – Experts provided considerable information about additional data and considerations that will be important to consider and include in future iterations, but are not appropriate or possible for this iteration.

Experts consulted

- Robert Plotnikoff, Washington Department of Ecology
- Curt Kraemer, Washington Department of Fish and Wildlife
- Chad Jackson, Washington Department of Fish and Wildlife
- Tom Cropp, Washington Department of Fish and Wildlife
- Thom Johnson, Washington Department of Fish and Wildlife
- Chuck Baranski, Washington Department of Fish and Wildlife
- Marty Ereth, Skokomish Tribe
- George Pess, NOAA Fisheries
- Pete Bisson, U.S. Forest Service
- Sam Brenkman, Olympic National Park
- Jerry Gorsline, Washington Environmental Council

Analysis Gaps

There are a number of data and method limitations influence the outcome of this analysis. Research or data cataloging efforts that address these gaps will enhance future iterations of these analyses.

- There are virtually no freshwater species data in the form of occurrences. The Natural Heritage Program in Washington does not explicitly track freshwater species, and as such, there are limited or no data that adequately describe species populations. Further, where observation data do occur, most non-salmon targets do not have sufficient data to meet conservation goals, though in many cases it is probable that populations do exist.

- The data sources applied were limited primarily to state and federal statewide or distribution-wide data. Expert review of our methods, data, and products has suggested that there are considerable data gaps between state biologists' knowledge and data and that sanctioned by the parent agencies. Consolidation of data from field biologists with state sanctioned data sets will greatly enhance future analyses.

- HUC6s were used for assessment units primarily to facilitate integration with terrestrial Ecoregional Assessment analyses, which also used watershed polygons derived from HUCs. There are a number of limitations associated with using HUCs. First, most HUCs at this scale (HUC6) do not represent true or logical watershed boundaries. Especially along mainstem Class 2 and 3 rivers, HUCs often span the valley and include small tributaries on both sides, with arbitrary up- and downstream boundaries. Consequently, many do not represent logical management units, nor assessment units. Second, HUCs vary widely in size. Most are large enough to capture numerous occurrences of Class 1 watersheds. As such, a single HUC included to meet a single target goal may sweep in many occurrences of other targets resulting in overrepresentation of targets and selection of sub-optimal occurrences of many targets.

- Expert review included primarily salmon and trout biologists. Few local or regional experts were identified or available to provide review based on knowledge or perspective of other taxa.

- Taxa included in the analysis effectively include only fish, and primarily salmon and trout. Taxa were limited to fish, plants and invertebrates. Data for plants are largely unavailable. Data for invertebrates are completely unavailable. Data for freshwater mammals, birds, amphibians and other taxa were not included, as these were addressed in the terrestrial analysis. As such, the freshwater perspective is substantially limited in these analyses.

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Appendix 10.2. Salmon Methods

Salmon Appendix to Final Agreement with WDFW

A proposed method for including salmonids as targets in ERAs (Sept 9, 2004 version)

This document is an agreement among WDFW, The Nature Conservancy of Washington, The Nature Conservancy of Oregon, and the Nature Conservancy of Canada to follow the guidelines outlined herein for incorporating salmonids (*Oncorhynchus sp*. and *Salvelinus sp.*) into Ecoregional Assessments (EAs). It pertains specifically to EAs for the Modoc Plateau and East Cascades, West Cascades, Okanogan, and North Cascades ecoregions.

While it is acknowledged that salmonids are unique and important species in many respects, this agreement directs EA teams to incorporate salmonid targets in assessments using the same protocol as other species targets to the extent possible. Salmonids do differ, however, in important ways – they are wide ranging and they exhibit complex life histories in that they inhabit different habitats and even different ecoregions at different life stages, and populations may be genetically distinct even when not geographically isolated. As such, they may not fit into the molds and models established for most species targets in ecoregional assessments. This agreement serves as the foundation for addressing those aspects of assessment for which salmonids are unique or otherwise require special definition and attention.

The salmonid assessment method agreement includes the following components:

- Details for defining salmonid targets
- Application of Ecosystem Diagnosis and Treatment (EDT) methods to evaluate the relative conservation value of salmonid habitat
- Selection of analysis units for evaluating salmonid targets
- Integration of salmonid targets with terrestrial and other freshwater targets in ecoregional assessments.

Defining salmonid targets

Salmonid species targets will be defined by NOAA ESUs for salmon and steelhead in the United States, and USFWS Recovery Units for bull trout. Seasonal runs will be distinct targets as defined by ESUs. As an interim measure, salmonid targets in British Columbia will be defined as the sum of populations within major basins.

Salmon and steelhead targets will be defined as evolutionarily significant units (ESUs), as designated by the National Oceanic and Atmospheric Administration (NOAA). Each ESU is comprised of multiple stocks of a given species in an effort to identify populations (i.e., stocks) or groups of populations that are 1) substantially reproductively isolated from other populations, and 2) contribute substantially to ecological/genetic diversity of the biological species (Hard et al. 1996). As such, ESU boundaries are ecologically based, often resulting in ESU boundaries straddling state and international lines. For example, the Puget Sound/Strait of Georgia coho salmon ESU includes parts of Washington and British Columbia. Species-specific ESU boundaries have been defined by the NOAA Fisheries in six technical memorandum reports: NMFS-NWFSC-24, 25, 27, 32, 33, and 35. (Weitkamp et al. 1995; Hard et al. 1996; Busby et al. 1996; Johnson et al. 1997; Gustafson et al. 1997; Myers et al. 1998).

ESUs have not been defined in Canada, except where ESUs defined by NOAA extend into Canada. Where ESUs have not been defined in Canada, "Species at Risk Act Designated Units" will define salmon targets. These Species at Risk Act Designated Units will be defined within the next year. As an interim measure, major basins will be used to lump populations of a single season run of a single species as a target.

Seasonal run types of a given species within a given basin will be treated as separate targets (Table 1) where NOAA designates seasonal runs as distinct ESUs. For example, a spring-run Chinook salmon ESU will be treated as a separate target than a fall-run Chinook salmon ESU. Accordingly, it is possible that two ESUs (e.g., spring-run and fall-run) for a given species (e.g., Chinook salmon) may overlap spatially within an Ecological Drainage Unit (EDU). This delineation is consistent with both WDFW and NOAA Fisheries salmon recovery planning methods. Salmonid species with multiple run-types that are affected by this delineation include Chinook salmon, chum salmon, pink salmon (i.e., odd year and even year), and steelhead trout.

Additionally, bull trout (*Salvelinus confluentus*), an ESA listed char, will be included as a species target. Bull trout targets will be defined as the U.S. Fish and Wildlife Service's (USFWS) recovery units (RUs), the equivalent to NOAA Fisheries ESU designation system for salmon and steelhead. Rus and ESUs represent equivalent definitions employed by different agencies. Similar to the ESU designation system, multiple stocks of bull trout are included in a given RU and the boundaries cross state jurisdictions. Maps showing the size and location of Rus for Columbia River/Klamath River stocks and Coastal Puget Sound are available online at http://pacific.fws.gov/bulltrout/colkla/criticalhab.htm and http://pacific.fws.gov/bulltrout/jcs/index.html, respectively.

For each ESU and RU, we propose that the entire freshwater portion of the life-history be considered as a single, aggregated target rather than setting multiple independent targets for each freshwater life-history phase (e.g., spawner, egg, alevin, parr, out-migrant).

Table 8. Potential salmonid targets.

Species – Common Name	Multiple-Season Runs (Yes, No)	Number of ESUs in WA, OR, and CA
Chinook salmon	yes	15 ESUs
chum salmon	yes	4 ESUs
coho salmon	no	7 ESUs
sockeye salmon	no	6 ESUs
pink salmon	yes	2 ESUs
steelhead trout	yes	15 ESUs
bull trout	no	18 RUs

Remaining Target Issues

British Columbia does not have defined ESUs and may not have equivalent designations. Equivalent Species at Risk Act Designated Units are not anticipated before the end of 2004. NCC will develop interim target definitions for application to the EDU assessments in BC.

Evaluation of salmonid habitat

Salmonid habitat, derived from state or provincial datasets, will be evaluated on a reach scale using EDT preservation/protection values to rank the value of the habitat. WDFW will rank all EDT reaches for all targets in BC, WA and OR.

Salmonid targets will be represented by documented reach-scale spawning or rearing habitat. Where EDT data are available and relevant, EDT reaches will define target occurrences and distribution for species that have EDT data (chum, coho, Chinook, and steelhead). Where EDT is not relevant, state or provincial government reach-scale spawning and rearing habitat maps will be used to define distribution of salmonids. Habitat data in Washington will be supplied by the Washington Department of Fish and Wildlife's State Salmonid Stock Inventory (SaSI) database. SaSI data include the spatially explicit identification of spawning and freshwater rearing habitat for all stocks of salmon, steelhead trout, and bull trout in Washington. Habitat data in Oregon will be derived from ODFW databases. Salmonid habitat data in BC will likely be derived from a number of sources, including First Nations data. In British Columbia, data limitations may require the use of reach escapement data as equivalent to documented presence data in the United States. Habitat will be quantified by reach length in units appropriate to the assessment – kilometers or miles.

Assessment will involve the integration of habitat quality data to evaluate the relative conservation value of reach habitat. Relative habitat quality will be evaluated using Ecosystem Diagnosis and Treatment (EDT), developed by Mobrand Biometrics Inc., to characterize river reaches for protection potential. EDT will be used to develop ranks of relative protection value, which will be evaluated in combination with the quantity of habitat (reach length) to select salmon conservation areas. EDT is currently being applied to Washington State salmon recovery planning. EDT modeling has been conducted in nearly all basins with salmon that intersect the ecoregions currently under assessment in Washington, Oregon, and BC.

Within a watershed (e.g., Klickitat River watershed), EDT reaches are delineated for each salmon species. EDT characterizes habitat conditions for 46 habitat attributes (e.g., % of reach composed of pool habitat) for each reach and provides evaluations of current conditions and historical conditions. EDT then uses habitat-dependent survival rules to simulate population performance measures (i.e., intrinsic productivity, equilibrium abundance, life-history diversity) for both current and historical habitat conditions.

In addition to simulating population performance, EDT estimates both the restoration and protection potential for each reach. The protection potential will be applied to this assessment. In order to estimate protection potential, EDT simulates the relative decrease in population performance that would be expected if habitat conditions for a given reach become fully degraded (as defined by the habitat attribute values) beyond current habitat conditions. The result is a set of reach-specific protection values expressed as % change in population performance parameters from current conditions.

EDT models are species-specific and run-type specific resulting in the creation of *n* number of EDT models for a given watershed where *n* = the number of salmonid targets. Reach delineations and habitat characterizations are identical among EDT models for a given watershed. Spatial extent, however, and thus total number of reaches can vary among models due to differences in total spatial distribution among species. For example, the spatial distribution of coho salmon is usually larger in a given watershed than for chum salmon because coho typically spawn in tributary reaches and chum spawn in main stem reaches. Therefore the EDT coho salmon model would contain a greater number of reaches than the chum salmon model. Because the habitat ranks are conducted by target (by species within a basin), there may be inconsistency across targets in the ranks given. To rectify this, WDFW will re-rank all EDT reaches within each ESU such that consistent ranking criteria are applied across basins within an ESU. WDFW will provide reach-habitat ranks for all salmonid targets in Washington, Oregon, and BC.

In any case where EDT has not been conducted or is otherwise unavailable, occurrences will not be ranked and will be considered equal in quality. All applicable reaches (i.e., those identified by the SaSI database as spawning or rearing habitat) will receive equal habitat quality scores (i.e., habitat quality score = 500) unless other data indicate otherwise. In this case, freshwater suitability indices, applied to analysis units for all targets, will then be the primary means of selection of best available habitat.

Remaining habitat evaluation issues

BC habitat data may be derived from multiple sources.

Translating EDT and habitat reaches to numerical values

The product of reach length and EDT rank will be used to determine the relative value of all reaches for all targets, expressed as a numerical value for input to site selection algorithms for freshwater and integrated assessments. EDT quality ranks will serve as a species-specific suitability factor at the reach scale, but will not be a component of the general freshwater or integrated suitability factor.

The site selection algorithm will consider the relative quality, derived from the EDT output model, and quantity of habitat (i.e., EDT reach length). Thus, conservation value for a given EDT reach will be a numeric value that represents the product of reach length and the EDT derived index of habitat quality:

*Reach conservation value = Habitat Quality index * Reach Length*

Quantifying the habitat quality index value for a given EDT reach is a four-step process. First we will combine EDT assessments for a given salmonid target from all basins within a given ESU. Accordingly, a table will be created to that contains every EDT reach in a given ESU and the three EDT estimates of reach-specific protection potential: percent change in productivity, abundance, and life history diversity. Second, a single protection potential estimate for each reach will be calculated by summing percent change in productivity, abundance, and life history diversity for each reach. Third, all reaches will then be sorted by the new single protection potential estimate. Finally, The resulting reach-specific values will be normalized such that the maximum value equals 1000. This normalized value is a habitat quality index for each reach and will be based on the following equation:

$$\textit{Habitat Quality value of reach } i = 1000 * \left(p_i / p_1\right)$$

where p_i = the protection potential estimate for a given reach and p_1 = the protection potential estimate for the reach ranked as having the greatest estimate in the ESU.

Analysis units for salmonid targets

Salmonid habitat reaches will be defined by EDT analyses. These will be attributed to whatever analysis unit is used in the site selection algorithm for both freshwater assessment and for the integrated assessment.

Ecological Drainage Units (EDU) are the aquatic analog to terrestrial ecoregions. Separate freshwater assessments, which cover all native aquatic species, including salmonids, will be conducted for each EDU. Salmonid target lists (i.e., ESUs) will be developed by EDU for all EDUs intersecting the ecoregion. Assessment of each target will be conducted for the extent of its entire distribution within the EDU. Salmonid habitat will be represented by stream reaches, as indicated in the source data (EDT or SaSI in Washington). It is important to note the distinction between salmon habitat reaches and other species target "occurrences." Salmon habitat reaches are not equivalent to target occurrences, but serve a similar purpose in the context of setting and meeting goals for capturing habitat.

Salmonid habitat reaches will be attributed to whatever analysis unit is selected for the freshwater assessment and for the integrated ecoregional assessment. For freshwater assessments, analysis units are typically mainstem reaches of large rivers and stream networks or class 1 aquatic systems as defined by The Nature Conservancy. For integrated ecoregional assessments, analysis units may be hexagons or HUCs. In any case, salmonid habitat will be attributed to the respective analysis unit. As the details of integrating freshwater, marine and terrestrial realms are yet to be finalized, some uncertainty in mechanics of integration and analysis units remain. However, salmonid habitat reaches will be treated similarly to any other fine filter occurrence in integration.

Fine filter targets, including salmonids, are typically evaluated with respect to the geographic region most appropriate for their conservation. This presents a challenge for migratory species, as life histories of single targets, indeed individual fish, may span an extraordinarily large number of analysis units. It is acknowledged that single stream reaches represent only a small portion of a salmon life history. As such, assessment teams must ensure that other components of salmon life history not represented by the target occurrence (stream reach) are adequately considered.

Remaining analysis unit issues

- Protocol for integration of marine, freshwater and terrestrial assessments is still under development. Resolution of a standard approach to integration will be necessary to finalize protocol for salmonid analysis units.
- Kristy Ciruna (NCC) is actively evaluating a means to attribute reaches to hexagons such that reaches are not fragmented in the Okanagan EA. The protocol and mechanics for linking reach data to analysis units is yet to be finalized.

Conservation goals

Mid-risk conservation goals for salmonid targets will be consistent with goals established by NOAA's TRTs for each ESU, acknowledging however, that NOAA goals are typically expressed as percent of populations while assessment goals are expressed as percent or amount of habitat. In the absence of ESUs (in British Columbia), determination of goals will be consistent with other freshwater fine filter species.

The assessment is not intended to create a plan for salmon habitat conservation or recovery. However, the selection algorithm needs a quantitative objective with which to select the most important places for conservation of all biodiversity. In recognition of the scientific uncertainty and profound policy decisions involved in setting conservation goals, The Nature Conservancy, WDFW, and Nature Conservancy of Canada have agreed to produce three alternative portfolios corresponding to lower, mid, and higher risk of species loss.

Each EDU assessment and ecoregional assessment team will determine mid-level goals for respective targets. Lower and higher risk goals will be established according to protocol outlined in the standard agreement. Each salmonid target (ESU) may require different goals, and as such, goals cannot be universally defined in this agreement. However, this agreement directs each team to set mid-risk goals for salmonids that will be consistent with goals established by NOAA's Technical Recovery Teams (TRTs) for each ESU to the extent possible. NOAA goals are typically expressed in terms of numbers of fish, whereas ecoregional assessments will express goals as a given percentage of the combined habitat quantity and quality values derived from EDT and salmonid habitat data. For each target, goals should be set that roughly match the same amount of habitat as would be necessary to meet TRT goals.

Ecosystem Diagnosis and Treatment

An ecosystem Diagnosis and Treatment (EDT) model output was used to represent the quality and quantity of habitat for Chinook salmon in the Puget Sound EDU. EDT is a system for rating the quality, quantity, and diversity of habitat along a stream, relative to the needs of a focal species (Mobrand et al. 1997; Lestelle 2004). EDT has been used by government agencies and tribes to analyze salmon habitat value throughout the Pacific Northwest. EDT produces two metrics of relative habitat value: restoration potential and protection potential.

The EDT process begins by dividing a stream network into reaches. The model characterizes the condition of 46 habitat attributes for each reach to provide evaluations of current and historical conditions. EDT then uses habitat-dependent survival rules to simulate three population performance measures—intrinsic productivity, equilibrium abundance, and life-history diversity—for both current and historical habitat conditions. Based on the simulated population performance, EDT estimates the restoration and protection potentials for each reach. To calculate protection potential, EDT simulates the relative decrease in population performance that would be expected if habitat conditions for a given reach become fully degraded beyond current habitat conditions. The result is a set of reach-specific protection values expressed as percent change in population performance parameters from current conditions. The protection potential was used for the assessment, as described below.

Calculating the habitat quality index for a given EDT reach was a four-step process. First, EDT assessments were combined for a given salmonid target from all basins within a given Evolutionary Significant Unit (ESU). A table was created that contained every EDT reach in a given ESU and values of the three performance measures for each reach. Second, a single protection potential estimate for each reach was calculated by summing percent change in productivity, abundance, and life history diversity for each reach. Third, all reaches were sorted by the new single protection potential estimate. Finally, the resulting reach-specific values were normalized such that the maximum value equaled 1000:

$$\textit{Habitat Quality Index of reach } i = (p_i / p_{max}) \times 1000$$

where p_i is the protection potential estimate for a given reach and p_{max} is the protection potential estimate for the reach ranked as having the greatest protection potential in the ESU. Results of EDT analyses that had been done for salmon recovery efforts in the Puget Sound Basin were obtained. In the Puget Sound EDU, EDT analyses had been done for Chinook only.

Most assessment units (i.e., a class 1 watershed) encompassed more than one EDT reach. Hence, the conservation value of an assessment unit was the sum of habitat quality index values for all reaches in the assessment unit. This is the value that was used in MARXAN as the quantity available toward goals for each assessment unit. This cumulative value was calculated separately for Chinook and steelhead targets.

Appendix 10.3. Suitability Index

DERIVATION OF SUITABILITY INDEX
PUGET SOUND EDU WASHINGTON

A suitability index is a function that relates a variety of factors that affect relative integrity and likelihood of conservation success across the landscape, or among watersheds. The suitability index considers measurable impacts, or factors which are known to be highly correlated with impacts, to freshwater habitat and biodiversity. The suitability index also considers the probable cost, or investment of resources necessary for conservation action. A related concept to suitability is "cost", or the relative cost of conservation action. Cost is the opposite of suitability. Input to the site selection algorithm requires that all suitability factors be represented by a single "cost" value. This single value must represent the combination of factors and their relative importance in the context of cost, as opposed to suitability. The algorithm favors analysis units with lower cost values.

A wide range of factors was considered for the suitability index for freshwater biodiversity conservation in western Washington. Selection of factors considered the following criteria:

- Data are available and consistent across the assessment entire area (EDU)
- Resolution of data is appropriate relative to scale of assessment unit and the impact or cost measured
- Applicable (quantifiable) metrics can be related to relative impact
- Data are of adequate quality and reliability

The Nature Conservancy's Freshwater Initiative developed a suitability index for the Puget Sound EDU as part of the first iteration freshwater assessment for this EDU (2003) in support of the WPG ecoregional assessment. This suitability index included dams, roads, and land use, all weighted equally. Other factors, namely water quality, were also evaluated, but ultimately the index selected included only three factors. The same factors were used in the second iteration (2005) to promote consistency of freshwater suitability indices among integrated ecoregional assessments intersecting the same EDU and to promote a relatively simple approach to estimating suitability recommended by the Freshwater Advisory Group. Significant staff and time constraints imposed on the second iteration also limited opportunity to revisit the index. This suitability index includes the same factors, the same relative weighting of factors, and the same data sources as were applied in the first iteration of the Puget Sound EDU assessment which was conducted as part of the WPG ecoregional assessment (2003),.

Suitability Factors

1. *Land use*. This factor refers to non-natural land uses at the watershed scale. Land use is a primary determinant of sediment and chemical inputs to a stream and impacts to hydrologic regime. NLCD data (30m resolution) were used to determine the percent non-natural area. Non-natural land includes the following NLCD categories: residential, recreational, mines, cropland, orchards, vineyards, pasture, small grain and fallow. Natural lands will include grassland and herbaceous, forest, shrub, wetland, bare rock, and water.

2. *Dam density*. Dam density was measured as the ratio of number of dams to area (hectares) within an analysis unit. Dams significantly impact the timing and magnitude of flows within a stream, water temperature, and geomorphologic processes. Dam data are derived from the StreamNet database (http://www.streamnet.org). It is acknowledged that dams vary considerably in size, impoundment volume, and impacts to downstream and upstream habitat, biota and geomorphic processes, and that dam density is likely a very rough estimate of this impact at best.

3. *Road density.* Road density was measured as the ratio of total length (meters) of roads in the analysis unit to total length of streams (meters). The presence of roads that cross streams and road density within the watersheds which gives us information about land use and probable unnatural sedimentation. It also provides information concerning increased impervious surface in the watershed. Road data are from Washington Department of Transportation.

Percent non-natural land, dam density, and road density are the three equally weighted terms in the freshwater suitability index. Suitability for each freshwater planning unit (HUC-6) and for each Class 2 and Class 3 watershed was calculated as:

Cost Value = 1000*(0.33*A + 0.33 *B + 0.33*C), where

- A = % non-natural land use
- B = normalized dam density
- C = normalized road density

Factors that were considered but not selected for the suitability index are explained below. Where noted, some of these factors may be considered outside of the context of suitability once a preliminary conservation portfolio is generated.

- *Network location***:** Network location refers to the position of a stream system relative to other reaches downstream. There will likely be occurrences of sytems with relatively high suitability, but which are limited due to downstream conditions. For example, if a downstream reach has a temperature or other water quality limitation, it may affect the connectedness of upstream reaches. Evaluation of this aspect of network location, however, is considered too cumbersome for practical application. It will instead be evaluated on a case by case basis and through expert review. Upstream systems selected as important for conservation will also consider downstream limitations, but outside of the suitability index.

- *Channelization* – Channelization refers to physical alteration of the channel and its floodplain. Channelization is not explicitly included because there are no appropriate datasets. However, channelization is closely correlated with land use and roads, both of which are represented in the suitability index.

- *Water quality* – Available water quality data (303d) is not considered adequate in coverage to apply as a suitability factor. However, land use, which is included in the suitability index, is highly correlated with water quality.

- *Barriers* – Stream barriers include small dams, culverts, and diversion dam structures. While there is a fairly comprehensive data set that identifies barriers, data has been inconsistently collected across watersheds, and barriers are not described sufficiently to differentiate between detrimental and relatively benign impacts.

APPENDIX 11 – TERRESTRIAL SYSTEMS DESCRIPTIONS

Appendix 11 – Terrestrial Systems Descriptions

INTERNATIONAL ECOLOGICAL CLASSIFICATION STANDARD:

TERRESTRIAL ECOLOGICAL CLASSIFICATIONS

Ecological Systems of the North Cascades Ecoregion (south of the Coastal Forests & Mtns of SE AK and BC Ecoregion), British Columbia, Canada, and Washington, USA

05 April 2005

by

NatureServe

1101 Wilson Blvd., 15th floor
Arlington, VA 22209

This subset of the International Ecological Classification Standard covers terrestrial ecological systems attributed to the North Cascades Ecoregion**.** This classification has been developed in consultation with many individuals and agencies and incorporates information from a variety of publications and other classifications. Comments and suggestions regarding the contents of this subset should be directed to Gwen Kittel, NatureServe Western Office, Boulder, CO gwen_kittel@natureserve.org.

NatureServe
A Network Connecting Science With Conservation

Citations:

The following citation should be used in any published materials which reference ecological system and/or International Vegetation Classification (IVC hierarchy) and association data:

NatureServe. 2005. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA. U.S.A. Data current as of 04 April 2005.

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Arlington, VA 22209

These data are extracted from:

NatureServe. 2005. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA. U.S.A. Data current as of 04 April 2005

This document may be generally cited as follows:

NatureServe[1]. 2005. International Ecological Classification Standard: Terrestrial Ecological Classifications. North Cascade Ecoregion. NatureServe Central Databases. Arlington, VA and NatureServe Western Office, Boulder, CO. Data current as of 04 April 2005.

[1] NatureServe is an international organization including NatureServe regional offices, a NatureServe central office, U.S. State Natural Heritage Programs, and Conservation Data Centres (CDC) in Canada and Latin America and the Caribbean. Ecologists from the following organizations have contributed the development of the ecological systems classification:

United States
Central NatureServe Office, Arlington, VA; Eastern Regional Office, Boston, MA; Midwestern Regional Office, Minneapolis, MN; Southeastern Regional Office, Durham, NC; Western Regional Office, Boulder, CO; Alabama Natural Heritage Program, Montgomery AL; Alaska Natural Heritage Program, Anchorage, AK; Arizona Heritage Data Management Center, Phoenix AZ; Arkansas Natural Heritage Commission Little Rock, AR; Blue Ridge Parkway, Asheville, NC; California Natural Heritage Program, Sacramento, CA; Colorado Natural Heritage Program, Fort Collins, CO; Connecticut Natural Diversity Database, Hartford, CT; Delaware Natural Heritage Program, Smyrna, DE; District of Columbia Natural Heritage Program/National Capital Region Conservation Data Center, Washington DC; Florida Natural Areas Inventory, Tallahassee, FL; Georgia Natural Heritage Program, Social Circle, GA; Great Smoky Mountains National Park, Gatlinburg, TN; Gulf Islands National Seashore, Gulf Breeze, FL; Hawaii Natural Heritage Program, Honolulu, Hawaii; Idaho Conservation Data Center, Boise, ID; Illinois Natural Heritage Division/Illinois Natural Heritage Database Program, Springfield, IL; Indiana Natural Heritage Data Center, Indianapolis, IN; Iowa Natural Areas Inventory, Des Moines, IA; Kansas Natural Heritage Inventory, Lawrence, KS; Kentucky Natural Heritage Program, Frankfort, KY; Louisiana Natural Heritage Program, Baton Rouge, LA; Maine Natural Areas Program, Augusta, ME; Mammoth Cave National Park, Mammoth Cave, KY; Maryland Wildlife & Heritage Division, Annapolis, MD; Massachusetts Natural Heritage & Endangered Species Program, Westborough, MA; Michigan Natural Features Inventory, Lansing, MI; Minnesota Natural Heritage & Nongame Research and Minnesota County Biological Survey, St. Paul, MN; Mississippi Natural Heritage Program, Jackson, MI; Missouri Natural Heritage Database, Jefferson City, MO; Montana Natural Heritage Program, Helena, MT; National Forest in North Carolina, Asheville, NC; National Forests in Florida, Tallahassee, FL; National Park Service, Southeastern Regional Office, Atlanta, GA; Navajo Natural Heritage Program, Window Rock, AZ; Nebraska Natural Heritage Program, Lincoln, NE; Nevada Natural Heritage Program, Carson City, NV; New Hampshire Natural Heritage Inventory, Concord, NH; New Jersey Natural Heritage Program, Trenton, NJ; New Mexico Natural Heritage Program, Albuquerque , NM; New York Natural Heritage Program, Latham, NY; North Carolina Natural Heritage Program, Raleigh, NC; North Dakota Natural Heritage Inventory, Bismarck, ND; Ohio Natural Heritage Database, Columbus, OH; Oklahoma Natural Heritage Inventory, Norman, OK; Oregon Natural Heritage Program, Portland, OR; Pennsylvania Natural Diversity Inventory, PA; Rhode Island Natural Heritage Program, Providence, RI; South Carolina Heritage Trust, Columbia, SC; South Dakota Natural Heritage Data Base, Pierre, SD; Tennessee Division of Natural Heritage, Nashville, TN; Tennessee Valley Authority Heritage Program, Norris, TN; Texas Conservation Data Center, San Antonio, TX; Utah Natural Heritage Program, Salt Lake City, UT; Vermont Nongame & Natural Heritage Program, Waterbury, VT; Virginia Division of Natural Heritage, Richmond, VA; Washington Natural Heritage Program, Olympia, WA; West Virginia Natural Heritage Program, Elkins, WV; Wisconsin Natural Heritage Program, Madison, WI; Wyoming Natural Diversity Database, Laramie, WY

Canada
Alberta Natural Heritage Information Centre, Edmonton, AB, Canada; Atlantic Canada Conservation Data Centre, Sackville, New Brunswick, Canada; British Columbia Conservation Data Centre, Victoria, BC, Canada; Manitoba Conservation Data Centre. Winnipeg, MB, Canada; Ontario Natural Heritage Information Centre, Peterborough, ON, Canada; Quebec Conservation Data Centre, Quebec, QC, Canada; Saskatchewan Conservation Data Centre, Regina, SK, Canada; Yukon Conservation Data Centre, Yukon, Canada

Latin American and Caribbean
Centro de Datos para la Conservacion de Bolivia, La Paz , Bolivia; Centro de Datos para la Conservacion de Colombia, Cali,Valle, Columbia; Centro de Datos para la Conservacion de Ecuador, Quito, Ecuador; Centro de Datos para la Conservacion de Guatemala, Ciudad de Guatemala , Guatemala; Centro de Datos para la Conservacion de Panama, Querry Heights , Panama; Centro de Datos para la Conservacion de Paraguay, San Lorenzo , Paraguay; Centro de Datos para la Conservacion de Peru, Lima, Peru; Centro de Datos para la Conservacion de Sonora, Hermosillo, Sonora , Mexico; Netherlands Antilles Natural Heritage Program, Curacao , Netherlands Antilles; Puerto Rico-Departmento De Recursos Naturales Y Ambientales, Puerto Rico; Virgin Islands Conservation Data Center, St. Thomas, Virgin Islands.

NatureServe also has partnered with many International and United States Federal and State organizations, which have also contributed significantly to the development of the International Classification. Partners include the following The Nature Conservancy; Provincial Forest Ecosystem Classification Groups in Canada; Canadian Forest Service; Parks Canada; United States Forest Service; National GAP Analysis Program; United States National Park Service; United States Fish and Wildlife Service; United States Geological Survey; United States Department of Defense; Ecological Society of America; Environmental Protection Agency; Natural Resource Conservation Services; United States Department of Energy; and the Tennessee Valley Authority. Many individual state organizations and people from academic institutions have also contributed to the development of this classification.

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CES306.Pending Northern Interior Spruce-fir Woodland and Forest
CES306.Pending Northern Interior Dry-Mesic Mixed Conifer Forest

CES204.063 North Pacific Bog and Fen

Classif. Resp.: West
Primary Division: North American Pacific Maritime (204)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)
Diagnostic Classifiers: Lowland [Foothill]; Shrubland (Shrub-dominated); Temperate [Temperate Oceanic]; Depressional; Organic Peat (>40 cm); Sphagnum spp.
Non-Diagnostic Classifiers:
Concept Summary: This wetland system occurs in peatlands along the Pacific coast from southeastern Alaska to northern California, west of the coastal mountain summits but including the Puget Sound lowlands. Elevations are mostly under 457 m (1500 feet), and annual precipitation ranges from 890-3050 mm (35-120 inches). These wetlands are relatively abundant in Alaska and British Columbia but diminish rapidly in size and number further south. They occur in river valleys, around lakes and marshes, or on slopes. Organic soils are characterized by an abundance of sodium cations from oceanic precipitation. Poor fens and bogs are often intermixed except in a few calcareous areas in Alaska and British Columbia where rich fen vegetation may dominate. *Sphagnum* characterizes poor fens and bogs (pH <5.5), and the two are lumped here, while "brown mosses" and sedges characterize rich fens (pH >5.5). Mire profiles in Alaska and British Columbia may be flat, raised (domed), or sloping, but most occurrences in Washington and Oregon are flat with only localized hummock development. Vegetation is usually a mix of conifer-dominated swamp, shrub swamp, and open sphagnum or sedge mire, often with small lakes and ponds interspersed. Vegetation includes many species common to boreal continental bogs and fens but is characterized by coastal species including *Chamaecyparis nootkatensis, Pinus contorta var. contorta, Picea sitchensis, Tsuga heterophylla, Ledum glandulosum, Thuja plicata, Gaultheria shallon, Spiraea douglasii, Carex aquatilis var. dives, Carex lyngbyei, Carex obnupta, Carex pluriflora, Darlingtonia californica, Sphagnum pacificum, Sphagnum henryense*, and *Sphagnum mendocinum*.
Classification Comments: This system is distinguished and split from ~Boreal Depressional Bog (CES103.871)$$ and ~Boreal Fen (CES103.872)$$. The communities comprising this system are not well described or classified.
Internal Comments: GK 12-04: EPA Wetlands I project called this system [partially/strictly] isolated (Mar 2004); review during EPA Wetlands II project removed this system from list of isolated types (Dec 2004).
Similar Ecological Systems:
- Boreal Depressional Bog (CES103.871)
- Boreal Fen (CES103.872)

DISTRIBUTION

Range: Occurs along the Pacific coast from southeastern Alaska to northern California, west of the coastal mountain summits but including the Puget Sound lowlands. Occurrences diminish rapidly in size and number south of British Columbia.

Divisions: 204:C, 206:P
Nations: CA, US
Subnations: AK?, BC, OR, WA
TNC Ecoregions: 1:C, 2:C, 3:C, 69:C, 70:C, 81:C

SPATIAL CHARACTERISTICS

SOURCES

Reference: Comer et al. 2003*

Version: 14 Dec 2004
Stakeholders: Canada, West
Concept Auth.: J.C. Christy
Maint. Resp.: West

CES200.998 Temperate Pacific Subalpine-Montane Wet Meadow
** NOT MAPPED **

Primary Division:
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)
Diagnostic Classifiers: Herbaceous; Muck; Graminoid; 30-180-day hydroperiod
Concept Summary: Montane and subalpine wet meadows occur in open wet depressions, basins and flats among montane and subalpine forests from California's Transverse and Peninsular ranges north to the Alaskan coastal forests at varying elevations depending on latitude. Sites are usually seasonally wet, often drying by late summer, and many occur in a tension zone between perennial wetlands and uplands, where water tables fluctuate in response to long-term climatic cycles. They may have surface water for part of the year, but depths rarely exceed a few centimeters. Soils are mostly mineral and may show typical hydric soil characteristics, and shallow organic soils may occur as inclusions. This system often occurs as a mosaic of several plant associations with varying dominant herbaceous species that may include *Camassia quamash, Carex bolanderi, Carex utriculata, Carex exsiccata, Dodecatheon jeffreyi, Glyceria striata (= Glyceria elata), Carex nigricans, Calamagrostis canadensis, Juncus nevadensis, Caltha leptosepala ssp. howellii, Veratrum californicum*, and *Scirpus* and/or *Schoenoplectus* spp. Trees occur peripherally or on elevated microsites and include *Picea engelmannii, Abies lasiocarpa, Abies amabilis, Tsuga mertensiana*, and *Chamaecyparis nootkatensis*. Common shrubs may include *Salix* spp., *Vaccinium uliginosum, Betula nana*, and *Vaccinium macrocarpon*. Wet meadows are tightly associated with snowmelt and typically are not subjected to high disturbance events such as flooding.
Comments: Rocky Mountain Alpine-Montane Wet Meadow (CES306.812) occurs to the east of the coastal and Sierran mountains, in the semi-arid interior regions of western North America. Boreal wet meadow systems occur further north and east in boreal regions where the climatic regime is generally colder than that of the Rockies or Pacific Northwest regions.

Floristics of these three systems are somewhat similar, but there are differences related to biogeographic affinities of the species composing the vegetation.

DISTRIBUTION

Range: This system is found from California's Transverse and Peninsular ranges north to the Alaskan coastal forests at varying elevations depending on latitude.

Divisions: 204:C, 206:C

TNC Ecoregions: 3:C, 4:C, 5:C, 12:C, 16:C, 69:C, 81:C

Subnations: AK, BC, CA, NV, OR, WA

CONCEPT

Associations:

- *Calamagrostis canadensis* Western Herbaceous Vegetation (CEGL001559, G4)
- *Carex amplifolia* Herbaceous Vegetation (CEGL003427, G3)
- *Carex aquatilis* Herbaceous Vegetation (CEGL001802, G5)
- *Carex lasiocarpa* Herbaceous Vegetation (CEGL001810, G4?)
- *Carex nebrascensis - Carex microptera* Herbaceous Vegetation (CEGL001815, G3G4)
- *Carex nebrascensis* Herbaceous Vegetation (CEGL001813, G4)
- *Carex nigricans - Erythronium montanum* Herbaceous Vegetation (CEGL001817, G4)
- *Carex nigricans - Luetkea pectinata* Herbaceous Vegetation (CEGL001819, G4)
- *Carex nigricans* Herbaceous Vegetation (CEGL001816, G4)
- *Carex scopulorum* Herbaceous Vegetation (CEGL001822, G5)
- *Carex simulata* Herbaceous Vegetation (CEGL001825, G4)
- *Deschampsia caespitosa* Herbaceous Vegetation (CEGL001599, G4)
- *Eleocharis acicularis* Herbaceous Vegetation (CEGL001832, G4?)
- *Eleocharis palustris* Herbaceous Vegetation (CEGL001833, G5)
- *Juncus balticus* Herbaceous Vegetation (CEGL001838, G5)
- *Senecio triangularis - Mimulus guttatus* Herbaceous Vegetation (CEGL001988, G3?)
- *Senecio triangularis - Veratrum californicum* Herbaceous Vegetation (CEGL001989, G4)
- *Vaccinium uliginosum / Deschampsia caespitosa* Dwarf-shrubland (CEGL001250, G2)
- *Veratrum californicum - Juncus nevadensis* Herbaceous Vegetation (CEGL001946, G3G4)

Alliances:

- *Calamagrostis canadensis* Seasonally Flooded Herbaceous Alliance (A.1400)
- *Carex amplifolia* Saturated Herbaceous Alliance (A.2584)
- *Carex aquatilis* Seasonally Flooded Herbaceous Alliance (A.1404)
- *Carex lasiocarpa* Seasonally Flooded Herbaceous Alliance (A.1415)
- *Carex nebrascensis* Seasonally Flooded Herbaceous Alliance (A.1417)
- *Carex nigricans* Seasonally Flooded Herbaceous Alliance (A.1418)
- *Carex scopulorum* Seasonally Flooded Herbaceous Alliance (A.1420)
- *Carex simulata* Saturated Herbaceous Alliance (A.1469)
- *Deschampsia caespitosa* Seasonally Flooded Herbaceous Alliance (A.1408)
- *Eleocharis acicularis* Seasonally Flooded Herbaceous Alliance (A.1421)
- *Eleocharis palustris* Seasonally Flooded Herbaceous Alliance (A.1422)
- *Juncus balticus* Seasonally Flooded Herbaceous Alliance (A.1374)
- *Senecio triangularis* Semipermanently Flooded Herbaceous Alliance (A.1680)
- *Senecio triangularis* Temporarily Flooded Herbaceous Alliance (A.1667)
- *Vaccinium uliginosum* Saturated Dwarf-shrubland Alliance (A.1123)
- *Veratrum californicum* Temporarily Flooded Herbaceous Alliance (A.1663)

SPATIAL CHARACTERISTICS

SOURCES

References: Barbour and Major 1988, Comer et al. 2003, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995
Version: 31 Mar 2005 **Stakeholders:** Canada, West
Concept Author: P. Comer **LeadResp:** West

CES200.091 Temperate Pacific Tidal Salt and Brackish Marsh

Primary Division:
Land Cover Class: Herbaceous Wetland
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)
Diagnostic Classifiers: Temperate [Temperate Hyperoceanic, Temperate Oceanic]; Tidal / Estuarine [Haline, Oligohaline]; Saline Water Chemistry; 30-180-day hydroperiod
Concept Summary: Intertidal salt and brackish marshes are found throughout the Pacific Coast, from south-central Alaska to the central Oregon Coast. They are primarily associated with estuaries or coastal lagoons. This is a small-patch system, confined to specific environments defined by ranges of salinity, tidal inundation regime, and soil texture. Patches usually occur as zonal mosaics of multiple communities. They vary in location and abundance with daily and seasonal dynamics of freshwater input from inland balanced against evaporation and tidal flooding of saltwater. Low marshes are located in areas that flood every day and are dominated by a variety of low-growing forbs and low to medium-height graminoids, especially *Salicornia virginica, Distichlis spicata, Schoenoplectus maritimus (= Scirpus maritimus), Carex lyngbyei*, and *Triglochin maritima*. High marshes are located in areas that flood infrequently and are dominated by medium-tall graminoids and low forbs, especially *Deschampsia caespitosa, Argentina egedii, Juncus balticus*, and *Symphyotrichum subspicatum (= Aster subspicatus)*. Transition zone (slightly brackish) marshes are often dominated by *Typha* spp. or *Schoenoplectus acutus*. *Atriplex prostrata (= Atriplex triangularis), Juncus mexicanus, Phragmites* spp., *Cordylanthus* spp., and *Lilaeopsis masonii* are important species in California.
Comments: Discussions with John Christy and Todd Keeler-Wolf led us to conclude to lump all West Coast salt and brackish marshes into one system because they co-occur so intimately and frequently, are not readily distinguished without detailed on-the-ground surveys, and are totally intergradient (seemingly continuous variation) in terms of degree of salinity and resulting vegetation.

DISTRIBUTION

Range: This system is found throughout the Pacific Coast, from south-central Alaska to the California Coast.
Divisions: 204:C
TNC Ecoregions: 1:C, 2:C, 3:C, 14:C, 15:C, 16:P, 69:C, 70:C, 71:C

Subnations: AK, BC, CA, OR, WA

CONCEPT

Associations:

- *Argentina egedii - Juncus balticus* Herbaceous Vegetation (CEGL003382, G3G4)
- *Argentina egedii - Symphyotrichum subspicatum* Herbaceous Vegetation (CEGL003288, G3G4)
- *Carex lyngbyei - (Distichlis spicata, Triglochin maritima)* Herbaceous Vegetation (CEGL003285, G4)
- *Carex lyngbyei - Argentina egedii* Herbaceous Vegetation (CEGL003289, G4)
- *Carex lyngbyei* Herbaceous Vegetation (CEGL003369, G4)
- *Deschampsia caespitosa - (Carex lyngbyei, Distichlis spicata)* Herbaceous Vegetation (CEGL003357, G3G4)
- *Deschampsia caespitosa - Argentina egedii* Herbaceous Vegetation (CEGL003383, G3G4)
- *Deschampsia caespitosa - Sidalcea hendersonii* Herbaceous Vegetation (CEGL003384, G2)
- *Distichlis spicata - (Salicornia virginica)* Herbaceous Vegetation (CEGL003356, G4)
- *Festuca rubra - (Argentina egedii)* Herbaceous Vegetation (CEGL003424, G1)
- *Glaux maritima* Herbaceous Vegetation [Provisional] (CEGL003286, G3)
- *Salicornia (bigelovii, virginica)* Tidal Herbaceous Vegetation [Provisional] (CEGL003123, GNRQ)
- *Salicornia virginica - Distichlis spicata - Triglochin maritima - (Jaumea carnosa)* Herbaceous Vegetation (CEGL003366, G3)
- *Salicornia virginica* Herbaceous Vegetation (CEGL003380, G3G4)
- *Schoenoplectus (americanus, pungens)* Tidal Herbaceous Vegetation [Provisional] (CEGL003367, G3)
- *Schoenoplectus maritimus* Tidal Herbaceous Vegetation [Provisional] (CEGL003287, G3)
- *Triglochin maritima - (Salicornia virginica)* Herbaceous Vegetation (CEGL003381, G4)

Alliances:

- *Argentina egedii* Tidal Herbaceous Alliance (A.2621)
- *Carex lyngbyei* Tidal Herbaceous Alliance (A.2622)
- *Deschampsia caespitosa* Tidal Herbaceous Alliance (A.2623)
- *Distichlis spicata* Tidal Herbaceous Alliance (A.1882)
- *Festuca rubra* Tidal Herbaceous Alliance (A.2583)
- *Salicornia virginica* Tidal Herbaceous Alliance (A.2618)
- *Sarcocornia perennis - (Distichlis spicata, Salicornia* spp.) Tidal Herbaceous Alliance (A.1704)

SPATIAL CHARACTERISTICS

SOURCES

References: Barbour and Major 1988, Boggs 2002, Chappell and Christy 2004, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995, Viereck et al. 1992, Western Ecology Working Group n.d.

Version: 09 Feb 2005 **Stakeholders:** Canada, West

Concept Author: K. Boggs, C. Chappell, G. Kittel **LeadResp:** West

CES204.086 East Cascades Mesic Montane Mixed-Conifer Forest and Woodland

Primary Division: North American Pacific Maritime (204)

Land Cover Class: Forest and Woodland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Udic; Very Long Disturbance Interval; F-Landscape/Medium Intensity; Needle-Leaved Tree; Abies grandis - Mixed; Tsuga heterophylla, Thuja plicata; Pseudotsuga menziesii; Long (>500 yrs) Persistence
Concept Summary: This ecological system occurs on the upper east slopes of the Cascades in Washington, south of Lake Chelan and south to Mount Hood in Oregon. Elevations range from 610 to 1220 m (2000-4000 feet) in a very restricted range occupying less than 5% of the forested landscape in the east Cascades. This system is associated with a submesic climate regime with annual precipitation ranging from 100 to 200 cm (40-80 inches) and maximum winter snowpacks that typically melt off in spring at lower elevations. This ecological system is composed of variable montane coniferous forests typically below Pacific silver fir forests along the crest east of the Cascades. This system also includes montane forests along rivers and slopes, and in mesic "coves" which were historically protected from wildfires. Most occurrences of this system are dominated by a mix of *Pseudotsuga menziesii* with *Abies grandis* and/or *Tsuga heterophylla*. Several other conifers can dominate or codominate, including *Thuja plicata, Pinus contorta, Pinus monticola*, and *Larix occidentalis*. *Abies grandis* and other fire-sensitive, shade-tolerant species dominate forests on many sites once dominated by *Pseudotsuga menziesii* and *Pinus ponderosa*, which were formerly maintained by wildfire. They are very productive forests in the eastern Cascades which have been priority stands for timber production. *Mahonia nervosa, Linnaea borealis, Paxistima myrsinites, Acer circinatum, Spiraea betulifolia, Symphoricarpos hesperius, Cornus nuttallii, Rubus parviflorus*, and *Vaccinium membranaceum* are common shrub species. The composition of the herbaceous layer reflects local climate and degree of canopy closure and contains species more restricted to the Cascades, for example, *Achlys triphylla, Anemone deltoidea*, and *Vancouveria hexandra*. Typically, stand-replacement fire-return intervals are 150-500 years with moderate-severity fire-return intervals of 50-100 years.
Comments: Includes *Tsuga heterophylla* and *Thuja plicata* associations and moister *Abies grandis* associations in eastern Cascades.

DISTRIBUTION

Range: This ecological system occurs on the upper east slopes of the Cascades in Washington, south of Lake Chelan and south to Mount Hood in Oregon.
Divisions: 204:C
TNC Ecoregions: 4:C
Subnations: BC, OR, WA

CONCEPT

Associations:
- *Abies concolor - Pinus contorta / Carex pensylvanica - Achnatherum occidentale* Forest (CEGL000256, G3)
- *Abies grandis - Picea engelmannii / Maianthemum stellatum* Forest (CEGL000278, G2)
- *Abies grandis - Pseudotsuga menziesii / Trientalis borealis* ssp. *latifolia* Forest (CEGL000040, G3)
- *Abies grandis - Thuja plicata / Achlys triphylla* Forest (CEGL002669, G2)
- *Abies grandis - Tsuga heterophylla / Clintonia uniflora* Forest (CEGL000286, G2)
- *Abies grandis / Acer circinatum* Forest (CEGL000266, G4)
- *Abies grandis / Achlys triphylla* Forest (CEGL000268, G3)

- *Abies grandis / Arctostaphylos nevadensis* Woodland (CEGL000915, G2G3)
- *Abies grandis / Chrysolepis chrysophylla* Forest (CEGL000038, G1)
- *Abies grandis / Polemonium pulcherrimum* Forest (CEGL000039, G3)
- *Abies grandis / Symphoricarpos albus* Forest (CEGL000282, G3?)
- *Abies grandis / Vaccinium membranaceum - Achlys triphylla* Forest (CEGL000291, G2G3)

Alliances:

- *Abies concolor* Forest Alliance (A.152)
- *Abies grandis* Forest Alliance (A.153)
- *Abies grandis* Woodland Alliance (A.558)

Dynamics: Landfire VDDT models: R#MCONm Eastside mixed conifer moist (GF/DF) model is applied with stages A-B-E.

SPATIAL CHARACTERISTICS

Adjacent Ecological System Comments: This system lies between and interfingers with the higher North Pacific Mountain Hemlock (CES204.838), North Pacific Mesic Western Hemlock-Silver Fir Forest (CES204.097) or Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland (CES306.830) and the lower Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest (CES306.805). Westward in the Columbia River Gorge, this system merges with North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest (CES204.001).

SOURCES

References: Hessburg et al. 1999, Hessburg et al. 2000, Lillybridge et al. 1995, Topik 1989, Topik et al. 1988, Western Ecology Working Group n.d.

Version: 31 Mar 2005 **Stakeholders:** Canada, West

Concept Author: R. Crawford **LeadResp:** West

CES204.098 North Pacific Dry-Mesic Silver Fir-Western Hemlock-Douglas-fir Forest

Primary Division: North American Pacific Maritime (204)

Land Cover Class: Forest and Woodland

Spatial Scale & Pattern: Matrix

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Forest and Woodland (Treed); Tsuga heterophylla - Abies amabilis

Concept Summary: This forested system occurs only in the Pacific Northwest mountains, primarily west of the Cascade Crest. It generally occurs in an elevational band between *Pseudotsuga menziesii - Tsuga heterophylla* forests and *Tsuga mertensiana* forests. It dominates mid-montane dry to mesic maritime and some submaritime climatic zones from northwestern British Columbia to northwestern Oregon. In British Columbia and in the Olympic Mountains, this system occurs on the leeward side of the mountains only. In the Washington Cascades, it occurs on both windward and leeward sides of the mountains (in other words, it laps over the Cascade Crest to the "eastside"). Stand-replacement fires are regular with mean return intervals of about 200-500 years. Fire frequency tends to decrease

with increasing elevation and continentality but still remains within this typical range. A somewhat variable winter snowpack that typically lasts for 2-6 months is characteristic. The climatic zone within which it occurs is sometimes referred to as the "rain-on-snow" zone because of the common occurrence of major winter rainfall on an established snowpack. *Tsuga heterophylla* and/or *Abies amabilis* dominate the canopy of late-seral stands, though *Pseudotsuga menziesii* is usually also common because of its long life span, and *Chamaecyparis nootkatensis* can be codominant, especially at higher elevations. *Abies procera* forests (usually mixed with silver fir) are included in this system and occur in the Cascades from central Washington to central Oregon and rarely in the Coast Range of Oregon. *Pseudotsuga menziesii* is a common species (unlike the mesic western hemlock-silver fir forest system) that regenerates after fires and therefore is frequent as a codominant, except at the highest elevations; the prevalence of this species is an important indicator in relation to the related climatically wetter North Pacific Mesic Western Hemlock-Silver Fir Forest (CES204.097). *Abies lasiocarpa* sometimes occurs as a codominant on the east side of the Cascades and in submaritime British Columbia. Understory species that tend to be more common or unique in this type compared to the wetter North Pacific Mesic Western Hemlock-Silver Fir Forest (CES204.097) include *Achlys triphylla, Mahonia nervosa, Xerophyllum tenax, Vaccinium membranaceum, Rhododendron macrophyllum*, and *Rhododendron albiflorum*. *Vaccinium ovalifolium*, while still common, only dominates on more moist sites within this type, unlike in the related type where it is nearly ubiquitous.
Comments: Unlike North Pacific Mesic Western Hemlock-Silver Fir Forest (CES204.097), the dominant natural process here is stand-replacement fires which occur on average every 200-500 years. Where old-growth does exist, it is mostly "young old-growth" 200-500 years in age. Natural-origin stands less than 200 years old are also common.

DISTRIBUTION

Range: This system occurs only in the Pacific Northwest mountains, on the leeward side of coastal mountains in both British Columbia and in the Olympic Mountains of Washington. It occurs throughout most of the Washington Cascades on both west and east sides (sporadically on the east) and in the western Cascades of northern to central Oregon. It occurs very sporadically in the Willapa Hills of southwestern Washington and in the northern Oregon Coast Range.
Divisions: 204:C
TNC Ecoregions: 1:C, 3:C, 69:C, 70:C, 81:C
Subnations: BC, OR, WA

CONCEPT

Associations:
- *Abies amabilis - Abies concolor / Mahonia nervosa* Forest (CEGL000215, G2G3)
- *Abies amabilis - Abies concolor / Maianthemum stellatum* Forest (CEGL000216, G4)
- *Abies amabilis / Achlys triphylla* Forest (CEGL000003, G4)
- *Abies amabilis / Gaultheria shallon* Forest (CEGL000220, G4)
- *Abies amabilis / Mahonia nervosa* Forest (CEGL000217, G4)
- *Abies amabilis / Menziesia ferruginea* Forest (CEGL000224, G4)
- *Abies amabilis / Oplopanax horridus* Forest (CEGL000004, G5)

- *Abies amabilis / Polystichum munitum* Forest (CEGL000006, G4)
- *Abies amabilis / Rhododendron albiflorum* Forest (CEGL000225, G5)
- *Abies amabilis / Rhododendron macrophyllum - Gaultheria shallon* Forest (CEGL000222, G4)
- *Abies amabilis / Rhododendron macrophyllum - Mahonia nervosa* Forest (CEGL000218, G4)
- *Abies amabilis / Rhododendron macrophyllum - Vaccinium ovalifolium* Forest (CEGL000226, G4)
- *Abies amabilis / Rhododendron macrophyllum / Xerophyllum tenax* Forest (CEGL000227, G4)
- *Abies amabilis / Tiarella trifoliata* Forest (CEGL000007, G4)
- *Abies amabilis / Vaccinium membranaceum - Tiarella trifoliata* Forest (CEGL000237, G4)
- *Abies amabilis / Vaccinium membranaceum - Vaccinium ovalifolium* Forest (CEGL002610, G4G5)
- *Abies amabilis / Vaccinium membranaceum / Clintonia uniflora* Forest (CEGL002625, G4)
- *Abies amabilis / Vaccinium membranaceum / Rubus lasiococcus* Forest (CEGL000236, G4)
- *Abies amabilis / Vaccinium membranaceum / Xerophyllum tenax* Forest (CEGL000239, G4)
- *Abies amabilis / Vaccinium membranaceum* Forest (CEGL000235, G4)
- *Abies amabilis / Vaccinium ovalifolium - Gaultheria shallon* Forest (CEGL002626, G4)
- *Abies amabilis / Vaccinium ovalifolium / Clintonia uniflora* Forest (CEGL000233, G5)
- *Abies amabilis / Vaccinium ovalifolium / Mahonia nervosa* Forest (CEGL000232, G4)
- *Abies amabilis / Vaccinium ovalifolium / Tiarella trifoliata* Forest (CEGL000009, G4)
- *Abies amabilis / Vaccinium ovalifolium / Xerophyllum tenax* Forest (CEGL002609, G4)
- *Abies amabilis / Vaccinium ovalifolium* Forest (CEGL000231, G4G5)
- *Abies amabilis / Vaccinium scoparium* Forest (CEGL000238, G4)
- *Chamaecyparis nootkatensis / Vaccinium ovalifolium* Forest (CEGL000351, G4Q)

Alliances:

- *Abies amabilis - Abies concolor* Forest Alliance (A.160)
- *Abies amabilis* Giant Forest Alliance (A.102)
- *Abies amabilis* Seasonally Flooded Forest Alliance (A.187)
- *Chamaecyparis nootkatensis* Forest Alliance (A.162)

Dynamics: Landfire VDDT models: R#ABAMlo; they use *Pseudotsuga menziesii* as an indicator so some of the eastside *Abies amabilis* are included with *Picea engelmannii* or *Pinus monticola*.

SPATIAL CHARACTERISTICS

SOURCES

References: DeMeo et al. 1992, DeVelice et al. 1999, Franklin and Dyrness 1973, Martin et al. 1995, Viereck et al. 1992, Western Ecology Working Group n.d.

Version: 31 Mar 2005 **Stakeholders:** Canada, West

Concept Author: C. Chappell **LeadResp:** West

CES204.842 North Pacific Hypermaritime Western Red-cedar-Western Hemlock Forest

Primary Division: North American Pacific Maritime (204)

Land Cover Class: Forest and Woodland

Spatial Scale & Pattern: Matrix

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Forest and Woodland (Treed); Temperate [Temperate Hyperoceanic]; Tsuga heterophylla, Thuja plicata

Concept Summary: These forests occupy the outer coastal portions of British Columbia, southeastern Alaska, and Washington. Its center of distribution is the northern coast of British Columbia, as *Thuja plicata* approaches its northernmost limit in the southern half of southeastern Alaska. These forests occur mainly on islands but also fringe the mainland. They are never more than 25 km from saltwater; elevation ranges from 0 to 600 m. The climate is hypermaritime, with cool summers, very wet winters, abundant fog, and without a major snowpack (unlike the western hemlock-silver fir system). These forests very rarely burn and are more influenced by gap disturbance processes and intense windstorms than by fire. The terrain is mostly gentle, of low topographic relief, and often rocky. Soils typically have a distinct humus layer overlying mineral horizons or bedrock, and where the system is best developed in central British Columbia, the humus layers are very thick (mean 17-35 cm). Soils are often imperfectly drained. The forests are often open and scrubby but can be closed. *Thuja plicata* and *Tsuga heterophylla* are the dominant tree species throughout, and *Chamaecyparis nootkatensis* joins them from northern Vancouver Island north. *Pinus contorta* and *Tsuga mertensiana* can be abundant in some locations in the central and northern portion of the range. *Abies amabilis* is widespread (except in southern Washington) and can be common but is not dominant. In Washington, nearly pure stands of *Tsuga heterophylla* are common and seem to be associated with microsites most exposed to intense windstorms. A shrub layer of *Gaultheria shallon, Vaccinium ovalifolium*, and *Menziesia ferruginea* is usually well-developed. The fern *Blechnum spicant* in great abundance is typical of hypermaritime conditions. *Oxalis oregana* is important in the understory of moist sites in Washington. The abundance of *Thuja plicata* in relation to other conifers is one of the diagnostic characters of these forests; the other is the low abundance of *Pseudotsuga menziesii* and *Picea sitchensis*. Where these forests are best developed they occur in a mosaic with forested wetlands, bogs, and Sitka spruce forests (the latter in riparian areas and on steep, more productive soils).

DISTRIBUTION

Range: This system is found in the outer coastal portions of British Columbia and southeastern Alaska, as well as northwestern Washington.

Divisions: 204:C

TNC Ecoregions: 1:C, 3:?, 69:C, 70:C

Subnations: AK, BC, WA

CONCEPT

Associations:

- *Abies amabilis / Gaultheria shallon / Blechnum spicant* Forest (CEGL000221, G3)
- *Tsuga heterophylla - Chamaecyparis nootkatensis / Vaccinium ovalifolium - Menziesia ferruginea* Forest (CEGL003242, G4)
- *Tsuga heterophylla - Chamaecyparis nootkatensis / Vaccinium ovalifolium - Oplopanax horridus* Forest (CEGL003241, G3)
- *Tsuga heterophylla - Chamaecyparis nootkatensis / Vaccinium ovalifolium* Forest (CEGL003239, G5)
- *Tsuga heterophylla - Thuja plicata / Gaultheria shallon* Woodland (CEGL003227, G5)

- *Tsuga heterophylla - Thuja plicata / Polystichum munitum* Forest (CEGL003228, G5)
- *Tsuga heterophylla - Thuja plicata / Vaccinium ovalifolium - Gaultheria shallon* Woodland (CEGL003225, G5)
- *Tsuga heterophylla - Thuja plicata / Vaccinium ovalifolium - Tiarella trifoliata* Forest (CEGL003224, G5)
- *Tsuga heterophylla - Thuja plicata / Vaccinium ovalifolium* Forest (CEGL003222, G5)
- *Tsuga heterophylla / Oxalis oregana - Polystichum munitum* Forest (CEGL000106, G3)
- *Tsuga heterophylla / Oxalis oregana* Forest (CEGL000105, G3G4)

Alliances:

- *Abies amabilis* Giant Forest Alliance (A.102)
- *Tsuga heterophylla* Forest Alliance (A.145)
- *Tsuga heterophylla* Giant Forest Alliance (A.112)
- *Tsuga heterophylla* Woodland Alliance (A.549)

SPATIAL CHARACTERISTICS

SOURCES

References: Banner et al. 1993, Bigley and Hull 1995, Comer et al. 2003, DeMeo et al. 1992, DeVelice et al. 1999, Green and Klinka 1994, Martin et al. 1995
Version: 07 Feb 2005 **Stakeholders:** Canada, West
Concept Author: G. Kittel and C. Chappell**LeadResp:** West

CES204.001 North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Temperate [Temperate Oceanic]; Tsuga heterophylla, Pseudotsuga menziesii
Concept Summary: This system comprises much of the major lowland forests of western Washington, northwestern Oregon, eastern Vancouver Island, and the southern Coast Ranges in British Columbia. In southwestern Oregon, it becomes local and more small-patch in nature. It occurs throughout low-elevation western Washington, except on extremely dry or moist to very wet sites. In Oregon it occurs on the western slopes of the Cascades, around the margins of the Willamette Valley, and in the Coast Range. These forests occur on the drier to intermediate moisture habitats and microhabitats within the Western Hemlock Zone of the Pacific Northwest. Climate is relatively mild and moist to wet. Mean annual precipitation is mostly 90-254 cm (35-100 inches) (but as low as 20 inches in the extreme rainshadow) predominantly as winter rain. Snowfall ranges from rare to regular, and summers are relatively dry. Elevation ranges from sea level to 610 m (2000 feet) in northern Washington to 1067 m (3500 feet) in Oregon. Topography ranges from relatively flat glacial tillplains to steep mountainous terrain. This is generally the most extensive forest in the lowlands on the west side of the Cascades and forms the matrix within which other systems occur as patches. Throughout its range it occurs in a mosaic with North Pacific Maritime Wet-Mesic Douglas-

fir-Western Hemlock Forest (CES204.002); in dry areas it occurs adjacent to or in a mosaic with North Pacific Dry Douglas-fir and Madrone Forest and Woodland (CES204.845) and at higher elevations intermingles with either North Pacific Dry-Mesic Silver Fir-Western Hemlock-Douglas-fir Forest (CES204.098) or North Pacific Mesic Western Hemlock-Silver Fir Forest (CES204.097).

Overstory canopy is dominated by *Pseudotsuga menziesii*, with *Tsuga heterophylla* generally present in the subcanopy or as a canopy dominant in old-growth stands. *Abies grandis, Thuja plicata*, and *Acer macrophyllum* codominants are also represented. In the driest climatic areas, *Tsuga heterophylla* may be absent, and *Thuja plicata* takes its place as a late-seral or subcanopy tree species. *Gaultheria shallon, Mahonia nervosa, Rhododendron macrophyllum, Linnaea borealis, Achlys triphylla*, and *Vaccinium ovatum* typify the poorly to well-developed shrub layer. *Acer circinatum* is a common codominant with one of more of these other species. The fern *Polystichum munitum* can be codominant with one or more of the evergreen shrubs on sites with intermediate moisture availability (mesic). If *Polystichum munitum* is thoroughly dominant or greater than about 40-50% cover, then the stand is probably in the more moist North Pacific Maritime Wet-Mesic Douglas-fir-Western Hemlock Forest (CES204.002). Young stands may lack *Tsuga heterophylla* or *Thuja plicata*, especially in the Puget Lowland. *Tsuga heterophylla* is generally the dominant regenerating tree species. Other common associates include *Acer macrophyllum, Abies grandis*, and *Pinus monticola*. In southwestern Oregon, *Pinus lambertiana, Calocedrus decurrens*, and occasionally *Pinus ponderosa* may occur in these forests. Soils are generally well-drained and are mesic to dry for much of the year. This is in contrast to North Pacific Maritime Wet-Mesic Douglas-fir-Western Hemlock Forest (CES204.002), which occurs on sites where soils remain moist to subirrigated for much of the year and fires were less frequent. Fire is (or was) the major natural disturbance. In the past (pre-1880), fires were high-severity or, less commonly, moderate-severity, with natural return intervals of 100 years or less in the driest areas, to a few hundred years in areas with more moderate to wet climates. In the drier climatic areas (central Oregon Cascades, Puget Lowlands, Georgia Basin), this system was typified by a moderate-severity fire regime involving occasional stand-replacing fires and more frequent moderate-severity fires. This fire regime would create a complex mosaic of stand structures across the landscape.

DISTRIBUTION

Range: This system comprises the major lowland and low montane forests of western Washington, northwestern Oregon, and southwestern British Columbia. In British Columbia and Washington, it is uncommon to absent on the windward side of the coastal mountains where fire is rare. It also occurs locally in far southwestern Oregon (Klamath ecoregion) as small to large patches.
Divisions: 204:C
TNC Ecoregions: 1:C, 3:C, 5:C, 69:C, 81:C
Subnations: BC, OR, WA

CONCEPT

Associations:

- *Pseudotsuga menziesii - (Tsuga heterophylla) / Rhododendron macrophyllum* Forest (CEGL000086, G3)
- *Pseudotsuga menziesii - Tsuga heterophylla / Gaultheria shallon* Forest (CEGL000084, G3)
- *Pseudotsuga menziesii - Tsuga heterophylla / Holodiscus discolor* Forest (CEGL000067, G3)
- *Pseudotsuga menziesii - Tsuga heterophylla / Mahonia nervosa* Forest (CEGL000083, G2)
- *Pseudotsuga menziesii - Tsuga heterophylla / Rhododendron macrophyllum - Vaccinium ovatum - Gaultheria shallon* Forest (CEGL002615, G2)
- *Pseudotsuga menziesii - Tsuga heterophylla / Vaccinium ovatum* Forest (CEGL002614, G2)
- *Pseudotsuga menziesii / Acer circinatum - Holodiscus discolor* Forest (CEGL000109, G3Q)
- *Pseudotsuga menziesii / Gaultheria shallon / Polystichum munitum* Forest (CEGL000070, G4)
- *Thuja plicata - Tsuga heterophylla / Rhododendron macrophyllum / Linnaea borealis* Forest (CEGL000485, G3)
- *Thuja plicata - Tsuga heterophylla / Whipplea modesta* Forest (CEGL000486, G2G3)
- *Tsuga heterophylla / Acer glabrum* var. *douglasii / Linnaea borealis* Forest (CEGL002608, G3Q)
- *Tsuga heterophylla / Achlys triphylla* Forest (CEGL000094, G4)
- *Tsuga heterophylla / Chrysolepis chrysophylla* Forest (CEGL000099, G3)
- *Tsuga heterophylla / Gaultheria shallon / Polystichum munitum* Forest (CEGL000101, G4)
- *Tsuga heterophylla / Gaultheria shallon* Forest (CEGL000100, G4)
- *Tsuga heterophylla / Linnaea borealis* Forest (CEGL000104, G3)
- *Tsuga heterophylla / Mahonia nervosa - Gaultheria shallon* Forest (CEGL000096, G4)
- *Tsuga heterophylla / Mahonia nervosa / Achlys triphylla* Forest (CEGL000095, G4)
- *Tsuga heterophylla / Mahonia nervosa / Linnaea borealis* Forest (CEGL000097, G3Q)
- *Tsuga heterophylla / Mahonia nervosa* Forest (CEGL000492, G4)
- *Tsuga heterophylla / Vaccinium membranaceum / Linnaea borealis* Forest (CEGL000119, G4)
- *Tsuga heterophylla / Vaccinium membranaceum / Xerophyllum tenax* Forest (CEGL000120, G3)
- *Tsuga heterophylla / Vaccinium ovatum* Forest (CEGL000121, G3)

Alliances:

- *Pseudotsuga menziesii - Tsuga heterophylla* Forest Alliance (A.107)
- *Pseudotsuga menziesii* Forest Alliance (A.157)
- *Pseudotsuga menziesii* Giant Forest Alliance (A.108)
- *Thuja plicata* Forest Alliance (A.166)
- *Thuja plicata* Giant Forest Alliance (A.111)
- *Tsuga heterophylla* Giant Forest Alliance (A.112)

Dynamics: Fire is (or was) the major natural disturbance. In the past (pre-1880), fires were high-severity or, less commonly, moderate-severity, with natural return intervals of 100 years or less in the driest areas, to a few hundred years in areas with more moderate to wet climates. In the drier climatic areas (central Oregon Cascades, Puget Lowlands, Georgia Basin), this system was typified by a moderate-severity fire regime involving occasional stand-replacement fires and more frequent moderate-severity fires. This fire regime would create a complex mosaic of stand structures across the landscape. Landfire VDDT models: #RDFHEdry Douglas-fir Hemlock dry mesic describes general successional stage relationship with bias to OR.

SPATIAL CHARACTERISTICS

Adjacent Ecological System Comments: In dry areas it occurs adjacent to or in a mosaic with North Pacific Dry Douglas-fir Forest and Woodland (CES204.845) and at higher, moister elevations intermingles with either North Pacific Dry-Mesic Silver Fir-Western Hemlock-Douglas-fir Forest (CES204.098) or North Pacific Mesic Western Hemlock-Silver Fir Forest (CES204.097). Throughout its range it occurs in a mosaic with North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest (CES204.002).

SOURCES

References: Western Ecology Working Group n.d.
Version: 31 Mar 2005 **Stakeholders:** Canada, West
Concept Author: G. Kittel and C. Chappell**LeadResp:** West

CES204.837 North Pacific Maritime Mesic Subalpine Parkland

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Upper Montane]; Tsuga mertensiana; Late-lying snowpack
Concept Summary: This system occurs throughout the mountains of the Pacific Northwest, from the southern Cascades of Oregon to the mountains of south-central Alaska. It occurs at the transition zone of forest to alpine, forming a subalpine forest-meadow ecotone. Clumps of trees to small patches of forest interspersed with low shrublands and meadows characterize this system. Krummholz often occurs near the upper elevational limit of this type where it grades into alpine vegetation. Associations include woodlands, forested and subalpine meadow types. It occurs on the west side of the Cascade Mountains where deep, late-lying snowpack is the primary environmental factor. Major tree species are *Tsuga mertensiana, Abies amabilis, Chamaecyparis nootkatensis*, and *Abies lasiocarpa*. This system includes British Columbia Hypermaritime and Maritime Parkland (*Tsuga mertensiana*). Dominant dwarf-shrubs include *Phyllodoce empetriformis, Cassiope mertensiana*, and *Vaccinium deliciosum*. Dominant herbaceous species include *Lupinus arcticus ssp. subalpinus, Valeriana sitchensis, Carex spectabilis*, and *Polygonum bistortoides*. There is very little disturbance, either windthrow or fire. The major process controlling vegetation is the very deep long-lasting snowpacks (deepest in the North Pacific region) limiting tree regeneration. Trees get established only in favorable microsites (mostly adjacent to existing trees) or during drought years with low snowpack. It is distinguished from more interior dry parkland primarily by the presence of *Tsuga mertensiana* or *Abies amabilis* and absence or paucity of *Pinus albicaulis* and *Larix lyallii*.

DISTRIBUTION

Range: This system occurs throughout the mountains of the Pacific Northwest, from the southern Cascades of Oregon to the mountains of south-central Alaska.
Divisions: 204:C
TNC Ecoregions: 1:C, 4:C, 7:C, 69:C, 70:C, 81:C

Subnations: AK, BC, OR, WA

CONCEPT

Associations:

- *Carex spectabilis - Polygonum bistortoides* Herbaceous Vegetation (CEGL001828, G4)
- *Carex spectabilis - Potentilla flabellifolia* Herbaceous Vegetation (CEGL001829, G4Q)
- *Carex spectabilis* Herbaceous Vegetation (CEGL001827, G5)
- *Cassiope mertensiana / Luetkea pectinata* Dwarf-shrubland (CEGL001397, G3G4)
- *Chamaecyparis nootkatensis* Subalpine Parkland Woodland (CEGL000350, G3)
- *Luetkea pectinata - Saxifraga tolmiei* Herbaceous Vegetation (CEGL001918, G5)
- *Lupinus arcticus* ssp. *subalpinus - Carex spectabilis* Herbaceous Vegetation (CEGL001973, G4)
- *Phyllodoce empetriformis / Lupinus latifolius* Dwarf-shrubland (CEGL001406, G4?)
- *Phyllodoce empetriformis / Vaccinium deliciosum* Dwarf-shrubland (CEGL001407, G4)
- *Phyllodoce empetriformis* Parkland Dwarf-shrubland (CEGL001404, G5)
- *Potentilla flabellifolia - Polygonum bistortoides* Herbaceous Vegetation (CEGL001981, G4Q)
- *Saussurea americana - Heracleum maximum* Herbaceous Vegetation (CEGL001945, G3G4)
- *Tsuga mertensiana - Abies amabilis / Phyllodoce empetriformis - Vaccinium deliciosum* Woodland (CEGL000914, G4)
- *Tsuga mertensiana / Cassiope mertensiana* Woodland (CEGL003251, G5)
- *Vaccinium deliciosum* Parkland Dwarf-shrubland (CEGL001427, G4G5)
- *Vaccinium membranaceum - Vaccinium deliciosum* Dwarf-shrubland (CEGL001428, G4?Q)
- *Valeriana sitchensis - Carex spectabilis* Herbaceous Vegetation (CEGL001996, G4)
- *Valeriana sitchensis - Ligusticum grayi* Herbaceous Vegetation (CEGL001997, G3G4Q)
- *Valeriana sitchensis - Veratrum viride* Herbaceous Vegetation (CEGL001998, G4)

Alliances:

- *Carex spectabilis* Herbaceous Alliance (A.1300)
- *Cassiope mertensiana* Dwarf-shrubland Alliance (A.1081)
- *Chamaecyparis nootkatensis* Woodland Alliance (A.554)
- *Luetkea pectinata - Saxifraga tolmiei* Herbaceous Alliance (A.1629)
- *Lupinus arcticus* Herbaceous Alliance (A.1609)
- *Phyllodoce empetriformis* Dwarf-shrubland Alliance (A.1083)
- *Potentilla flabellifolia* Herbaceous Alliance (A.1610)
- *Saussurea americana* Temporarily Flooded Herbaceous Alliance (A.1662)
- *Tsuga mertensiana - Abies amabilis* Woodland Alliance (A.555)
- *Tsuga mertensiana* Woodland Alliance (A.550)
- *Vaccinium deliciosum* Dwarf-shrubland Alliance (A.1115)
- *Valeriana sitchensis* Herbaceous Alliance (A.1611)

SPATIAL CHARACTERISTICS

SOURCES

References: Banner et al. 1993, Comer et al. 2003, Franklin and Dyrness 1973, Green and Klinka 1994

Version: 08 Feb 2005 **Stakeholders:** Canada, West

Concept Author: G. Kittel **LeadResp:** West

CES204.002 North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix, Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Temperate [Temperate Oceanic]; Tsuga heterophylla, Pseudotsuga menziesii
Concept Summary: This system is a significant component of the lowland and low montane forests of western Washington, northwestern Oregon, and southwestern British Columbia. It occurs throughout low-elevation western Washington, except on extremely dry sites and in the hypermaritime zone near the outer coast where it is rare. In Oregon it occurs on the western slopes of the Cascades, around the margins of the Willamette Valley, and on the west side of the Coast Ranges, and is reduced to locally small patches in southwestern Oregon. In British Columbia, it occurs on the eastern (leeward) side of Vancouver Island, commonly and rarely on the windward side, and in the southern Coast Ranges. These forests occur on moist habitats and microhabitats, mainly lower slopes or valley landforms, within the Western Hemlock Zone of the Pacific Northwest. They differ from North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest (CES204.001) primarily in having more hydrophilic undergrowth species, moist to subirrigated soils, high abundance of shade- and moisture-tolerant canopy trees, as well as higher stand productivity, due to higher soil moisture and lower fire frequency. Climate is relatively mild and moist to wet. Mean annual precipitation is mostly 90-254 cm (35-100 inches) (but as low as 20 inches in the extreme rainshadow) predominantly as winter rain. Snowfall ranges from rare to regular (but consistent winter snowpacks are absent or minimal), and summers are relatively dry. Elevation ranges from sea level to 610 m (2000 feet) in northern Washington to 1067 m (3500 feet) in Oregon. Topography ranges from relatively flat glacial tillplains to steep mountainous terrain. This is an extensive forest in the lowlands on the west side of the Cascades. In some wetter climatic areas, it forms the matrix within which other systems occur as patches, especially riparian wetlands. In many rather drier climatic areas, it occurs as small to large patches within a matrix of North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest (CES204.001); in dry areas, it can occur adjacent to or in a mosaic with North Pacific Dry Douglas-fir and Madrone Forest and Woodland (CES204.845) and at higher elevations intermingles with either North Pacific Dry-Mesic Silver Fir-Western Hemlock-Douglas-fir Forest (CES204.098) or North Pacific Mesic Western Hemlock-Silver Fir Forest (CES204.097).

Overstory canopy is dominated by *Pseudotsuga menziesii, Tsuga heterophylla*, and/or *Thuja plicata*, as well as *Chamaecyparis lawsoniana* in southwestern Oregon. *Pseudotsuga menziesii* is usually at least present to more typically codominant or dominant. *Acer* *macrophyllum* and *Alnus rubra* (the latter primarily where there has been historic logging disturbance) are commonly found as canopy or subcanopy codominants, especially at lower elevations. In a natural landscape, small patches can be dominated in the canopy by these broadleaf trees for several decades after a severe fire. *Polystichum munitum, Oxalis oregana, Rubus spectabilis*, and *Oplopanax horridus* typify the poorly to well-developed herb and shrub layers. *Gaultheria shallon, Mahonia nervosa, Rhododendron macrophyllum*, and *Vaccinium ovatum* are often present but are generally not as abundant as the aforementioned indicators; except where *Chamaecyparis lawsoniana* is a canopy codominant, they may be the dominant understory. *Acer circinatum* is a very common codominant as a tall shrub. Forested stands with abundant *Lysichiton americanus* , an indicator of seasonally flooded or saturated soils, belong in North Pacific Coniferous Swamp (CES204.867). Stands included are best represented on lower mountain slopes of the coastal ranges with high precipitation, long frost-free periods, and low fire frequencies. Young stands may lack *Tsuga heterophylla* or *Thuja plicata*, especially in the Puget Lowland. *Tsuga heterophylla* is generally the dominant regenerating tree species. Other common associates include *Abies grandis*, which can be a codominant especially in the Willamette Valley - Puget Trough - Georgia Basin ecoregion. Soils are moist to somewhat wet but not saturated for much of the year and are well-drained to somewhat poorly drained. Typical soils for *Polystichum* sites would be deep, fine- to moderately coarse-textured, and for *Oplopanax* sites, soils typically have an impermeable layer at a moderate depth. Both types of soils are well-watered from upslope sources, seeps, or hyperheic sources. This is in contrast to North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest (CES204.001), which occurs on well-drained soils, south-facing slopes, and dry ridges and slopes where soils remain mesic to dry for much of the year. Fire is (or was) the major natural disturbance in all but the wettest climatic areas. In the past (pre-1880), fires were high-severity or, less commonly, moderate-severity, with natural return intervals of a few hundred to several hundred years. This system was formerly supported by occasional, stand-replacing fires. More frequent moderate-severity fires would generally not burn these moister microsites.

DISTRIBUTION

Range: This system is a significant component of the lowland and low montane forests of western Washington, northwestern Oregon, and southwestern British Columbia.
Divisions: 204:C
TNC Ecoregions: 1:C, 3:C, 5:C, 69:C, 81:C
Subnations: BC, OR, WA

CONCEPT

Associations:

- *Abies concolor - Chamaecyparis lawsoniana - Pseudotsuga menziesii / (Mahonia nervosa) / Achlys triphylla* Forest (CEGL000041, G2)
- *Abies concolor - Chamaecyparis lawsoniana / Quercus sadleriana / Leucothoe davisiae - Rhododendron macrophyllum* Forest (CEGL000042, G2)
- *Abies grandis - Tsuga heterophylla / Polystichum munitum* Forest (CEGL000287, G2)
- *Acer macrophyllum / Acer circinatum* Forest (CEGL000560, G4G5)
- *Alnus rubra / Polystichum munitum* Forest (CEGL000638, G4)

- *Chamaecyparis lawsoniana - Picea sitchensis / Vaccinium ovatum - Rhododendron macrophyllum* Forest (CEGL000054, G1)
- *Chamaecyparis lawsoniana - Pseudotsuga menziesii / (Rhododendron macrophyllum) / Xerophyllum tenax* Forest (CEGL000044, G1)
- *Chamaecyparis lawsoniana - Pseudotsuga menziesii / Lithocarpus densiflorus / Gaultheria shallon* Forest (CEGL000043, G2)
- *Chamaecyparis lawsoniana - Tsuga heterophylla / Gaultheria shallon - Rhododendron macrophyllum* Forest (CEGL000045, G1)
- *Chamaecyparis lawsoniana - Tsuga heterophylla / Polystichum munitum* Forest (CEGL000046, G1)
- *Chamaecyparis lawsoniana / Vaccinium ovatum* Forest (CEGL000048, G1)
- *Pseudotsuga menziesii - Tsuga heterophylla / Polystichum munitum* Forest (CEGL000085, G3?)
- *Pseudotsuga menziesii / Acer circinatum* Forest (CEGL000417, G5?)
- *Pseudotsuga menziesii / Polystichum munitum* Forest (CEGL000450, G4G5Q)
- *Thuja plicata - Tsuga heterophylla / Oxalis oregana* Forest (CEGL000483, G2)
- *Thuja plicata / Gaultheria shallon* Forest (CEGL000475, G1G2)
- *Thuja plicata / Linnaea borealis* Forest (CEGL000089, G2)
- *Tsuga heterophylla - (Thuja plicata) / Oplopanax horridus / Polystichum munitum* Forest (CEGL000497, G4)
- *Tsuga heterophylla / Acer circinatum - Rubus spectabilis* Forest (CEGL000092, G3G4)
- *Tsuga heterophylla / Acer circinatum / Achlys triphylla* Forest (CEGL000090, G3G4)
- *Tsuga heterophylla / Gaultheria shallon - Rubus spectabilis* Forest (CEGL000102, G4)
- *Tsuga heterophylla / Oxalis oregana - Polystichum munitum* Forest (CEGL000106, G3)
- *Tsuga heterophylla / Polystichum munitum - Tiarella trifoliata* Forest (CEGL002627, G3)
- *Tsuga heterophylla / Polystichum munitum* Forest (CEGL000108, G4)
- *Tsuga heterophylla / Rubus spectabilis* Forest (CEGL000114, G4)
- *Tsuga heterophylla / Vaccinium ovalifolium* Forest (CEGL000118, G4)

Alliances:

- *Abies grandis* Giant Forest Alliance (A.114)
- *Acer macrophyllum* Forest Alliance (A.263)
- *Alnus rubra* Forest Alliance (A.264)
- *Chamaecyparis lawsoniana* Forest Alliance (A.104)
- *Pseudotsuga menziesii - Tsuga heterophylla* Forest Alliance (A.107)
- *Pseudotsuga menziesii* Forest Alliance (A.157)
- *Pseudotsuga menziesii* Giant Forest Alliance (A.108)
- *Thuja plicata* Giant Forest Alliance (A.111)
- *Tsuga heterophylla* Giant Forest Alliance (A.112)
- *Tsuga heterophylla* Seasonally Flooded Forest Alliance (A.185)
- *Tsuga heterophylla* Temporarily Flooded Forest Alliance (A.174)

Dynamics: Fire is (or was) the major natural disturbance in all but the wettest climatic areas. In the past (pre-1880), fires were high-severity or, less commonly, moderate-severity, with natural return intervals of a few hundred to several hundred years. This system was formerly supported by occasional, stand-replacing fires. More frequent moderate-severity fires would generally not burn these moister microsites.

SPATIAL CHARACTERISTICS

Adjacent Ecological System Comments: In some wetter climatic areas, it forms the matrix within which other systems occur as patches, especially riparian wetlands. In many rather drier climatic areas, it occurs as small to large patches within a matrix of North Pacific

Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest (CES204.001). In dry areas, it can occur adjacent to or in a mosaic with North Pacific Dry Douglas-fir Forest and Woodland (CES204.845) and at higher elevations intermingles with either North Pacific Dry-Mesic Silver Fir-Western Hemlock-Douglas-fir Forest (CES204.098) or North Pacific Mesic Western Hemlock-Silver Fir Forest (CES204.097).

SOURCES

References: Western Ecology Working Group n.d.
Version: 07 Feb 2005 **Stakeholders:** Canada, West
Concept Author: G. Kittel and C. Chappell**LeadResp:** West

CES204.097 North Pacific Mesic Western Hemlock-Silver Fir Forest

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Forest and Woodland
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Tsuga heterophylla - Abies amabilis
Concept Summary: This forested system occurs only in the Pacific Northwest mountains entirely west of the Cascade Crest from coastal British Columbia to Washington. It generally occurs in an elevational band between *Pseudotsuga menziesii - Tsuga heterophylla* or hypermaritime zone forests and *Tsuga mertensiana* forests. It dominates mid-montane maritime climatic zones on the windward side of Vancouver Island, the Olympic Peninsula, and wettest portions of the North Cascades in Washington (north of Snoqualmie River). Windthrow is a common small-scale disturbance in this system, and gap creation and succession are important processes. Stand-replacement fires are relatively infrequent to absent, with return intervals of several hundred or more years. A somewhat variable winter snowpack that typically lasts for 2-6 months is characteristic. The climatic zone within which it occurs is sometimes referred to as the "rain-on-snow" zone because of the common occurrence of major winter rainfall on an established snowpack. *Tsuga heterophylla* and/or *Abies amabilis* dominate the canopy of late-seral stands, and *Chamaecyparis nootkatensis* can be codominant, especially at higher elevations. *Thuja plicata* is also common and sometimes codominates in British Columbia. *Pseudotsuga menziesii* is relatively rare to absent in this system, as opposed to the similar but drier North Pacific Dry-Mesic Silver Fir-Western Hemlock-Douglas-fir Forest (CES204.098). The major understory dominant species is *Vaccinium ovalifolium*. Understory species that help distinguish this system from the drier silver fir system (they are much more common here) include *Oxalis oregana, Blechnum spicant*, and *Rubus pedatus*.
Comments: Jan Henderson suggests using 90 inches mean precipitation at sea level (with modification for topographic moisture) to distinguish wet and dry silver fir systems. Fire regime is significantly different at regional scale between the dry and mesic; this difference appears to be consistent throughout the range of the types. The mesic rarely, if ever, burns; it is dominated by what is sometimes called "old old-growth" stands that run from 700 to over

1000 years in age. Research in British Columbia indicates these coastal rainforests may burn an average of once every 2000 years. The major processes then are small-scale gap dynamics, not stand-replacement fires. This difference is related to climate, not site moisture, with the mesic having a very wet climate that is more coastal, less continental, with cooler summers, and warmer winters on average.

DISTRIBUTION

Range: This system occurs only in the Pacific Northwest mountains (Coastal and westside Cascadian). It occurs on the windward side of coastal mountains in both British Columbia and in the Olympic Mountains and north Cascade Range of Washington.
Divisions: 204:C
TNC Ecoregions: 1:C, 3:C, 69:C, 70:C, 81:C
Subnations: AK, BC, WA

CONCEPT

Associations:

- *Abies amabilis / Oplopanax horridus* Forest (CEGL000004, G5)
- *Abies amabilis / Oxalis oregana* Forest (CEGL000005, G4)
- *Abies amabilis / Polystichum munitum* Forest (CEGL000006, G4)
- *Abies amabilis / Vaccinium ovalifolium / Clintonia uniflora* Forest (CEGL000233, G5)
- *Abies amabilis / Vaccinium ovalifolium / Erythronium montanum* Forest (CEGL000234, G3)
- *Abies amabilis / Vaccinium ovalifolium / Tiarella trifoliata* Forest (CEGL000009, G4)
- *Abies amabilis / Vaccinium ovalifolium* Forest (CEGL000231, G4G5)

Alliances:

- *Abies amabilis* Giant Forest Alliance (A.102)
- *Abies amabilis* Seasonally Flooded Forest Alliance (A.187)

SPATIAL CHARACTERISTICS

SOURCES

References: DeMeo et al. 1992, DeVelice et al. 1999, Franklin and Dyrness 1973, Martin et al. 1995, Viereck et al. 1992, Western Ecology Working Group n.d.
Version: 30 Mar 2005 **Stakeholders:** Canada, West
Concept Author: G. Kittel, mod. C. Chappell **LeadResp:** West

CES204.838 North Pacific Mountain Hemlock Forest

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Forest and Woodland (Treed); Temperate [Temperate Oceanic]; Tsuga mertensiana
Concept Summary: This forested system occurs throughout the mountains of the North Pacific, from the southern Cascades of Oregon north to southeastern Alaska. It is the

predominant forest of subalpine elevations in the coastal mountains of British Columbia, southeastern Alaska, western Washington and western Oregon. Farther inland, *Tsuga mertensiana* becomes limited to the coldest and wettest pockets of the more continental subalpine fir forests, described from the Cascades and northern Rocky Mountains. In the northern Rocky Mountains of northern Idaho and Montana, this type occurs as small to large patches within a matrix of subalpine fir-Engelmann spruce forests only in the most maritime of environments. On the leeward side of the Cascades, this is usually a dense canopy composed of *Abies lasiocarpa* and *Tsuga mertensiana*, with some *Picea engelmannii* or *Abies amabilis*. These occur between 1275 and 1675 m elevation. It also occurs on mountain slopes on the outer coastal islands of British Columbia and Alaska. It lies between the Western Hemlock, Pacific Silver Fir, or Shasta Red Fir zones and the Subalpine Parkland or Alpine Tundra Zone, at elevations ranging from 300 to 2300 m (1000-7500 feet). The lower and upper elevation limits decrease from south to north and from east to west. The climate is generally characterized by short, cool summers, rainy autumns and long, cool, wet winters with heavy snow cover for 5-9 months. The heavy snowpack is ubiquitous, but at least in southern Oregon and perhaps the northern Rocky Mountains and eastern Cascades, summer drought is more significant. These more summer-dry climatic areas also have occasional high-severity fires, unlike the majority of the range of the system which experiences fires very rarely or never. *Tsuga mertensiana* and *Abies amabilis* are the characteristic dominant tree species over most of the range. *Abies amabilis* is absent from southern Oregon and the northern Rocky Mountains and less abundant than elsewhere in the central Oregon Cascades and the eastern slopes of the Cascades. *Chamaecyparis nootkatensis* is abundant in the more coastal portions, while *Abies lasiocarpa* is found inland and becomes increasingly common near the transition to the Subalpine Fir-Engelmann Spruce Zone. In the northern Rocky Mountains, this forest system is codominated by *Abies lasiocarpa* and/or *Picea engelmannii*. In the Cascades of central to southern Oregon, *Abies X shastensis* is typically present and often codominant. *Tsuga heterophylla* often occurs at lower elevations in this system but is much less abundant than *Tsuga mertensiana*. *Picea sitchensis* and *Thuja plicata* are occasionally present, especially on the outer coast of Alaska. Deciduous trees are rare. Parklands (open woodlands or sparse trees with dwarf-shrub or herbaceous vegetation) are not part of this system but of North Pacific Maritime Mesic Parkland (CES204.837).

DISTRIBUTION

Range: This system occurs throughout the mountains of the North Pacific, from the southern Cascades of Oregon north to southeastern Alaska.
Divisions: 204:C
TNC Ecoregions: 1:C, 3:C, 7:C, 69:C, 81:C
Subnations: AB, BC, ID, MT, OR, WA

CONCEPT

Associations:

- *Tsuga mertensiana - Abies amabilis / Caltha leptosepala* ssp. *howellii* Forest (CEGL000501, G3)
- *Tsuga mertensiana - Abies amabilis / Elliottia pyroliflorus* Woodland (CEGL000503, G3G4)
- *Tsuga mertensiana - Abies amabilis / Oplopanax horridus* Forest (CEGL000507, G3G4)
- *Tsuga mertensiana - Abies amabilis / Rhododendron albiflorum* Forest (CEGL002632, G5)

- *Tsuga mertensiana - Abies amabilis / Rhododendron macrophyllum* Forest (CEGL000124, G4)
- *Tsuga mertensiana - Abies amabilis / Rubus lasiococcus* Forest (CEGL000509, G3)
- *Tsuga mertensiana - Abies amabilis / Tiarella trifoliata* var. *unifoliata - Streptopus lanceolatus* Forest (CEGL000125, G3G4)
- *Tsuga mertensiana - Abies amabilis / Vaccinium membranaceum - Vaccinium ovalifolium* Forest (CEGL002620, G4G5)
- *Tsuga mertensiana - Abies amabilis / Vaccinium membranaceum - Valeriana sitchensis* Forest (CEGL002619, G4)
- *Tsuga mertensiana - Abies amabilis / Vaccinium membranaceum - Xerophyllum tenax* Forest (CEGL000515, G4)
- *Tsuga mertensiana - Abies amabilis / Vaccinium membranaceum* Forest (CEGL002618, G4?)
- *Tsuga mertensiana - Abies amabilis / Vaccinium ovalifolium - Clintonia uniflora* Forest (CEGL000512, G4G5)
- *Tsuga mertensiana - Abies amabilis / Vaccinium ovalifolium - Erythronium montanum* Forest (CEGL000513, G3G4)
- *Tsuga mertensiana - Abies amabilis / Vaccinium ovalifolium - Maianthemum dilatatum* Forest (CEGL002617, G3G4)
- *Tsuga mertensiana - Abies amabilis / Xerophyllum tenax* Forest (CEGL000500, G3)
- *Tsuga mertensiana - Chamaecyparis nootkatensis / Gaultheria shallon* Woodland (CEGL003214, G5)
- *Tsuga mertensiana - Chamaecyparis nootkatensis / Vaccinium ovalifolium* Forest (CEGL003208, G5)
- *Tsuga mertensiana / Chimaphila umbellata* Forest (CEGL000502, G4)
- *Tsuga mertensiana / Clintonia uniflora* Forest (CEGL000504, G3)
- *Tsuga mertensiana / Elliottia pyroliflorus* Woodland (CEGL003248, G4G5)
- *Tsuga mertensiana / Luzula glabrata* var. *hitchcockii* Forest (CEGL000505, G5)
- *Tsuga mertensiana / Menziesia ferruginea* Forest (CEGL000506, G4)
- *Tsuga mertensiana / Quercus sadleriana / Orthilia secunda* Forest (CEGL000123, G3G4)
- *Tsuga mertensiana / Rhododendron albiflorum* Forest (CEGL000508, GNR)
- *Tsuga mertensiana* / Sparse Understory Forest (CEGL008685, G3G4)
- *Tsuga mertensiana / Streptopus amplexifolius* Forest (CEGL000511, G2)
- *Tsuga mertensiana / Vaccinium membranaceum* Forest (CEGL000514, G4)
- *Tsuga mertensiana / Vaccinium ovalifolium / Caltha leptosepala* ssp. *howellii* Woodland (CEGL003247, G5)
- *Tsuga mertensiana / Vaccinium ovalifolium / Nephrophyllidium crista-galli* Woodland (CEGL003245, G5)
- *Tsuga mertensiana / Vaccinium ovalifolium* Forest (CEGL003244, G5)
- *Tsuga mertensiana / Vaccinium scoparium* Forest (CEGL000126, G4)
- *Tsuga mertensiana / Xerophyllum tenax* Forest (CEGL000516, G4)

Alliances:

- *Tsuga mertensiana - Abies amabilis* Forest Alliance (A.158)
- *Tsuga mertensiana - Abies amabilis* Giant Forest Alliance (A.113)
- *Tsuga mertensiana - Abies amabilis* Saturated Forest Alliance (A.207)
- *Tsuga mertensiana - Abies amabilis* Woodland Alliance (A.555)
- *Tsuga mertensiana* Forest Alliance (A.146)
- *Tsuga mertensiana* Seasonally Flooded Forest Alliance (A.186)
- *Tsuga mertensiana* Woodland Alliance (A.550)

Dynamics: Landfire VDDT models: R#ABAMup.

SPATIAL CHARACTERISTICS

SOURCES

References: Comer et al. 2003, Franklin 1988, Klinka and Chourmouzis 2002

Version: 31 Mar 2005 **Stakeholders:** Canada, West
Concept Author: G. Kittel and C. Chappell**LeadResp:** West

CES204.854 North Pacific Avalanche Chute Shrubland

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Montane]; Shrubland (Shrub-dominated); Avalanche
Concept Summary: This tall shrubland system occurs throughout mountainous regions of the Pacific Northwest, from the southern Cascades and Coast Ranges north to south-central Alaska. This system occurs on sideslopes of mountains on glacial till or colluvium. These habitats range from moderately xeric to wet and occur on snow avalanche chutes at montane elevations. In the mountains of Washington, talus sites and snow avalanche chutes very often coincide spatially. On the west side of the Cascades, the major dominant species are *Acer circinatum, Alnus viridis ssp. sinuata, Rubus parviflorus*, and small trees, especially *Chamaecyparis nootkatensis*. Forbs, grasses, or other shrubs can also be locally dominant. *Prunus virginiana, Amelanchier alnifolia, Vaccinium membranaceum* or *Vaccinium scoparium*, and *Fragaria* spp. are common species on drier avalanche tracks on the east side of the Cascades (Ecosystems Working Group 1998). The main feature of this system is that it occurs on steep, frequently disturbed (snow avalanches) slopes. Avalanche chutes can be quite long, extending from the subalpine into the montane and foothill toeslopes.

DISTRIBUTION

Range: This system occurs throughout mountainous regions of the Pacific Northwest, from the southern Cascades and Coast Ranges north to south-central Alaska.
Divisions: 204:C
TNC Ecoregions: 1:C, 3:C, 4:C, 69:C, 70:C, 81:C
Subnations: AK, BC, OR, WA

CONCEPT

Associations:

- *Alnus viridis* ssp. *sinuata / Acer circinatum* Shrubland (CEGL001155, G4G5)
- *Chamaecyparis nootkatensis / Oplopanax horridus* Forest (CEGL000349, G3)

Alliances:

- *Alnus viridis* ssp. *sinuata* Temporarily Flooded Shrubland Alliance (A.966)
- *Chamaecyparis nootkatensis* Temporarily Flooded Forest Alliance (A.178)

SPATIAL CHARACTERISTICS

SOURCES

References: Boggs 2000, Comer et al. 2003, Ecosystems Working Group 1998, Franklin and Dyrness 1973, Viereck et al. 1992
Version: 31 Mar 2005 **Stakeholders:** Canada, West

Concept Author: K. Boggs and G. Kittel **LeadResp:** West

CES204.862 North Pacific Dry and Mesic Alpine Dwarf-Shrubland, Fell-field and Meadow ** NOT MAPPED **

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Alpine/AltiAndino [Alpine/AltiAndino]; Shrubland (Shrub-dominated)
Concept Summary: This system occurs above the environmental limit of trees, at the highest elevations of the mountain regions of the Pacific Northwest Coast. It is confined to the coldest, wind-blown areas above treeline and above the subalpine parkland. This system is found at elevations above 2350 m (7200 feet) in the Klamath Mountains and Cascades north into the Cascade and Coastal mountains of British Columbia. It is commonly comprised of a mosaic of plant communities with characteristic species including *Cassiope mertensiana, Phyllodoce empetriformis, Phyllodoce glanduliflora, Luetkea pectinata, Saxifraga tolmiei*, and *Carex* spp. It occurs on slopes and depressions where snow lingers, the soil has become relatively stabilized, and the water supply is more or less constant. Vegetation in these areas is controlled by snow retention, wind desiccation, permafrost, and a short growing season. This system includes all vegetated areas in the alpine zone of the North Pacific. Typically it is a mosaic of dwarf-shrublands, fell-fields, tundra (sedge turfs), and sparsely vegetated snowbed communities. Small patches of krummholz (shrub-form trees) are also part of this system and occur at the lower elevations. Communities are dominated by graminoids, foliose lichens, dwarf-shrubs, and/or forbs. Vegetation cover ranges from about 5 or 10% (snowbeds) to nearly 100%. The alpine tundra of the northern Cascades has floristic affinities with many mountain regions in western North America. The strongest relationships are with the Arctic and Cordilleran regions to the north and east.

DISTRIBUTION

Range: This system occurs above the environmental limit of trees, at the highest elevations of the mountain regions of the Pacific Northwest Coast.
Divisions: 204:C
TNC Ecoregions: 1:C, 3:C, 69:C, 70:C, 81:C
Subnations: AK, BC, OR, WA

CONCEPT

Associations:

- *Antennaria lanata* Herbaceous Vegetation (CEGL001949, G4)
- *Arabis lyallii - Packera cana* Herbaceous Vegetation (CEGL001950, G3?)
- *Arctostaphylos uva-ursi* Dwarf-shrubland (CEGL001392, G3G4)
- *Calamagrostis purpurascens* Herbaceous Vegetation (CEGL001850, G2)

- *Carex breweri* Herbaceous Vegetation (CEGL001805, G3?)
- *Carex capitata* Herbaceous Vegetation (CEGL001807, G3?)
- *Carex nardina* Scree Herbaceous Vegetation (CEGL001812, GNR)
- *Carex pellita* Herbaceous Vegetation (CEGL001809, G3)
- *Carex proposita* Herbaceous Vegetation (CEGL001859, G3?)
- *Carex scirpoidea* ssp. *pseudoscirpoidea* Herbaceous Vegetation (CEGL001865, G3?)
- *Cassiope mertensiana - Phyllodoce empetriformis* Dwarf-shrubland (CEGL001398, G5)
- *Cassiope mertensiana / Luetkea pectinata* Dwarf-shrubland (CEGL001397, G3G4)
- *Cassiope mertensiana* Dwarf-shrubland (CEGL001395, G3G4)
- *Dryas octopetala* Dwarf-shrub Herbaceous Vegetation (CEGL001891, G3?)
- *Empetrum nigrum / Lupinus sellulus* var. *lobbii* Dwarf-shrubland (CEGL001400, G3G4)
- *Empetrum nigrum* Dwarf-shrubland (CEGL001399, G3G4)
- *Erigeron aureus - Lupinus sellulus* var. *lobbii* Herbaceous Vegetation (CEGL001961, G3G4)
- *Eriogonum pyrolifolium - Luzula piperi* Herbaceous Vegetation (CEGL001963, G4)
- *Festuca roemeri - Phlox diffusa* ssp. *longistylis* Herbaceous Vegetation (CEGL001622, G2)
- *Pedicularis contorta - Carex spectabilis* Herbaceous Vegetation (CEGL001977, G3?)
- *Phlox diffusa* ssp. *longistylis - Arenaria capillaris* Herbaceous Vegetation (CEGL001978, G3?)
- *Phlox diffusa* ssp. *longistylis - Carex spectabilis* Herbaceous Vegetation (CEGL001979, GNR)
- *Phyllodoce glanduliflora / Oreostemma alpigenum* Dwarf-shrubland (CEGL001408, G3G4)
- *Salix cascadensis / Festuca brachyphylla* Dwarf-shrubland (CEGL001433, G3G4)
- *Salix nivalis / Festuca brachyphylla* Dwarf-shrubland (CEGL001434, G3G4)
- *Saxifraga tolmiei - Luzula piperi* Herbaceous Vegetation (CEGL001986, G4)

Alliances:

- *Antennaria lanata* Herbaceous Alliance (A.1640)
- *Arabis lyallii* Herbaceous Alliance (A.1641)
- *Arctostaphylos uva-ursi* Dwarf-shrubland Alliance (A.1079)
- *Calamagrostis purpurascens* Herbaceous Alliance (A.1301)
- *Carex breweri* Herbaceous Alliance (A.1296)
- *Carex capitata* Herbaceous Alliance (A.1297)
- *Carex nardina* Herbaceous Alliance (A.1299)
- *Carex pellita* Seasonally Flooded Herbaceous Alliance (A.1414)
- *Carex proposita* Herbaceous Alliance (A.1305)
- *Carex scirpoidea* ssp. *pseudoscirpoidea* Herbaceous Alliance (A.1306)
- *Cassiope mertensiana* Dwarf-shrubland Alliance (A.1081)
- *Dryas octopetala* Dwarf-shrub Herbaceous Alliance (A.1577)
- *Empetrum nigrum* Dwarf-shrubland Alliance (A.1078)
- *Erigeron aureus* Herbaceous Alliance (A.1643)
- *Eriogonum pyrolifolium* Herbaceous Alliance (A.1644)
- *Festuca idahoensis* Alpine Herbaceous Alliance (A.1313)
- *Pedicularis contorta* Herbaceous Alliance (A.1649)
- *Phlox diffusa* Herbaceous Alliance (A.1650)
- *Phyllodoce glanduliflora* Dwarf-shrubland Alliance (A.1084)
- *Salix (reticulata, nivalis)* Dwarf-shrubland Alliance (A.1119)
- *Salix cascadensis* Dwarf-shrubland Alliance (A.1118)
- *Saxifraga tolmiei* Herbaceous Alliance (A.1653)

Dynamics: Landfire VDDT models: #RALME includes this and Rocky Mountain alpine systems.

SPATIAL CHARACTERISTICS

SOURCES

References: Comer et al. 2003, Ecosystems Working Group 1998, Franklin and Dyrness 1973, Holland and Keil 1995, Viereck et al. 1992
Version: 31 Mar 2005 **Stakeholders:** Canada, West
Concept Author: K. Boggs, C. Chappell, R. Crawford **LeadResp:** West

CES204.087 North Pacific Montane Shrubland ** NOT MAPPED **

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Shrubland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Shrubland (Shrub-dominated)
Concept Summary: This system occurs as small to large patches scattered throughout the North Pacific region, but it is largely absent from the windward sides of the coastal mountains where fires are rare due to very wet climates. It is defined as long-lived seral shrublands that persist for several decades or more after major wildfires, or smaller patches of shrubland on dry sites that are marginal for tree growth and that have typically also experienced fire. This system occurs on ridgetops and upper to middle mountain slopes and is more common on sunny southern aspects. It occurs from about 152 m (500 feet) elevation up to the lower limits of subalpine parkland. Vegetation is mostly deciduous broadleaf shrubs, sometimes mixed with shrub-stature trees or sparse evergreen needleleaf trees. It can also be dominated by evergreen shrubs, especially *Xerophyllum tenax* (usually considered a forb). Species composition is highly variable, and some of most common species include *Acer circinatum, Vaccinium membranaceum, Ceanothus velutinus, Holodiscus discolor*, and *Rubus parviflorus*.

DISTRIBUTION

Range: This system occurs as small to large patches scattered throughout mountainous regions of the Pacific Northwest, from the southern Cascade and Coast ranges north to south-central Alaska.
Divisions: 204:C
TNC Ecoregions: 1:C, 3:C, 4:C, 69:C, 70:C, 81:C
Subnations: AK, BC, OR, WA

CONCEPT

Associations:

- *Acer circinatum / Athyrium filix-femina - Tolmiea menziesii* Shrubland (CEGL003291, G5)
- *Amelanchier alnifolia / Xerophyllum tenax* Herbaceous Vegetation (CEGL001066, GNRQ)
- *Rubus parviflorus / Chamerion angustifolium - Heracleum maximum* Shrubland (CEGL001127, G4)
- *Vaccinium membranaceum / Xerophyllum tenax* Shrubland (CEGL005891, G3?)
- *Xerophyllum tenax - Sanguisorba officinalis* Herbaceous Vegetation (CEGL003439, G1)

Alliances:

- *Acer circinatum* Shrubland Alliance (A.2600)
- *Rubus parviflorus* Shrubland Alliance (A.931)
- *Vaccinium membranaceum* Shrubland Alliance (A.2632)
- *Xerophyllum tenax* Herbaceous Alliance (A.1600)

SPATIAL CHARACTERISTICS

SOURCES

References: Chappell and Christy 2004, Franklin and Dyrness 1973, Western Ecology Working Group n.d.
Version: 08 Feb 2005 **Stakeholders:** Canada, West
Concept Author: C. Chappell **LeadResp:** West

CES204.099 North Pacific Alpine and Subalpine Dry Grassland ** NOT MAPPED **

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Alpine/AltiAndino [Alpine/AltiAndino]; Montane [Upper Montane]; Herbaceous; Deep Soil; Ustic; Intermediate Disturbance Interval; Graminoid; Tussock-forming grasses
Concept Summary: This high-elevation, grassland system is dominated by perennial grasses and forbs found on dry sites, particularly south-facing slopes, typically imbedded in or above subalpine forests and woodlands. Disturbance such as fire also plays a role in maintaining these open grassy areas, although drought and exposed site locations are primary characteristics limiting tree growth. It is most extensive in the eastern Cascades, although it also occurs in the Olympic Mountains. Alpine and subalpine dry grasslands are small openings to large open ridges above or drier than high-elevation conifer trees. In general, soil textures are much finer, and soils are often deeper under grasslands than in the neighboring forests. These grasslands, although composed primarily of tussock-forming species, do exhibit a dense sod that makes root penetration difficult for tree species. Typical dominant species include *Festuca idahoensis, Festuca viridula*, and *Festuca roemeri* (the latter species occurring only in the Olympic Mountains). This system is similar to Northern Rocky Mountain Subalpine Dry Grassland (CES306.806), differing in its including dry alpine habitats, more North Pacific floristic elements, greater snowpack, and higher precipitation.

DISTRIBUTION

Range: This system occurs only in the Pacific Northwest mountains (Coastal and westside Cascadian).
Divisions: 204:C, 306:C
TNC Ecoregions: 1:C, 3:C, 4:C, 81:C

Subnations: BC?, OR?, WA

CONCEPT

Associations:
- *Festuca roemeri - Phlox diffusa* ssp. *longistylis* Herbaceous Vegetation (CEGL001622, G2)
- *Festuca viridula - Eucephalus ledophyllus* Herbaceous Vegetation (CEGL001632, G4)
- *Festuca viridula - Festuca idahoensis* Herbaceous Vegetation (CEGL001633, G2?Q)
- *Festuca viridula - Lupinus latifolius* Herbaceous Vegetation (CEGL001635, G4)

Alliances:
- *Festuca idahoensis* Alpine Herbaceous Alliance (A.1313)
- *Festuca viridula* Herbaceous Alliance (A.1257)

SPATIAL CHARACTERISTICS

SOURCES

References: Ecosystems Working Group 1998, Western Ecology Working Group n.d.
Version: 31 Mar 2005 **Stakeholders:** Canada, West
Concept Author: R. Crawford **LeadResp:** West

CES204.089 North Pacific Herbaceous Bald and Bluff ** NOT MAPPED **

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Small patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Herbaceous; Bluff; Ridge/Summit/Upper Slope
Concept Summary: This system consists of mostly herbaceous-dominated areas located primarily on shallow soils from eastern Vancouver Island and the Georgia Basin south to at least the southern end of the Willamette Valley and adjacent slopes of the Coast Ranges and western Cascades, excluding areas adjacent to the outer coastline (hypermaritime climate). They are largely, if not completely, absent from the windward side of Vancouver Island, the Olympic Peninsula, and the Coast Ranges of Washington and Oregon. Due to shallow soils, steep slopes, sunny aspect, and/or upper slope position, these sites are dry and marginal for tree establishment and growth except in favorable microsites. Rock outcrops are a typical small-scale feature within balds and are considered part of this system. Sites with many favorable microsites can have a "savanna" type structure with a sparse tree layer of *Pseudotsuga menziesii* or, less commonly, *Quercus garryana*. The climate is relatively dry to wet (20 to perhaps 100 inches annual precipitation), always with a distinct dry summer season when these sites usually become droughty enough to limit tree growth and establishment. Seeps are a frequent feature in many balds and result in vernally moist to wet areas within the balds that dry out by summer. Vegetation differences are associated with relative differences in soil moisture. Most sites have little snowfall, but sites in the *Abies amabilis* zone (montane *Tsuga heterophylla* in British Columbia) can have significant winter

snowpacks. Snowpacks would be expected to melt off sooner on these sunny aspect sites than surrounding areas. Fog and salt spray probably have some influence (but less than in the hypermaritime) on exposed slopes or bluffs adjacent to saltwater shorelines in the Georgia Basin, where soils on steep coastal bluffs sometime deviate from the norm and are deep glacial deposits. Slightly to moderately altered serpentine soils occur rarely. Fires, both lightning-ignited and those ignited by Native Americans, undoubtedly at least occasionally burn all these sites. Lower elevation sites in the Georgia Basin, Puget Trough, and Willamette Valley probably were burned somewhat more frequently and in some cases intentionally. Because of this fire history, the extent of this system has declined locally through tree invasion and growth, as areas formerly maintained herbaceous by burning have filled in with trees.

Grasslands are the most prevalent vegetation cover, though forblands are also common especially in the mountains. Dwarf-shrublands occur commonly, especially in mountains or foothills, as very small patches for the most part, usually in a matrix of herbaceous vegetation, most often near edges. Dominant or codominant native grasses include *Festuca roemeri, Danthonia californica, Achnatherum lemmonii, Festuca rubra* (near saltwater), and *Koeleria macrantha*. Forb diversity can be high. Some typical codominant forbs include *Camassia quamash, Camassia leichtlinii, Triteleia hyacinthina, Mimulus guttatus* (seeps), *Plectritis congesta, Lomatium martindalei, Allium cernuum*, and *Phlox diffusa* (can be considered a dwarf-shrub). Important dwarf-shrubs are *Arctostaphylos uva-ursi, Arctostaphylos nevadensis*, and *Juniperus communis*. Small patches and strips dominated by the shrub *Arctostaphylos columbiana* are a common feature nested within herbaceous balds. Significant portions of some balds, especially on rock outcrops, are dominated by bryophytes (mosses) and to a lesser degree lichens.

DISTRIBUTION

Range: This system occurs in the Willamette Valley, Puget Trough, Georgia Basin, eastern and northern Olympic Mountains, eastern side of Vancouver Island, western and northwestern Cascades of Washington, probably on the leeward side of the Coast Mountains in British Columbia (submaritime climates)?, Old Cascades of western Oregon, and Oregon Coast Ranges (but not the coast itself).
Divisions: 204:C
TNC Ecoregions: 1:C, 2:C, 3:P, 81:C
Subnations: BC, OR, WA

CONCEPT

Associations:

- *Achnatherum lemmonii / Racomitrium canescens* Herbaceous Vegetation (CEGL001800, G1)
- *Danthonia californica* Valley Grassland Herbaceous Vegetation (CEGL001598, G1Q)
- *Festuca roemeri - Cerastium arvense - Koeleria macrantha* Herbaceous Vegetation (CEGL003349, G1)
- *Festuca rubra - (Camassia leichtlinii, Grindelia stricta* var. *stricta)* Herbaceous Vegetation (CEGL003347, G1)
- *Lomatium martindalei* Herbaceous Vegetation (CEGL001972, G2)

Alliances:

- *Achnatherum lemmonii* Herbaceous Alliance (A.1292)
- *Danthonia californica* Herbaceous Alliance (A.1254)
- *Festuca roemeri* Herbaceous Alliance (A.2503)
- *Festuca rubra* Herbaceous Alliance (A.1236)
- *Lomatium martindalei* Herbaceous Alliance (A.1647)

SPATIAL CHARACTERISTICS

SOURCES

References: Chappell and Christy 2004, Franklin and Dyrness 1973, Western Ecology Working Group n.d.
Version: 04 Apr 2005 **Stakeholders:** Canada, West
Concept Author: C. Chappell **LeadResp:** West

CES204.100 North Pacific Montane Grassland ** NOT MAPPED **

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Herbaceous; Temperate [Temperate Oceanic]; Mesotrophic Soil; Shallow Soil; Intermediate Disturbance Interval; F-Patch/Low Intensity
Concept Summary: This system includes open dry meadows and grasslands on the west side of the Cascades Mountains and northern Sierra Nevada. They occur in montane elevations up to 3500 m (10,600 feet). Soils tend to be deeper and more well-drained than the surrounding forest soils. Soils can resemble prairie soils in that the A-horizon is dark brown, relatively high in organic matter, slightly acid, and usually well-drained. Dominant species include *Elymus* spp., *Festuca idahoensis*, and *Nassella cernua*. These large-patch grasslands are intermixed with matrix stands of red fir, lodgepole pine, and dry-mesic mixed conifer forests and woodlands.
Comments: Upon review, Washington Heritage ecologists determined this system does not occur in Washington.

DISTRIBUTION

Range: West side of the Cascades Mountains and northern Sierra Nevada, in montane elevations up to 3500 m (10,600 feet).
Divisions: 204:C, 206:C
TNC Ecoregions: 5:P, 12:C, 81:C
Subnations: CA, NV, OR

CONCEPT

Associations:
Alliances:

SPATIAL CHARACTERISTICS

SOURCES

References: Barbour and Major 1988, Comer et al. 2003, Holland and Keil 1995, Sawyer and Keeler-Wolf 1995
Version: 24 Mar 2003 **Stakeholders:** West
Concept Author: P. Comer, G. Kittel **LeadResp:** West

CES204.090 North Pacific Hardwood-Conifer Swamp

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)
Diagnostic Classifiers: Lowland [Lowland]; Forest and Woodland (Treed); Temperate [Temperate Oceanic]; Depressional [Lakeshore]; Needle-Leaved Tree; Broad-Leaved Deciduous Tree; Pinus contorta; Sphagnum spp.; Eutrophic Water
Concept Summary: This wetland system occurs from south coastal Alaska to coastal Washington and Oregon, west of the coastal mountain summits (not interior). They are quite abundant in southeastern Alaska, less so farther south. Forested swamps are mostly small-patch size, occurring sporadically in glacial depressions, in river valleys, around the edges of lakes and marshes, or on slopes with seeps that form subirrigated soils. These are primarily on flat to gently sloping lowlands up to 457 m (1500 feet) elevation but also occur up to near the lower limits of continuous forest (below the subalpine parkland). It can occur on steeper slopes where soils are shallow over unfractured bedrock. This system is indicative of poorly drained, mucky areas, and areas are often a mosaic of moving water and stagnant water. Soils can be woody peat, muck, or mineral. It can be dominated by any one or a number of conifer and hardwood species (*Tsuga heterophylla, Picea sitchensis, Tsuga mertensiana, Chamaecyparis nootkatensis, Pinus contorta var. contorta, Alnus rubra, Fraxinus latifolia, Betula papyrifera*) that are capable of growing on saturated or seasonally flooded soils. Overstory is often less than 50% cover, but shrub understory can have high cover. The southern end of the range of this type, e.g., the Willamette Valley, tends to have more hardwood-dominated stands (especially *Fraxinus latifolia*) and very little in the way of conifer-dominated stands. While the typical landscape context for the type is extensive upland forests, for the *Fraxinus latifolia* stands, landscapes were very often formerly dominated by prairies and now by agriculture. Many conifer-dominated stands have been converted to dominance by *Alnus rubra* due to timber harvest.
Comments: Shrub swamps are usually not intermixed with the forested swamps and tend to be more wet. Deciduous and conifer forested swamps are often intermixed and more similar to each other in hydrology, and so are combined here in this system.

DISTRIBUTION

Range: This system occurs from south coastal Alaska south to northwestern Oregon, including the Willamette Valley, west of the Cascade Crest.
Divisions: 204:C
TNC Ecoregions: 1:C, 2:C, 3:C, 69:C, 81:C
Subnations: AK, BC, OR, WA

CONCEPT

Associations:

- *Abies amabilis / Lysichiton americanus* Forest (CEGL000223, G3)
- *Alnus rubra / Athyrium filix-femina - Lysichiton americanus* Forest (CEGL003388, G3G4)
- *Alnus rubra / Rubus spectabilis / Carex obnupta - Lysichiton americanus* Forest (CEGL003389, G3G4)
- *Fraxinus latifolia - (Populus balsamifera* ssp. *trichocarpa) / Cornus sericea* Forest (CEGL003390, G4)
- *Fraxinus latifolia / Carex deweyana - Urtica dioica* Forest (CEGL003365, G1)
- *Fraxinus latifolia / Carex obnupta* Forest (CEGL000640, G4)
- *Fraxinus latifolia / Juncus patens* Forest (CEGL003391, G2)
- *Fraxinus latifolia / Spiraea douglasii* Forest (CEGL003392, G3)
- *Fraxinus latifolia / Symphoricarpos albus* Forest (CEGL003393, G4)
- *Picea sitchensis / Carex obnupta - Lysichiton americanus* Forest (CEGL000400, G2G3)
- *Picea sitchensis / Cornus sericea / Lysichiton americanus* Forest (CEGL000055, G2)
- *Picea sitchensis / Oplopanax horridus / Lysichiton americanus* Forest (CEGL003257, G4)
- *Picea sitchensis / Vaccinium ovalifolium / Lysichiton americanus* Forest (CEGL003265, G5)
- *Pinus contorta* (var. *latifolia*, var. *murrayana*) / *Vaccinium uliginosum* Forest (CEGL000171, G3)
- *Pinus contorta - (Populus tremuloides) / Vaccinium uliginosum* Forest (CEGL000158, G3Q)
- *Pinus contorta / Carex (aquatilis, angustata)* Woodland (CEGL000140, G4Q)
- *Pinus contorta / Deschampsia caespitosa* Forest (CEGL000147, G3)
- *Pinus contorta / Empetrum nigrum* Woodland (CEGL003202, G5)
- *Pinus contorta* var. *murrayana - Populus tremuloides / Spiraea douglasii* Forest (CEGL000157, G3G4)
- *Populus balsamifera* ssp. *trichocarpa - Alnus rubra / Carex obnupta* Woodland (CEGL003361, G2)
- *Populus tremuloides / Carex obnupta* Forest (CEGL003371, G2)
- *Thuja plicata - Tsuga heterophylla / Lysichiton americanus* Forest (CEGL002670, G3?)
- *Tsuga heterophylla - Chamaecyparis nootkatensis / Vaccinium ovalifolium / Lysichiton americanus* Forest (CEGL003240, G5)
- *Tsuga heterophylla - Thuja plicata / Vaccinium ovalifolium / Lysichiton americanus* Forest (CEGL003223, G5)
- *Tsuga heterophylla / Oplopanax horridus / Lysichiton americanus* Forest (CEGL003235, G4G5)
- *Tsuga mertensiana - Chamaecyparis nootkatensis / Elliottia pyroliflorus / Nephrophyllidium crista-galli* Woodland (CEGL003215, G4)
- *Tsuga mertensiana - Chamaecyparis nootkatensis / Gaultheria shallon / Lysichiton americanus* Woodland (CEGL003213, G5)
- *Tsuga mertensiana - Chamaecyparis nootkatensis / Lysichiton americanus - Athyrium filix-femina* Forest (CEGL003216, G3G4)
- *Tsuga mertensiana - Chamaecyparis nootkatensis / Vaccinium ovalifolium / Lysichiton americanus* Forest (CEGL003209, G5)

Alliances:

- *Abies amabilis* Seasonally Flooded Forest Alliance (A.187)
- *Alnus rubra* Seasonally Flooded Forest Alliance (A.342)
- *Fraxinus latifolia* Seasonally Flooded Forest Alliance (A.343)

- *Picea sitchensis* Saturated Forest Alliance (A.205)
- *Picea sitchensis* Seasonally Flooded Forest Alliance (A.182)
- *Picea sitchensis* Temporarily Flooded Forest Alliance (A.169)
- *Pinus contorta - Populus tremuloides* Seasonally Flooded Forest Alliance (A.440)
- *Pinus contorta* Saturated Woodland Alliance (A.577)
- *Pinus contorta* Seasonally Flooded Forest Alliance (A.188)
- *Pinus contorta* Temporarily Flooded Forest Alliance (A.175)
- *Pinus contorta* Temporarily Flooded Woodland Alliance (A.562)
- *Populus balsamifera* ssp. *trichocarpa* Temporarily Flooded Woodland Alliance (A.635)
- *Populus tremuloides* Seasonally Flooded Forest Alliance (A.340)
- *Tsuga heterophylla* Saturated Forest Alliance (A.203)
- *Tsuga heterophylla* Seasonally Flooded Forest Alliance (A.185)
- *Tsuga mertensiana* Seasonally Flooded Forest Alliance (A.186)
- *Tsuga mertensiana* Seasonally Flooded Woodland Alliance (A.570)

SPATIAL CHARACTERISTICS

SOURCES

References: Banner et al. 1993, Chappell 1999, Chappell and Christy 2004, Chappell et al. 2001, DeMeo et al. 1992, DeVelice et al. 1999, Green and Klinka 1994, Martin et al. 1995, Shephard 1995, Western Ecology Working Group n.d.
Version: 09 Feb 2005 **Stakeholders:** Canada, West
Concept Author: K. Boggs, G. Kittel, C. Chappell **LeadResp:** West

CES204.869 North Pacific Lowland Riparian Forest and Shrubland

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)
Diagnostic Classifiers: Lowland [Lowland]; Forest and Woodland (Treed); Riverine / Alluvial
Concept Summary: Lowland riparian systems occur throughout the Pacific Northwest. They are the low-elevation, alluvial floodplains that are confined by valleys and inlets and are more abundant in the central and southern portions of the Pacific Northwest Coast. These forests and tall shrublands are linear in character, occurring on floodplains or lower terraces of rivers and streams. Major broadleaf dominant species are *Acer macrophyllum, Alnus rubra, Populus balsamifera ssp. trichocarpa, Salix sitchensis, Salix lucida ssp. lasiandra, Cornus sericea*, and *Fraxinus latifolia*. Conifers tend to increase with succession in the absence of major disturbance. Conifer-dominated types are relatively uncommon and not well-described; *Abies grandis, Picea sitchensis*, and *Thuja plicata* are important. Riverine flooding and the succession that occurs after major flooding events are the major natural processes that drive this system. Very early-successional stages can be sparsely vegetated or dominated by herbaceous vegetation.

DISTRIBUTION

Range: This system occurs throughout the Pacific Northwest elevationally below the Silver Fir Zone.
Divisions: 204:C
TNC Ecoregions: 1:C, 69:C, 81:C
Subnations: AK, BC, OR, WA

CONCEPT

Associations:

- *Abies grandis - Acer macrophyllum / Symphoricarpos albus* Forest (CEGL000519, G3Q)
- *Acer circinatum / Athyrium filix-femina - Tolmiea menziesii* Shrubland (CEGL003291, G5)
- *Acer macrophyllum - Pseudotsuga menziesii / Acer circinatum / Polystichum munitum* Forest (CEGL003394, G4)
- *Acer macrophyllum - Pseudotsuga menziesii / Corylus cornuta / Hydrophyllum tenuipes* Forest (CEGL000517, G3)
- *Acer macrophyllum / Acer circinatum* Forest (CEGL000560, G4G5)
- *Acer macrophyllum / Carex deweyana* Forest (CEGL003297, G3)
- *Acer macrophyllum / Rubus spectabilis* Forest (CEGL000561, G4)
- *Acer macrophyllum / Rubus ursinus* Forest (CEGL003395, G3)
- *Acer macrophyllum / Symphoricarpos albus / Urtica dioica* ssp. *gracilis* Forest (CEGL003396, G3)
- *Acer macrophyllum / Urtica dioica* ssp. *gracilis* Forest (CEGL003397, G3)
- *Alnus (incana, viridis* ssp. *sinuata) / Lysichiton americanus - Oenanthe sarmentosa* Shrubland (CEGL003293, G1)
- *Alnus rubra / Acer circinatum / Claytonia sibirica* Forest (CEGL003298, G4G5)
- *Alnus rubra / Elymus glaucus* Forest (CEGL003398, G4)
- *Alnus rubra / Oplopanax horridus - Rubus spectabilis* Forest (CEGL003399, G4G5)
- *Alnus rubra / Oxalis (oregana, trilliifolia)* Forest (CEGL003400, G4)
- *Alnus rubra / Petasites frigidus* Forest (CEGL003401, G4)
- *Alnus rubra / Rubus parviflorus* Forest (CEGL003402, G4)
- *Alnus rubra / Rubus spectabilis / Carex obnupta - Lysichiton americanus* Forest (CEGL003389, G3G4)
- *Alnus rubra / Rubus spectabilis* Forest (CEGL000639, G4G5)
- *Alnus rubra / Stachys chamissonis* var. *cooleyae - Tolmiea menziesii* Forest (CEGL003403, G4)
- *Cornus sericea - Salix (hookeriana, sitchensis)* Shrubland (CEGL003292, G3)
- *Cornus sericea* Shrubland (CEGL001165, G4Q)
- *Corydalis scouleri* Herbaceous Vegetation (CEGL001939, G3?Q)
- *Equisetum arvense* Herbaceous Vegetation (CEGL003314, G5)
- *Fraxinus latifolia - (Populus balsamifera* ssp. *trichocarpa) / Cornus sericea* Forest (CEGL003390, G4)
- *Fraxinus latifolia - Populus balsamifera* ssp. *trichocarpa / Acer circinatum* Forest (CEGL003404, G3)
- *Fraxinus latifolia - Populus balsamifera* ssp. *trichocarpa / Corylus cornuta - Physocarpus capitatus* Forest (CEGL003364, G3)
- *Fraxinus latifolia - Populus balsamifera* ssp. *trichocarpa / Rubus spectabilis* Forest (CEGL003405, G2)
- *Fraxinus latifolia - Populus balsamifera* ssp. *trichocarpa / Symphoricarpos albus* Forest (CEGL000641, G4)
- *Fraxinus latifolia / Carex deweyana - Urtica dioica* Forest (CEGL003365, G1)
- *Fraxinus latifolia / Carex obnupta* Forest (CEGL000640, G4)
- *Fraxinus latifolia / Symphoricarpos albus* Forest (CEGL003393, G4)
- *Picea sitchensis - Alnus rubra / Rubus spectabilis* Woodland (CEGL003253, G3)
- *Picea sitchensis - Populus balsamifera* ssp. *trichocarpa / Oplopanax horridus* Forest (CEGL003278, G3)
- *Picea sitchensis / Alnus viridis* ssp. *sinuata* Woodland (CEGL003254, G5)

- *Picea sitchensis / Carex obnupta - Lysichiton americanus* Forest (CEGL000400, G2G3)
- *Picea sitchensis / Oplopanax horridus - Rubus spectabilis* Forest (CEGL003256, G4)
- *Picea sitchensis / Oplopanax horridus* Temporarily Flooded Forest (CEGL003258, G5)
- *Populus balsamifera* (ssp. *trichocarpa*, ssp. *balsamifera*) / *Symphoricarpos (albus, oreophilus, occidentalis)* Forest (CEGL000677, G2)
- *Populus balsamifera* ssp. *trichocarpa - Acer macrophyllum / Equisetum hyemale* Forest (CEGL003406, G3)
- *Populus balsamifera* ssp. *trichocarpa - Acer macrophyllum / Symphoricarpos albus* Forest (CEGL003363, G3)
- *Populus balsamifera* ssp. *trichocarpa - Alnus rhombifolia* Forest (CEGL000668, G1)
- *Populus balsamifera* ssp. *trichocarpa - Alnus rubra / Rubus spectabilis* Forest (CEGL003407, G2G3)
- *Populus balsamifera* ssp. *trichocarpa - Alnus rubra / Symphoricarpos albus* Forest (CEGL003362, G3)
- *Populus balsamifera* ssp. *trichocarpa - Fraxinus latifolia* Forest (CEGL000674, G2Q)
- *Populus balsamifera* ssp. *trichocarpa - Picea sitchensis - (Acer macrophyllum) / Oxalis oregana* Forest (CEGL003418, G2G3)
- *Populus balsamifera* ssp. *trichocarpa / Alnus incana* Forest (CEGL000667, G3)
- *Populus balsamifera* ssp. *trichocarpa / Cornus sericea / Impatiens capensis* Forest (CEGL003408, G1)
- *Populus balsamifera* ssp. *trichocarpa / Cornus sericea* Forest (CEGL000672, G3G4)
- *Populus balsamifera* ssp. *trichocarpa / Oplopanax horridus* Woodland (CEGL003284, G3)
- *Populus balsamifera* ssp. *trichocarpa / Rubus spectabilis* Woodland (CEGL003283, G3)
- *Populus tremuloides / Carex pellita* Forest (CEGL000577, G2)
- *Quercus garryana - (Fraxinus latifolia) / Symphoricarpos albus* Forest (CEGL003299, G2)
- *Salix geyeriana - Salix eriocephala* Shrubland (CEGL001213, GU)
- *Salix geyeriana - Salix lemmonii / Carex aquatilis* var. *dives* Shrubland (CEGL001212, G3)
- *Salix lucida* ssp. *lasiandra / Salix fluviatilis* Woodland (CEGL000949, G3Q)
- *Salix lucida* ssp. *lasiandra / Urtica dioica* ssp. *gracilis* Woodland (CEGL003409, G2)
- *Salix sitchensis / Equisetum arvense - Petasites frigidus* Shrubland (CEGL003296, G4?)
- *Tsuga heterophylla - (Thuja plicata) / Oplopanax horridus / Polystichum munitum* Forest (CEGL000497, G4)

Alliances:

- *Acer circinatum* Shrubland Alliance (A.2600)
- *Acer macrophyllum* Forest Alliance (A.263)
- *Acer macrophyllum* Seasonally Flooded Forest Alliance (A.339)
- *Alnus incana* Seasonally Flooded Shrubland Alliance (A.986)
- *Alnus rubra* Seasonally Flooded Forest Alliance (A.342)
- *Cornus sericea* Temporarily Flooded Shrubland Alliance (A.968)
- *Corydalis scouleri* Temporarily Flooded Herbaceous Alliance (A.1660)
- *Equisetum (arvense, variegatum)* Semipermanently Flooded Herbaceous Alliance (A.3539)
- *Fraxinus latifolia* Seasonally Flooded Forest Alliance (A.343)
- *Fraxinus latifolia* Temporarily Flooded Forest Alliance (A.307)
- *Picea sitchensis - Populus balsamifera* ssp. *trichocarpa* Temporarily Flooded Forest Alliance (A.430)
- *Picea sitchensis* Saturated Forest Alliance (A.205)
- *Picea sitchensis* Temporarily Flooded Forest Alliance (A.169)
- *Picea sitchensis* Temporarily Flooded Woodland Alliance (A.561)
- *Populus balsamifera* ssp. *trichocarpa* Temporarily Flooded Forest Alliance (A.311)
- *Populus balsamifera* ssp. *trichocarpa* Temporarily Flooded Woodland Alliance (A.635)
- *Populus tremuloides* Temporarily Flooded Forest Alliance (A.300)
- *Pseudotsuga menziesii - Acer macrophyllum* Forest Alliance (A.427)
- *Quercus garryana* Forest Alliance (A.262)

- *Salix geyeriana* Temporarily Flooded Shrubland Alliance (A.975)
- *Salix lucida* Temporarily Flooded Woodland Alliance (A.647)
- *Salix sitchensis* Seasonally Flooded Shrubland Alliance (A.2599)
- *Tsuga heterophylla* Seasonally Flooded Forest Alliance (A.185)

SPATIAL CHARACTERISTICS

SOURCES

References: Chappell and Christy 2004, Comer et al. 2003, Franklin and Dyrness 1973
Version: 09 Feb 2005 **Stakeholders:** Canada, West
Concept Author: G. Kittel and C. Chappell**LeadResp:** West

CES204.866 North Pacific Montane Riparian Woodland and Shrubland

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Woody Wetland
Spatial Scale & Pattern: Linear
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.)
Diagnostic Classifiers: Forest and Woodland (Treed); Temperate [Temperate Oceanic]; Riverine / Alluvial
Concept Summary: This system occurs throughout mountainous areas of the Pacific Northwest coast, both on the mainland and on larger islands. It occurs on steep streams and narrow floodplains above foothills but below the alpine environments, e.g., above 1500 m (4550 feet) elevation in the Klamath Mountains and western Cascades of Oregon, up as high as 3300 m (10,000 feet) in the southern Cascades, and above 610 m (2000 feet) in northern Washington. Surrounding habitats include subalpine parklands and montane forests. In Washington they are defined as occurring primarily above the *Tsuga heterophylla* zone, i.e., beginning at or near the lower boundary of the *Abies amabilis* zone. Dominant species include *Pinus contorta var. murrayana, Populus balsamifera ssp. trichocarpa, Abies concolor, Abies magnifica, Populus tremuloides, Alnus incana ssp. tenuifolia (= Alnus tenuifolia), Alnus viridis ssp. crispa (= Alnus crispa), Alnus viridis ssp. sinuata (= Alnus sinuata), Alnus rubra, Rubus spectabilis, Ribes bracteosum, Oplopanax horridus, Acer circinatum*, and several *Salix* species. In Western Washington, major species are *Alnus viridis ssp. sinuata, Acer circinatum, Salix, Oplopanax horridus, Alnus rubra, Petasites frigidus, Rubus spectabilis*, and *Ribes bracteosum*. These are disturbance-driven systems that require flooding, scour and deposition for germination and maintenance. They occur on streambanks where the vegetation is significantly different than surrounding forests, usually because of its shrubby or deciduous character.

DISTRIBUTION

Range: This system occurs throughout mountainous areas of the Pacific Northwest Coast, both on the mainland and on larger islands, above 1500 m (4550 feet) elevation in the Klamath Mountains and western Cascades, up as high as 3300 m (10,000 feet) in the southern Cascades, and above 610 m (2000 feet) in northern Washington.

Divisions: 204:C
TNC Ecoregions: 1:C, 3:C, 4:C, 69:C, 81:C
Subnations: AK, BC, OR, WA

CONCEPT

Associations:

- *Alnus incana / Athyrium filix-femina* Shrubland (CEGL002628, G3)
- *Alnus incana / Cornus sericea* Shrubland (CEGL001145, G3G4)
- *Alnus incana / Equisetum arvense* Shrubland (CEGL001146, G3)
- *Alnus incana* / Mesic Forbs Shrubland (CEGL001147, G3)
- *Alnus incana / Spiraea douglasii* Shrubland (CEGL001152, G3)
- *Alnus incana / Symphoricarpos albus* Shrubland (CEGL001153, G3G4)
- *Alnus incana* Shrubland (CEGL001141, GNRQ)
- *Alnus viridis* ssp. *sinuata / Athyrium filix-femina - Cinna latifolia* Shrubland (CEGL001156, G4)
- *Alnus viridis* ssp. *sinuata / Oplopanax horridus* Shrubland (CEGL001157, G4G5)
- *Betula nana / Carex utriculata* Shrubland (CEGL001079, G4?)
- *Salix (boothii, geyeriana) / Carex aquatilis* Shrubland (CEGL001176, G3)
- *Salix boothii - Salix eastwoodiae / Carex nigricans* Shrubland (CEGL002607, G3)
- *Salix boothii - Salix geyeriana / Carex angustata* Shrubland (CEGL001185, G2)
- *Salix boothii - Salix lemmonii* Shrubland (CEGL001186, G3)
- *Salix boothii / Carex utriculata* Shrubland (CEGL001178, G4)
- *Salix commutata / Carex scopulorum* Shrubland (CEGL001189, G3)
- *Salix drummondiana / Carex utriculata* Shrubland (CEGL002631, G4)
- *Salix sitchensis / Equisetum arvense - Petasites frigidus* Shrubland (CEGL003296, G4?)

Alliances:

- *Alnus incana* Seasonally Flooded Shrubland Alliance (A.986)
- *Alnus incana* Temporarily Flooded Shrubland Alliance (A.950)
- *Alnus viridis* ssp. *sinuata* Seasonally Flooded Shrubland Alliance (A.1000)
- *Alnus viridis* ssp. *sinuata* Temporarily Flooded Shrubland Alliance (A.966)
- *Betula nana* Seasonally Flooded Shrubland Alliance (A.995)
- *Salix boothii* Seasonally Flooded Shrubland Alliance (A.1001)
- *Salix boothii* Temporarily Flooded Shrubland Alliance (A.972)
- *Salix commutata* Seasonally Flooded Shrubland Alliance (A.1003)
- *Salix drummondiana* Seasonally Flooded Shrubland Alliance (A.1004)
- *Salix sitchensis* Seasonally Flooded Shrubland Alliance (A.2599)

SPATIAL CHARACTERISTICS

SOURCES

References: Comer et al. 2003, Franklin and Dyrness 1973, Holland and Keil 1995
Version: 09 Feb 2005 **Stakeholders:** Canada, West
Concept Author: G. Kittel **LeadResp:** West

CES204.853 North Pacific Alpine and Subalpine Bedrock and Scree

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Barren

Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Alpine/AltiAndino; Talus (Substrate); Rock Outcrops/Barrens/Glades; Oligotrophic Soil; Very Shallow Soil; Alpine Slopes
Concept Summary: This system includes all the exposed rock and rubble above the forest line (subalpine parkland and above) in the North Pacific mountain ranges. This ecological system is restricted to the highest elevations in the Cascade Range, from southwestern British Columbia south into northern California. It is composed of barren and sparsely vegetated alpine substrates, typically including both bedrock outcrops and scree slopes, with nonvascular- (lichen-) dominated communities. Exposure to desiccating winds, rocky and sometimes unstable substrates, and a short growing season limit plant growth. There can be sparse cover of forbs, grasses, lichens, shrubs and small trees.

DISTRIBUTION

Divisions: 204:C
TNC Ecoregions: 1:C, 2:C, 3:C, 4:P, 81:C
Subnations: BC, CA, OR, WA

CONCEPT

Associations:
Alliances:

SPATIAL CHARACTERISTICS

SOURCES

References: Ecosystems Working Group 1998, Meidinger and Pojar 1991, Western Ecology Working Group n.d.
Version: 04 Apr 2005 **Stakeholders:** Canada, West
Concept Author: R. Crawford **LeadResp:** West

CES204.093 North Pacific Montane Massive Bedrock, Cliff and Talus

Primary Division: North American Pacific Maritime (204)
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch, Small patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Canyon; Cliff (Substrate); Talus (Substrate); Rock Outcrops/Barrens/Glades; Temperate [Temperate Oceanic]
Concept Summary: This ecological system is found from foothill to subalpine elevations and includes barren and sparsely vegetated landscapes (generally <10% plant cover) of steep cliff faces, narrow canyons, and larger rock outcrops of various igneous, sedimentary, and metamorphic bedrock types. Also included are unstable scree and talus that typically occur below cliff faces. The dominant process is drought and other extreme growing conditions created by exposed rock or unstable slopes typically associated with steep slopes. Fractures

in the rock surface and less steep or more stable slopes may be occupied by small patches of dense vegetation, typically scattered trees and/or shrubs. Characteristic trees includes *Chamaecyparis nootkatensis, Tsuga* spp., *Thuja plicata, Pseudotsuga menziesii*, or *Abies* spp. There may be scattered shrubs present, such as *Acer circinatum, Alnus* spp., and *Ribes* spp. Soil development is limited as is herbaceous cover. Mosses or lichens may be very dense, well-developed and display cover well over 10%.
Comments: This system was distinguished from montane cliffs and barrens in the Rockies based on a change in floristic division and the apparent abundance of nonvascular cover on rocks compared to drier divisions.

DISTRIBUTION

Range: This system occurs from northern California (north of Sierra Nevada Cliff and Canyon (CES206.901)) to southeastern Alaska.
Divisions: 204:C
TNC Ecoregions: 1:C, 2:C, 3:C, 4:C, 5:P, 69:C, 81:C
Subnations: AK, BC, OR, WA

CONCEPT

Associations:
Alliances:

SPATIAL CHARACTERISTICS

SOURCES

References: Western Ecology Working Group n.d.
Version: 30 Mar 2005 **Stakeholders:** Canada, West
Concept Author: R. Crawford **LeadResp:** West

CES300.728 North American Alpine Ice Field

Primary Division:
Land Cover Class: Barren
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Unvegetated (<10% vasc.); Upland
Diagnostic Classifiers: Alpine/AltiAndino [Alpine/AltiAndino]; Ice Fields / Glaciers; Glaciated; Alpine Slopes
Concept Summary: This widespread ecological system is composed of unvegetated landscapes of annual/perennial ice and snow at the highest elevations, where snowfall accumulation exceeds melting. The primary ecological processes include snow/ice retention, wind desiccation, and permafrost. The snowpack/ice field never melts or, if so, then for only a few weeks. The alpine substrate/ice field ecological system is part of the alpine mosaic consisting of alpine bedrock and scree, tundra dry meadow, wet meadow, fell-fields, and dwarf-shrubland.

Comments: The barren rock and rubble within the glaciers is part of this system, not the alpine rock and scree systems.

DISTRIBUTION

Range: This ecological system is found throughout North America where altitude results in permanent ice and snow fields, from the mountains of Alaska south and east through the cordillera of the Cascades and the Rocky Mountains.
Divisions: 104:C, 105:C, 204:C, 306:C
TNC Ecoregions: 3:C, 7:C, 9:C, 20:C, 69:C, 70:C, 71:P, 76:C, 77:P, 78:C, 79:C
Subnations: AB, AK, BC, CO, ID, MT, OR, WA, WY

CONCEPT

Associations:
Alliances:

SPATIAL CHARACTERISTICS

SOURCES

References: Comer et al. 2003, Meidinger and Pojar 1991, Neely et al. 2001
Version: 04 Apr 2005 **Stakeholders:** Canada, Midwest, West
Concept Author: NatureServe Western Ecology Team **LeadResp:** West

CES306.805 Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest - outside ecoregion

Primary Division: Rocky Mountain (306)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Matrix
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Montane]; Forest and Woodland (Treed); Ustic; Short Disturbance Interval; F-Patch/Low Intensity; Needle-Leaved Tree; Abies grandis - Mixed
Concept Summary: This ecological system is composed of highly variable montane coniferous forests found in the interior Pacific Northwest, from southernmost interior British Columbia, eastern Washington, eastern Oregon, northern Idaho, western Montana, and south along the east slope of the Cascades in Washington and Oregon. This system is associated with a submesic climate regime with annual precipitation ranging from 50 to 100 cm, with a maximum in winter or late spring. Winter snowpacks typically melt off in early spring at lower elevation sites. Elevations range from 460 to 1920 m. Most occurrences of this system are dominated by a mix of *Pseudotsuga menziesii* and *Pinus ponderosa*, and other typically seral species including *Pinus contorta, Pinus monticola*, and *Larix occidentalis*. *Picea engelmannii* becomes increasingly common towards the eastern edge of the range. The nature of this forest system is a matrix of large patches dominated or codominated by one or combinations of the above species; *Abies grandis* (a fire-sensitive, shade-tolerant species) has increased on many sites once dominated by *Pseudotsuga menziesii* and *Pinus ponderosa*,

which were formerly maintained by low-severity wildfire. Presettlement fire regimes were characterized by frequent, low-intensity ground fires that maintained relatively open stands of a mix of fire-resistant species. With vigorous fire suppression, longer fire-return intervals are now the rule, and multi-layered stands of *Pseudotsuga menziesii, Pinus ponderosa*, and/or *Abies grandis* provide fuel "ladders," making these forests more susceptible to high-intensity, stand-replacing fires. They are very productive forests which have been priorities for timber production. They rarely form either upper or lower timberline forests. Understories are dominated by graminoids, such as *Pseudoroegneria spicata, Calamagrostis rubescens, Carex geyeri*, and *Carex rossii*, that may be associated with deciduous shrubs, such as *Acer glabrum , Physocarpus malvaceus, Symphoricarpos albus, Spiraea betulifolia*, or *Vaccinium membranaceum* on mesic sites.

Comments: Need to re-assess the concept of this system in relation to Northern Rocky Mountain Western Larch Woodland (CES306.837) and to East Cascades Mesic Montane Mixed-Conifer Forest and Woodland (CES204.086). In PNV (PAGs) concept, this is mostly *Pseudotsuga menziesii*, moist *Pinus ponderosa* series, dry *Abies grandis* or warm, dry *Abies lasiocarpa* series in the CanRock, northern Middle Rockies, East Cascades and Okanagan ecoregions. Everett et al. (2000) in east Cascades of Washington indicate that this system forms fire polygons due to abrupt north and south topography with presettlement fire-return intervals of 11-12 years typically covering less than 810 ha. Currently, fires have 40- to 45-year return intervals with thousands of hectares in size. Northern Rocky Mountain Western Larch Woodland (CES306.837) is a large-patch type that occurs typically within this matrix or the Northern Rocky Mountain Western Hemlock-Western Red-cedar Forest (CES306.802) matrix. We need to define the percent cover of larch over 50% or over 75% relative cover of all trees for an occurrence to be placed in Northern Rocky Mountain Western Larch Woodland (CES306.837). Needs to be relative because these look(ed) like ponderosa savanna in places. East Cascades Mesic Montane Mixed-Conifer Forest and Woodland (CES204.086) has North Pacific floristic composition, and is mostly east Cascades ecoregion, peripheral in Okanagan ecoregion, and west Cascades. PAGs most of the *Abies grandis*, dry western red-cedar and western hemlock in the east Cascades. Environmentally, it is equivalent to Northern Rocky Mountain Western Hemlock-Western Red-cedar Forest (CES306.802). Contrasting this system (CES306.805) with Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland (CES306.828) and Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland (CES306.830) is important in the Middle Rockies ecoregion and Oregon.

DISTRIBUTION

Range: This system is found in the interior Pacific Northwest, from southern interior British Columbia south and east into Oregon, Idaho, and western Montana, and south along the east slope of the Cascades in Washington and Oregon.
Divisions: 204:C, 304:P, 306:C
TNC Ecoregions: 2:P, 4:C, 6:C, 7:C, 8:C, 68:C
Subnations: BC, ID, MT, OR, WA

CONCEPT

Associations:

- *Abies grandis / Acer glabrum* Forest (CEGL000267, G3)
- *Abies grandis / Arctostaphylos nevadensis* Woodland (CEGL000915, G2G3)
- *Abies grandis / Bromus vulgaris* Forest (CEGL002601, G3)
- *Abies grandis / Calamagrostis rubescens* Woodland (CEGL000916, G4?)
- *Abies grandis / Carex geyeri* Woodland (CEGL000917, G3)
- *Abies grandis / Linnaea borealis* Forest (CEGL000275, G3)
- *Abies grandis / Physocarpus malvaceus* Forest (CEGL000277, G3)
- *Abies grandis / Spiraea betulifolia* Forest (CEGL000281, G2)
- *Abies grandis / Symphoricarpos albus* Forest (CEGL000282, G3?)
- *Pinus monticola / Clintonia uniflora* Forest (CEGL000176, G1Q)
- *Pinus ponderosa - Pseudotsuga menziesii / Arctostaphylos nevadensis* Woodland (CEGL000208, G2)
- *Pinus ponderosa - Pseudotsuga menziesii / Arctostaphylos patula* Woodland (CEGL000209, G3)
- *Pinus ponderosa - Pseudotsuga menziesii / Calamagrostis rubescens* Woodland (CEGL000210, G2Q)
- *Pinus ponderosa - Pseudotsuga menziesii / Carex geyeri* Forest (CEGL000211, GNRQ)
- *Pinus ponderosa - Pseudotsuga menziesii / Penstemon fruticosus* Woodland (CEGL000212, G2G3)
- *Pinus ponderosa - Pseudotsuga menziesii / Physocarpus malvaceus* Forest (CEGL000213, GNRQ)
- *Pseudotsuga menziesii / Angelica* spp. Forest (CEGL005853, G2?)
- *Pseudotsuga menziesii / Arctostaphylos uva-ursi - Purshia tridentata* Forest (CEGL000426, G3?)
- *Pseudotsuga menziesii / Arctostaphylos uva-ursi* Cascadian Forest (CEGL000425, G3G4)
- *Pseudotsuga menziesii / Arctostaphylos uva-ursi* Forest (CEGL000424, G4)
- *Pseudotsuga menziesii / Arnica cordifolia* Forest (CEGL000427, G4)
- *Pseudotsuga menziesii / Bromus ciliatus* Forest (CEGL000428, G4)
- *Pseudotsuga menziesii / Calamagrostis rubescens* Woodland (CEGL000429, G5)
- *Pseudotsuga menziesii / Carex geyeri* Forest (CEGL000430, G4?)
- *Pseudotsuga menziesii / Carex rossii* Forest (CEGL000431, G2?)
- *Pseudotsuga menziesii / Clintonia uniflora - Xerophyllum tenax* Forest (CEGL005854, G4G5)
- *Pseudotsuga menziesii / Clintonia uniflora* Forest (CEGL005850, G4G5)
- *Pseudotsuga menziesii / Linnaea borealis* Forest (CEGL000441, G4)
- *Pseudotsuga menziesii / Mahonia repens* Forest (CEGL000442, G5)
- *Pseudotsuga menziesii / Menziesia ferruginea / Clintonia uniflora* Forest (CEGL005851, G3?)
- *Pseudotsuga menziesii / Osmorhiza berteroi* Forest (CEGL000445, G4G5)
- *Pseudotsuga menziesii / Paxistima myrsinites* Forest (CEGL000446, G2G3)
- *Pseudotsuga menziesii / Physocarpus malvaceus - Linnaea borealis* Forest (CEGL000448, G4)
- *Pseudotsuga menziesii / Physocarpus malvaceus* Forest (CEGL000447, G5)
- *Pseudotsuga menziesii / Spiraea betulifolia* Forest (CEGL000457, G5)
- *Pseudotsuga menziesii / Symphoricarpos albus* Forest (CEGL000459, G5)
- *Pseudotsuga menziesii / Symphoricarpos occidentalis* Forest (CEGL000461, G3?)
- *Pseudotsuga menziesii / Symphoricarpos oreophilus* Forest (CEGL000462, G5)
- *Pseudotsuga menziesii / Vaccinium caespitosum* Forest (CEGL000465, G5)
- *Pseudotsuga menziesii / Vaccinium membranaceum / Xerophyllum tenax* Forest (CEGL005852, G4G5)
- *Pseudotsuga menziesii / Vaccinium* spp. Forest (CEGL000464, G4Q)

Alliances:

- *Abies grandis* Forest Alliance (A.153)
- *Abies grandis* Woodland Alliance (A.558)
- *Pinus monticola* Forest Alliance (A.133)
- *Pinus ponderosa - Pseudotsuga menziesii* Forest Alliance (A.134)

- *Pinus ponderosa - Pseudotsuga menziesii* Woodland Alliance (A.533)
- *Pseudotsuga menziesii* Forest Alliance (A.157)
- *Pseudotsuga menziesii* Woodland Alliance (A.552)

Dynamics: Landfire VDDT models: R#MCONdy.

SPATIAL CHARACTERISTICS

SOURCES

References: Canadian Rockies Ecoregional Plan 2002, Comer et al. 2003, Cooper et al. 1987, Crawford and Johnson 1985, Daubenmire and Daubenmire 1968, Lillybridge et al. 1995, Pfister et al. 1977, Steele and Geier-Hayes 1995, Steele et al. 1981, Topik 1989, Topik et al. 1988, Williams and Lillybridge 1983

Version: 04 Apr 2005 **Stakeholders:** Canada, West

Concept Author: NatureServe Western Ecology Team **LeadResp:** West

CES306.807 Northern Rocky Mountain Subalpine Dry Parkland outside ecoregion

Primary Division: Rocky Mountain (306)

Land Cover Class: Forest and Woodland

Spatial Scale & Pattern: Large patch

Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland

Diagnostic Classifiers: Montane [Upper Montane]; Ridge/Summit/Upper Slope; Very Short Disturbance Interval; W-Patch/High Intensity; W-Landscape/Medium Intensity; Upper Treeline

Concept Summary: This system of the northern Rockies, Cascade Mountains, and northeastern Olympic Mountains is typically a high-elevation mosaic of stunted tree clumps, open woodlands, and herb- or dwarf-shrub-dominated openings, occurring above closed forest ecosystems and below alpine communities. It includes open areas with clumps of *Pinus albicaulis*, as well as woodlands dominated by *Pinus albicaulis*. In the Cascade Mountains and northeastern Olympic Mountains, the tree clump pattern is one manifestation, but it can also have woodlands with open canopy, without a tree clump/opening patchiness to them; in fact, that is quite common with whitebark pine. In interior British Columbia, it occurs between 1000 and 2100 m elevation. The upper and lower elevational limits, due to climatic variability and differing topography, vary considerably. Landforms include ridgetops, mountain slopes, glacial trough walls and moraines, talus slopes, landslides and rockslides, and cirque headwalls and basins. Some sites have little snow accumulation because of high winds and sublimation. In this harsh, often wind-swept environment, trees are often stunted and flagged from damage associated with wind and blowing snow and ice crystals, especially at the upper elevations of the type. The stands or patches often originate when *Picea engelmannii* or *Pinus albicaulis* colonize a sheltered site such as the lee side of a rock. *Abies lasiocarpa* can then colonize in the shelter of the *Picea engelmannii* and may form a dense canopy by branch layering. The climate is typically very cold in winter and dry in summer. In the Cascades and Olympic Mountains, the climate is more maritime in nature and wind is not as extreme, but summer drought is a more important process than in the related maritime mesic subalpine parkland system. Fire is known to occur infrequently in this system, at least where woodlands are present. In the Cascades and Olympics, *Abies lasiocarpa* sometimes dominates the tree layer without *Pinus albicaulis*, though in this dry parkland *Tsuga mertensiana* and *Abies amabilis* are largely absent. In the northern Washington Cascades, *Larix lyallii* occurs in this system, and the distinction between it and Northern Rocky Mountain Subalpine Larch Woodland (CES306.808) is less distinct than in the Rockies. Other woody species include shrubs and dwarf-shrubs, such as *Phyllodoce glanduliflora, Phyllodoce empetriformis, Kalmia polifolia, Ribes montigenum, Salix brachycarpa, Salix glauca, Salix planifolia, Vaccinium membranaceum*, and *Vaccinium scoparium*, that may be present to codominant. The herbaceous layer is sparse under dense shrub canopies or may be dense where the shrub canopy is open or absent.

DISTRIBUTION

Range: This system occurs in the northern Rocky Mountains, Cascade Mountains, and northeastern Olympic Mountains.
Divisions: 204:C, 306:C
TNC Ecoregions: 3:C, 7:C, 8:C, 9:P, 68:C
Subnations: AB, BC, ID, MT, WA, WY

CONCEPT

Associations:

- *Abies lasiocarpa - Picea engelmannii* Tree Island Forest (CEGL000329, GUQ)
- *Abies lasiocarpa - Pinus albicaulis / Arctostaphylos uva-ursi* Woodland (CEGL000751, G2Q)
- *Abies lasiocarpa - Pinus albicaulis / Vaccinium scoparium* Woodland (CEGL000752, G5?)
- *Abies lasiocarpa* Krummholz Shrubland (CEGL000985, G4)
- *Larix lyallii / Vaccinium deliciosum* Woodland (CEGL000952, G3)
- *Larix lyallii / Vaccinium scoparium / Luzula glabrata* var. *hitchcockii* Woodland (CEGL000951, G2G3)
- *Pinus albicaulis - (Abies lasiocarpa) / Carex geyeri* Woodland (CEGL000754, G2G3)
- *Pinus albicaulis - (Picea engelmannii) / Dryas octopetala* Woodland (CEGL005840, G2G3?)
- *Pinus albicaulis - Abies lasiocarpa / Menziesia ferruginea / Xerophyllum tenax* Woodland (CEGL005836, G3?)
- *Pinus albicaulis - Abies lasiocarpa / Vaccinium membranaceum / Xerophyllum tenax* Woodland (CEGL005837, G3?)
- *Pinus albicaulis - Abies lasiocarpa / Vaccinium scoparium / Luzula glabrata* var. *hitchcockii* Woodland (CEGL005839, G3?)
- *Pinus albicaulis - Abies lasiocarpa / Vaccinium scoparium / Xerophyllum tenax* Woodland (CEGL005838, G3?)
- Pinus albicaulis - Abies lasiocarpa Woodland (CEGL000128, G5?)
- *Pinus albicaulis / Calamagrostis rubescens* Woodland (CEGL000753, G2)
- *Pinus albicaulis / Carex rossii* Forest (CEGL000129, G3)
- *Pinus albicaulis / Festuca idahoensis* Woodland (CEGL000755, G4)
- *Pinus albicaulis / Juniperus communis* Woodland (CEGL000756, G4?)
- *Pinus albicaulis / Luzula glabrata* var. *hitchcockii* Woodland (CEGL000758, G3)
- *Pinus albicaulis / Vaccinium scoparium* Forest (CEGL000131, G4)
- *Pinus albicaulis* Woodland [Placeholder] (CEGL000127, G5?)

- *Pinus flexilis / Arctostaphylos uva-ursi* Woodland (CEGL000802, G4)

Alliances:

- *Abies lasiocarpa - Picea engelmannii* Forest Alliance (A.168)
- *Abies lasiocarpa* Krummholz Shrubland Alliance (A.811)
- *Larix lyallii* Woodland Alliance (A.631)
- *Pinus albicaulis - Abies lasiocarpa* Woodland Alliance (A.560)
- *Pinus albicaulis* Forest Alliance (A.132)
- *Pinus albicaulis* Woodland Alliance (A.531)
- *Pinus flexilis* Woodland Alliance (A.540)

SPATIAL CHARACTERISTICS

SOURCES

References: Canadian Rockies Ecoregional Plan 2002, Comer et al. 2003, Ecosystems Working Group 1998, Meidinger and Pojar 1991
Version: 08 Feb 2005 **Stakeholders:** Canada, West
Concept Author: NatureServe Western Ecology Team **LeadResp:** West

CES306.830 Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland - outside ecoregion

Primary Division: Rocky Mountain (306)
Land Cover Class: Forest and Woodland
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Montane [Upper Montane]; Forest and Woodland (Treed); Acidic Soil; Udic; Very Long Disturbance Interval [Seasonality/Summer Disturbance]; F-Patch/High Intensity; F-Landscape/Medium Intensity; Abies lasiocarpa - Picea engelmannii; RM Subalpine Dry-Mesic Spruce-Fir; Long (>500 yrs) Persistence
Concept Summary: This is a high-elevation system of the Rocky Mountains, dry eastern Cascades and eastern Olympic Mountains dominated by *Picea engelmannii* and *Abies lasiocarpa*. It extends westward into the northeastern Olympic Mountains and the northeastern side of Mount Rainier in Washington. *Picea engelmannii* is generally more important in southern forests than those in the Pacific Northwest. Occurrences are typically found in locations with cold-air drainage or ponding, or where snowpacks linger late into the summer, such as north-facing slopes and high-elevation ravines. They can extend down in elevation below the subalpine zone in places where cold-air ponding occurs; northerly and easterly aspects predominate. These forests are found on gentle to very steep mountain slopes, high-elevation ridgetops and upper slopes, plateau-like surfaces, basins, alluvial terraces, well-drained benches, and inactive stream terraces. In the Olympics and northern Cascades, the climate is more maritime than typical for this system, but due to the lower snowfall in these rainshadow areas, summer drought may be more significant than snowpack in limiting tree regeneration in burned areas. *Picea engelmannii* is rare in these areas. Mesic understory shrubs include *Menziesia ferruginea, Vaccinium membranaceum, Rhododendron*

albiflorum, Amelanchier alnifolia, Rubus parviflorus, Ledum glandulosum, Phyllodoce empetriformis, and *Salix* spp. Herbaceous species include *Actaea rubra, Maianthemum stellatum, Cornus canadensis, Erigeron eximius, Gymnocarpium dryopteris, Rubus pedatus, Saxifraga bronchialis, Tiarella* spp., *Lupinus arcticus ssp. subalpinus, Valeriana sitchensis*, and graminoids *Luzula glabrata var. hitchcockii* or *Calamagrostis canadensis*. Disturbances include occasional blow-down, insect outbreaks (30-50 years), mixed-severity fire, and stand-replacing fire (150-500 years).

Comments: The subalpine fir-dominated forests of the northeastern Olympic Mountains and the northeastern side of Mount Rainier are included here. They are more similar to subalpine fir forests on the eastern slopes of the Cascades than they are to mountain hemlock forests.

DISTRIBUTION

Range: This system is found at high elevations of the Rocky Mountains, extending east into the northeastern Olympic Mountains and the northeastern side of Mount Rainier in Washington.

Divisions: 204:C, 304:C, 306:C

TNC Ecoregions: 1:C, 4:C, 7:C, 8:C, 9:C, 11:C, 20:C, 21:C, 68:C

Subnations: AB, AZ, BC, CO, ID, MT, NM, NV, OR, UT, WA, WY

CONCEPT

Associations:

- *Abies lasiocarpa - Picea engelmannii / Acer glabrum* Forest (CEGL000294, G5)
- *Abies lasiocarpa - Picea engelmannii / Actaea rubra* Forest (CEGL000295, G4?)
- *Abies lasiocarpa - Picea engelmannii / Calamagrostis canadensis* Forest (CEGL000300, G5)
- *Abies lasiocarpa - Picea engelmannii / Carex geyeri* Forest (CEGL000304, G5)
- *Abies lasiocarpa - Picea engelmannii / Clintonia uniflora - Xerophyllum tenax* Forest (CEGL005892, G4G5)
- *Abies lasiocarpa - Picea engelmannii / Clintonia uniflora* Forest (CEGL005912, G5)
- *Abies lasiocarpa - Picea engelmannii / Luzula glabrata* var. *hitchcockii* Woodland (CEGL000317, G5)
- *Abies lasiocarpa - Picea engelmannii / Menziesia ferruginea - Vaccinium scoparium* Forest (CEGL005894, G2G4)
- *Abies lasiocarpa - Picea engelmannii / Menziesia ferruginea / Clintonia uniflora* Forest (CEGL005893, G4G5)
- *Abies lasiocarpa - Picea engelmannii / Menziesia ferruginea / Luzula glabrata* var. *hitchcockii* Woodland (CEGL005896, G4?)
- *Abies lasiocarpa - Picea engelmannii / Menziesia ferruginea / Streptopus amplexifolius* Woodland (CEGL005897, G3G4)
- *Abies lasiocarpa - Picea engelmannii / Menziesia ferruginea / Xerophyllum tenax* Forest (CEGL005895, G4G5)
- *Abies lasiocarpa - Picea engelmannii / Streptopus amplexifolius - Luzula glabrata* var. *hitchcockii* Woodland (CEGL005920, G2G3)
- *Abies lasiocarpa - Picea engelmannii / Vaccinium caespitosum / Clintonia uniflora* Forest (CEGL005918, G3G4)
- *Abies lasiocarpa - Picea engelmannii / Vaccinium membranaceum / Xerophyllum tenax* Forest (CEGL005917, GNR)
- *Abies lasiocarpa - Picea engelmannii / Vaccinium membranaceum* Rocky Mountain Forest (CEGL000341, G5)
- *Abies lasiocarpa - Picea engelmannii / Vaccinium scoparium / Thalictrum occidentale* Forest (CEGL005919, G3G4)

- *Abies lasiocarpa - Picea engelmannii / Vaccinium scoparium / Xerophyllum tenax* Forest (CEGL005914, G4G5)
- *Abies lasiocarpa - Picea engelmannii / Valeriana sitchensis* Woodland (CEGL005823, G2?)
- *Abies lasiocarpa - Picea engelmannii / Xerophyllum tenax - Luzula glabrata* var. *hitchcockii* Woodland (CEGL005898, G4G5)
- *Abies lasiocarpa - Picea engelmannii* Ribbon Forest (CEGL000328, GUQ)
- *Abies lasiocarpa / Caltha leptosepala* ssp. *howellii* Forest (CEGL000302, G3)
- *Abies lasiocarpa / Clematis columbiana* var. *columbiana* Forest (CEGL000306, G3?)
- *Abies lasiocarpa / Coptis occidentalis* Forest (CEGL000308, G4)
- *Abies lasiocarpa / Cornus canadensis* Forest (CEGL000309, G3G4)
- *Abies lasiocarpa / Erigeron eximius* Forest (CEGL000310, G5)
- *Abies lasiocarpa / Gymnocarpium dryopteris* Forest (CEGL002611, GNRQ)
- *Abies lasiocarpa / Ledum glandulosum* Forest (CEGL000314, G4)
- *Abies lasiocarpa* / Moss Forest (CEGL000321, G4)
- *Abies lasiocarpa / Phyllodoce empetriformis* Woodland (CEGL000920, G4Q)
- *Abies lasiocarpa / Rhododendron albiflorum* Woodland (CEGL000330, G4)
- *Abies lasiocarpa / Rubus parviflorus* Forest (CEGL000332, G5)
- *Abies lasiocarpa / Salix brachycarpa* Shrubland (CEGL000986, GUQ)
- *Abies lasiocarpa / Salix glauca* Shrubland (CEGL000987, GUQ)
- *Abies lasiocarpa / Vaccinium membranaceum / Valeriana sitchensis* Forest (CEGL002612, G4)
- *Abies lasiocarpa / Vaccinium membranaceum* Forest (CEGL000342, G4)
- *Betula papyrifera* - Conifer / *Clintonia uniflora* Woodland (CEGL005904, G3G4)
- *Chamerion angustifolium* Rocky Mountain Herbaceous Vegetation [Provisional] (CEGL005856, G4G5)
- *Picea engelmannii / Acer glabrum* Forest (CEGL000354, G2)
- *Picea engelmannii / Hypnum revolutum* Forest (CEGL000368, G3)
- *Picea engelmannii / Maianthemum stellatum* Forest (CEGL000415, G4?)
- *Picea engelmannii* / Moss Forest (CEGL000371, G4)
- *Picea engelmannii / Packera cardamine* Forest (CEGL000375, G2)
- *Picea engelmannii / Physocarpus malvaceus* Forest (CEGL002676, G3)
- *Populus balsamifera* ssp. *trichocarpa - Populus tremuloides* - Conifer / *Clintonia uniflora* Forest (CEGL005906, G3?)
- *Populus tremuloides - Abies lasiocarpa / Amelanchier alnifolia* Forest (CEGL000524, G3?)
- *Populus tremuloides - Abies lasiocarpa / Carex geyeri* Forest (CEGL000525, G3?)
- *Populus tremuloides - Abies lasiocarpa / Juniperus communis* Forest (CEGL000527, G3G4)

Alliances:

- *Abies lasiocarpa - Picea engelmannii* Forest Alliance (A.168)
- *Abies lasiocarpa - Populus tremuloides* Forest Alliance (A.422)
- *Abies lasiocarpa* Krummholz Shrubland Alliance (A.811)
- *Abies lasiocarpa* Seasonally Flooded Forest Alliance (A.190)
- *Abies lasiocarpa* Woodland Alliance (A.559)
- *Betula papyrifera* Woodland Alliance (A.603)
- *Chamerion angustifolium* Herbaceous Alliance (A.3535)
- *Picea engelmannii* Forest Alliance (A.164)
- *Populus balsamifera* ssp. *trichocarpa* Temporarily Flooded Forest Alliance (A.311)

Dynamics: Landfire VDDT models: #RSPFI and #RABLA.

SPATIAL CHARACTERISTICS

SOURCES

References: Alexander and Ronco 1987, Alexander et al. 1984a, Alexander et al. 1987, Anderson 1999, Brand et al. 1976, Canadian Rockies Ecoregional Plan 2002, Clagg 1975, Comer et al. 2002, Comer et al. 2003, Cooper et al. 1987, Daubenmire and Daubenmire 1968, DeVelice et al. 1986, Ecosystems Working Group 1998, Fitzgerald et al. 1994, Graybosch and Buchanan 1983, Henderson et al. 1989, Hess and Alexander 1986, Hess and Wasser 1982, Hoffman and Alexander 1976, Hoffman and Alexander 1980, Hoffman and Alexander 1983, Johnson and Clausnitzer 1992, Johnson and Simon 1987, Komarkova et al. 1988b, Lillybridge et al. 1995, Major et al. 1981, Mauk and Henderson 1984, Mehl 1992, Meidinger and Pojar 1991, Muldavin et al. 1996, Neely et al. 2001, Peet 1978a, Peet 1981, Pfister 1972, Pfister et al. 1977, Romme 1982, Schaupp et al. 1999, Steele and Geier-Hayes 1995, Steele et al. 1981, Tuhy et al. 2002, Veblen 1986, Whipple and Dix 1979, Williams and Lillybridge 1983, Williams et al. 1995, Wong and Iverson 2004, Wong et al. 2003, Youngblood and Mauk 1985

Version: 04 Apr 2005 **Stakeholders:** Canada, West

Concept Author: NatureServe Western Ecology Team **LeadResp:** West

CES306.816 Rocky Mountain Dry Tundra ** NOT MAPPED **

Primary Division: Rocky Mountain (306)
Land Cover Class: Herbaceous
Spatial Scale & Pattern: Large patch
Required Classifiers: Natural/Semi-natural; Vegetated (>10% vasc.); Upland
Diagnostic Classifiers: Alpine/AltiAndino [Alpine/AltiAndino]; Oligotrophic Soil; Very Shallow Soil; Mineral: W/ A-Horizon <10 cm; Aridic; Very Long Disturbance Interval; Graminoid; Alpine Slopes
Concept Summary: This widespread ecological system occurs above upper treeline throughout the Rocky Mountain cordillera, including alpine areas of ranges in Utah and Nevada, and isolated alpine sites in the northeastern Cascades. It is found on gentle to moderate slopes, flat ridges, valleys, and basins, where the soil has become relatively stabilized and the water supply is more or less constant. Vegetation in these areas is controlled by snow retention, wind desiccation, permafrost, and a short growing season. This system is characterized by a dense cover of low-growing, perennial graminoids and forbs. Rhizomatous, sod-forming sedges are the dominant graminoids, and prostrate and mat-forming plants with thick rootstocks or taproots characterize the forbs. Dominant species include *Artemisia arctica, Carex elynoides, Carex siccata, Carex scirpoidea, Carex nardina, Carex rupestris, Deschampsia caespitosa, Festuca brachyphylla, Festuca idahoensis, Geum rossii, Kobresia myosuroides, Phlox pulvinata*, and *Trifolium dasyphyllum*. Although alpine tundra dry meadow is the matrix of the alpine zone, it typically intermingles with alpine

bedrock and scree, ice field, fell-field, alpine dwarf-shrubland, and alpine/subalpine wet meadow systems.

DISTRIBUTION

Range: This system occurs above upper treeline throughout the North American Rocky Mountain cordillera, including alpine areas of ranges in Utah and Nevada, and isolated alpine sites in the northeastern Cascades.
Divisions: 204:P, 306:C
TNC Ecoregions: 7:C, 8:C, 9:C, 11:C, 20:C, 21:C, 68:C
Subnations: AB, AZ, BC, CO, ID, MT, NM, NV, OR, UT, WA, WY

CONCEPT

Associations:

- *Arenaria capillaris / Polytrichum piliferum* Herbaceous Vegetation (CEGL005855, G2G3)
- *Artemisia arctica* ssp. *arctica* Herbaceous Vegetation (CEGL001848, GU)
- *Calamagrostis purpurascens* Herbaceous Vegetation (CEGL001850, G2)
- *Carex arapahoensis* Herbaceous Vegetation (CEGL001851, GU)
- *Carex duriuscula - Poa secunda* Herbaceous Vegetation (CEGL001736, G2Q)
- *Carex ebenea - Trifolium parryi* Herbaceous Vegetation (CEGL001873, GUQ)
- *Carex elynoides - Geum rossii* Herbaceous Vegetation (CEGL001853, G4)
- *Carex elynoides - Lupinus argenteus* Herbaceous Vegetation (CEGL001854, G3)
- *Carex elynoides - Oreoxis* spp. Herbaceous Vegetation (CEGL001855, G4)
- *Carex elynoides - Oxytropis sericea* Herbaceous Vegetation (CEGL001856, G3)
- *Carex elynoides* Herbaceous Vegetation (CEGL001852, G4)
- *Carex haydeniana* Herbaceous Vegetation (CEGL001875, GU)
- *Carex perglobosa - Silene acaulis* Herbaceous Vegetation (CEGL001858, GU)
- *Carex rupestris - Geum rossii* Herbaceous Vegetation (CEGL001861, G4)
- *Carex rupestris - Potentilla ovina* Herbaceous Vegetation (CEGL001862, G4)
- *Carex rupestris - Trifolium dasyphyllum* Herbaceous Vegetation (CEGL001863, G3G4)
- *Carex rupestris* var. *drummondiana* Herbaceous Vegetation (CEGL001864, G4)
- *Carex scirpoidea - Geum rossii* Herbaceous Vegetation (CEGL001866, G4)
- *Carex scirpoidea - Potentilla diversifolia* Herbaceous Vegetation (CEGL001867, G3?)
- *Carex scirpoidea - Zigadenus elegans* Herbaceous Vegetation (CEGL005866, G4G5)
- *Carex siccata - Geum rossii* Herbaceous Vegetation (CEGL001808, GU)
- *Carex* spp. - *Geum rossii* Herbaceous Vegetation (CEGL001870, G4Q)
- *Carex vernacula* Herbaceous Vegetation (CEGL001868, GU)
- *Cirsium scopulorum - Polemonium viscosum* Herbaceous Vegetation (CEGL001959, GU)
- *Festuca brachyphylla - Geum rossii* var. *turbinatum* Herbaceous Vegetation (CEGL001895, GUQ)
- *Festuca brachyphylla - Trisetum spicatum* Herbaceous Vegetation (CEGL001896, G3?)
- *Festuca brachyphylla* Herbaceous Vegetation (CEGL001797, G4?)
- *Festuca thurberi* Subalpine Grassland Herbaceous Vegetation (CEGL001631, G3)
- *Geum rossii - Carex albonigra* Herbaceous Vegetation (CEGL001966, G1G2Q)
- *Geum rossii - Minuartia obtusiloba* Herbaceous Vegetation (CEGL001965, G3?)
- *Geum rossii - Selaginella densa* Herbaceous Vegetation (CEGL001968, G2G3Q)
- *Geum rossii - Trifolium* spp. Herbaceous Vegetation (CEGL001970, G3)
- *Geum rossii* Herbaceous Vegetation (CEGL001964, G4G5Q)
- *Kobresia myosuroides - Carex rupestris* var. *drummondiana* Herbaceous Vegetation (CEGL001907, G3)
- *Kobresia myosuroides - Geum rossii* Herbaceous Vegetation (CEGL001908, G5)

- *Kobresia myosuroides - Trifolium dasyphyllum* Herbaceous Vegetation (CEGL001909, GU)
- *Leucopoa kingii - Carex elynoides* Herbaceous Vegetation (CEGL001911, G3)
- *Leucopoa kingii - Oxytropis campestris* Herbaceous Vegetation (CEGL001912, G3?)
- *Leucopoa kingii - Phlox pulvinata* Herbaceous Vegetation (CEGL001913, G3)
- *Leucopoa kingii - Poa fendleriana* ssp. *fendleriana* Herbaceous Vegetation (CEGL001914, G3)
- *Leucopoa kingii* Herbaceous Vegetation (CEGL001910, G3Q)
- *Minuartia obtusiloba* Herbaceous Vegetation (CEGL001919, G4)
- *Poa arctica* ssp. *grayana* Herbaceous Vegetation (CEGL001924, GU)
- *Poa lettermanii* Herbaceous Vegetation (CEGL001927, GU)
- *Poa nervosa - Achnatherum lettermanii* Herbaceous Vegetation (CEGL001656, G1G2)
- *Pseudoroegneria spicata* - Cushion Plants Herbaceous Vegetation (CEGL001666, G3?)
- *Ribes montigenum* Shrubland (CEGL001133, GU)
- *Saxifraga chrysantha* Sparse Vegetation (CEGL001929, GU)
- *Sibbaldia procumbens - Polygonum bistortoides* Herbaceous Vegetation (CEGL001933, G3?)
- *Trifolium dasyphyllum* Herbaceous Vegetation (CEGL001935, G4)
- *Trifolium parryi* Herbaceous Vegetation (CEGL001936, GU)

Alliances:

- *Arenaria capillaris* Herbaceous Alliance (A.2630)
- *Artemisia arctica* Herbaceous Alliance (A.1624)
- *Calamagrostis purpurascens* Herbaceous Alliance (A.1301)
- *Carex (ebenea, haydeniana)* Herbaceous Alliance (A.1302)
- *Carex arapahoensis* Herbaceous Alliance (A.1319)
- *Carex duriuscula* Herbaceous Alliance (A.1283)
- *Carex elynoides* Herbaceous Alliance (A.1303)
- *Carex perglobosa* Herbaceous Alliance (A.1304)
- *Carex rupestris* Herbaceous Alliance (A.1307)
- *Carex scirpoidea* Herbaceous Alliance (A.1308)
- *Carex siccata* Herbaceous Alliance (A.1298)
- *Carex vernacula* Herbaceous Alliance (A.1309)
- *Cirsium scopulorum* Herbaceous Alliance (A.1608)
- *Festuca brachyphylla* Herbaceous Alliance (A.1321)
- *Festuca thurberi* Herbaceous Alliance (A.1256)
- *Geum rossii* Herbaceous Alliance (A.1645)
- *Kobresia myosuroides* Herbaceous Alliance (A.1326)
- *Leucopoa kingii* Herbaceous Alliance (A.1323)
- *Minuartia obtusiloba* Herbaceous Alliance (A.1630)
- *Poa arctica* Herbaceous Alliance (A.1311)
- *Poa lettermanii* Herbaceous Alliance (A.1327)
- *Poa nervosa* Herbaceous Alliance (A.1264)
- *Pseudoroegneria spicata* Herbaceous Alliance (A.1265)
- *Ribes montigenum* Shrubland Alliance (A.926)
- *Saxifraga (chrysantha, mertensiana)* Sparsely Vegetated Alliance (A.1632)
- *Sibbaldia procumbens* Herbaceous Alliance (A.1635)
- *Trifolium (dasyphyllum, nanum)* Herbaceous Alliance (A.1637)
- *Trifolium parryi* Herbaceous Alliance (A.1638)

SPATIAL CHARACTERISTICS

SOURCES

References: Anderson 1999, Baker 1980a, Bamberg 1961, Bamberg and Major 1968, Canadian Rockies Ecoregional Plan 2002, Comer et al. 2003, Cooper et al. 1997, Douglas and Bliss 1977, Ecosystems Working Group 1998, Komarkova 1976, Komarkova 1980, Meidinger and Pojar 1991, Neely et al. 2001, Schwan and Costello 1951, Thilenius 1975, Willard 1963

Version: 09 Feb 2005 **Stakeholders:** Canada, West

Concept Author: NatureServe Western Ecology Team **LeadResp:** West

CES306.Pending Northern Interior Spruce-fir Woodland and Forest

306, Forest and Woodland

Spatial Scale & Pattern: Large patch **Classification Confidence:** medium

Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland

Diagnostic Classifiers: Forest and Woodland (Treed), Udic, moderate Disturbance Interval, F-Landscape/Medium Intensity, Needle-Leaved Tree Picea glauca X engelmannii & Abies lasiocarpa dominants, Long (> 100 yrs) Persistence

Non-Diagnostic Classifiers: Montane [Montane], Montane [Lower Montane], Lowland [Foothill], Side Slope, Toeslope/Valley Bottom, Temperate, Temperate [Temperate Continental], Glaciated , Mesotrophic Soil

Concept Summary: This system occurs in interior British Columbia on the Fraser Plateau, Fraser Basin, Nass Basin, Central Canadian Rocky Mountains, Omineca Mountains, Skeena Mountains and Columbia Highlands and less so in the Rocky Mountain Trench and Thompson-Okanagan Plateau. It occurs between 500m and 1200m in the north and between 1000m and 1650m to the south. This is usually a closed forest with *Picea glauca or P. glauca X engelmannii* and *Abies lasiocarpa*. Younger stands may have *Pinus contorta, Pseudotsuga menziesii* or *Populus tremuloides* in the canopy. Understories typically are shrub and moss dominated. A moderately to well developed shrub layer commonly includes, *Lonicera involucrate, Ribes lacustre, Rubus parviflorus, Vaccinium membranaceum,* and *Viburnum edule.* A lush to moderately dense herbaceous layer may include *Cornus canadensis*, *Gymnocarpium dryopteris,* *Linnaea borealis*, *Rubus pedatus,*and *Tiarella unifoliata.* A moderately developed moss and lichen layer occurs in this system. This system appears over wide range of site and soils; middle to toe slopes, level areas or depressional areas usually morainal, fluvial or colluvial deposits. Some areas are moist, cool valley bottoms with cold air drainage.

DISTRIBUTION

Divisions: 207, 306

TNC Ecoregions:

Subnations/Nations: BC

CONCEPT

BC Broad Terrestrial Ecological Classification (1998):

- **DL Douglas-fir - Lodgepole Pine** in MSdc1 dc2 dm1 dm2 mw xk xk3 xv & SBSPmk SBS dw1 mm dw1
- **EF Engelmann Spruce – Subalpine fir Dry** in MS dc1 dc2 dm1 dm2 mw xk xk3 xv & SBS dw1 mm
- **SL Subboreal White Spruce - Lodgepole Pine** in MSdc1 dc2 dm2 xk xk3 & SBSPmk dw1 SBS mc1 mm
- **DF Interior Douglas-fir** in MSdc1 dc2 dm1 dm2 mw xk xk3 & SBSPS mk SBS dw1
- **SF White Spruce - Subalpine Fir** in MSdc1 cd2 dm1 dm2 mw xk xk3 & SBSdw1 mm

Associations:

SOURCES

References: Terrestrial Ecosystem task Force 1998, Meidinger and Pojar 1991, Wong, et al 2004.

Last updated: 05 Feb 2004 **Stakeholders:** WCS, CAN
Concept Author: R. Crawford **LeadResp:** WCS

CES306.Pending Northern Interior Dry-Mesic Mixed Conifer Forest

306, Forest and Woodland

Spatial Scale & Pattern: Matrix **Classification Confidence:** medium
Required Classifiers: Natural/Semi-natural, Vegetated (>10% vasc.), Upland
Diagnostic Classifiers: Forest and Woodland (Treed), Udic, Very Long Disturbance Interval, F-Landscape/Medium Intensity, Needle-Leaved Tree Pseudotsuga menziesii & Picea engelmann x glauca dominants, Long **(> 100 yrs) Persistence**

Non-Diagnostic Classifiers: Montane [Montane], Montane [Lower Montane], Lowland [Foothill], Side Slope, Toeslope/Valley Bottom, Temperate, Temperate [Temperate Continental], Glaciated , Mesotrophic Soil

Concept Summary: This ecological system occurs in interior British Columbia located between 500 and 1600 m elevation. The associated landscape is completely of glacial origin typical on gentle to steep slopes over well-drained to rapidly drained, nutrient poor, of colluvial, morainal, fluvial or glaciofluvial materials. Dense to open mixed conifer forests with shrub- or grass-dominated understories characterize this system. Canopies are usually composed of *Pseudotsuga menziesii* in the southern part of range while farther north and in more moist climatic zones it appears with *Picea engelmannii* X *glauca, Pinus contorta, Thuja plicata* or *Abies lasiocarpa. Betula papyifera* and *Larix occidentalis* may be canopy components in parts of the range. Understory dominance varies with local climate and site. Grass-dominated understory are usually *Calamagrostis rubescens*, sometimes with

Pseudoroegneria spicata. Shrub-dominated understories vary with site and location but often contain *Paxistima myrsinites, A. glabrum, Spiraea betulifolia, Symphoricarpos albus, Amelanchier alnifloia*, *Lonicera involucurata*, and *Rubus parvifolius.* Fire regimes are intermediate severity and frequency. Stand replacing fires estimated at 150 to 200 year return interval (Wong, 2004).

Comment: An absence of ponderosa pine in this system distinguishes it from the Northern Rocky Mountain Montane Mixed Conifer Forest system. Douglas-fir – ponderosa pine in bottomland position (IDFxh,xw) are part of the Ponderosa Pine Woodland and Savanna System.

DISTRIBUTION

Divisions: 306
TNC Ecoregions:
Subnations/Nations: BC:c, , WA:?

CONCEPT

BC Broad Terrestrial Ecological Classification (1998):

- **RB Western Redcedar - Paper Birch** in ICH mk1 mk2 mw2 mw5, IDFdk2 mw1 mw2 & MSdm2
- **RD Western Redcedar – Douglas-fir** in ICH mk1 mw2 mw3 mw5 & IDFdk2 dk2b dm1 mw1 mw2 xh1 xh1a xh2
- **DF Interior Douglas-fir** in ICH mk1 mk2 mw2 mw3 mw5 wk1 & IDFdm1 mw1 mw2 mw2b
- **DL Douglas-fir - Lodgepole Pine** in ICH mk2 mw2 mw3 mw5 wk1
- **SF White Spruce - Douglas-fir** in ICH mk1 mk2 mw3 mw5
- **IH Interior Western Hemlock** in ICH mk2

SOURCES

References: Terrestrial Ecosystems Task Force 1998, Meidinger and Pojar 1991
Last updated: 2 Feb 2004 **Stakeholders:** WCS, CAN
Concept Author: R.Crawford **LeadResp:** WCS

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APPENDIX 12 – ADDING OCCURRENCE DATA TO TERRESTRIAL ASSESSMENT UNITS

Appendix 12 – Adding Occurrence Data to Terrestrial Assessment Units

Fine-Filter Data Screening for Modeling Using MARXAN

The automated mapping of conservation site portfolios resulting from ecoregional assessment has been advanced significantly through use of the MARXAN software. This Appendix presents a rationale and guidelines for improving our methods of using fine-filter target occurrence data in this modeling process, with focus on local and intermediate scale targets as defined by Comer (2001).

The target occurrence data layers compiled during the process of ecoregional assessment not only inform the model in producing the resulting ecoregional site portfolio but, if well constructed, can also provide data for additional conservation priorities analyses.

Recent developments in ecoregional-scale modeling have focused on improving the representation of ecoregional-scale coarse-filter targets through the modeling and mapping of terrestrial and freshwater ecological systems, as well as improving conservation suitability/cost indices. Meanwhile, methods for representing fine-filter target habitats for modeling at this scale have received less attention.

To put the importance of fine-filter target occurrence data in perspective, it is important to understand their role in ecoregional assessment. Targets for ecoregional assessment are chosen to represent biodiversity through a coarse-filter/fine-filter approach: coarse-filter targets capturing ecological systems and their functions, and fine-filter targets representing rare or vulnerable populations of species or habitats which may not be adequately represented within coarse filter targets. To execute coarse-filter/fine-filter target capture through a data-driven model, spatial data layers must be created from available data to represent the distributions, locations, and extents of viable occurrences of both types of targets modeled at the appropriate scale.

Also notable is that the bulk of fine-filter occurrence data represent sites field inventoried by conservation biologists. Whereas coarse-filter occurrence data and suitability index data represent predictive models which include no quality assessment, the fine-filter occurrence data are ground-truthed sites which in many cases directly identify quality habitats needed for capture in the portfolio/scenario.

For these reasons, assembling a portfolio of sites which could conserve higher quality habitats for all targets will depend on how well the occurrence data presented to the model reflects the spatial extents and distributions of these occurrences. How efficient the portfolio will be in capturing these areas within a small portfolio footprint will depend upon how well the occurrence data are represented at the spatial scale of the model.

Achieving this goal is complicated by the wide variety of source data used for representing occurrences of fine-filter targets in ecoregional assessment. These source data may vary in how they represent target distribution and abundance, and in their spatial data types and scale accuracy, yet these data must be made comparable and merged to produce a data layer which informs the modeling process.

Results of the modeling process using a portfolio optimization tool such as MARXAN can be no more robust or defensible than the compiled data made available to the model as input data. With this in mind, two types of issues should be addressed when compiling and representing target occurrence data for modeling: *comparability* of occurrences, and *spatial representation* of occurrences at the scale of modeling.

Comparability: Meaningful statements of accounting for target capture through protecting portfolio conservation areas can only be made if we first have meaningful accounting of target presence, populations, abundance, and population viability in the modeled data from which the portfolio of sites was selected. For spatial modeling to succeed, it is essential that these data provide meaningful comparisons between individual populations, meta-populations, and habitats.

Likewise, *spatially representing occurrences* at the scale of modeling (best expressed by the size of analysis units used to model the data) is essential for automated site selection to succeed in capturing the extent of habitats supporting these targets, as expressed in the available data. Appropriate attention to scale and spatial data representation can improve our accuracy in modeling target habitats for prioritization within efficient conservation scenarios.

Step I. Data Screening

Target Occurrences are typically *disqualified* from occurrence data used in assessment based on these criteria:

- Old Observations: Observations greater than 20 years old may typically be disqualified; consider advice of data source, recent impacts to landscape, etc. Occurrences not found during recent surveys (element occurrences rank = f, ‘failed to find’) may be included or removed depending on priority of target and advice of data source.

- Historic or Extirpated: Occurrences known to be extirpated should not be used.

- Low Data Confidence: Consider eliminating unverified sightings, or records from non-credible sources.

- Not Viable: Occurrences with known low quality rankings or low probability of viability based on size/condition/landscape context (e.g., element occurrence rank below ‘c’) should not be used, particularly if data representing known viable populations are available.

  From Global Priorities Group, Purpose, Principles, and Standards for Ecoregional Assessments in The Nature Conservancy. Draft - 26 November, 2003:

  > “Where occurrences ranked for viability are available, those occurrences for which rank is unknown may be considered captured by the portfolio but should not be counted toward satisfaction of target goal.”

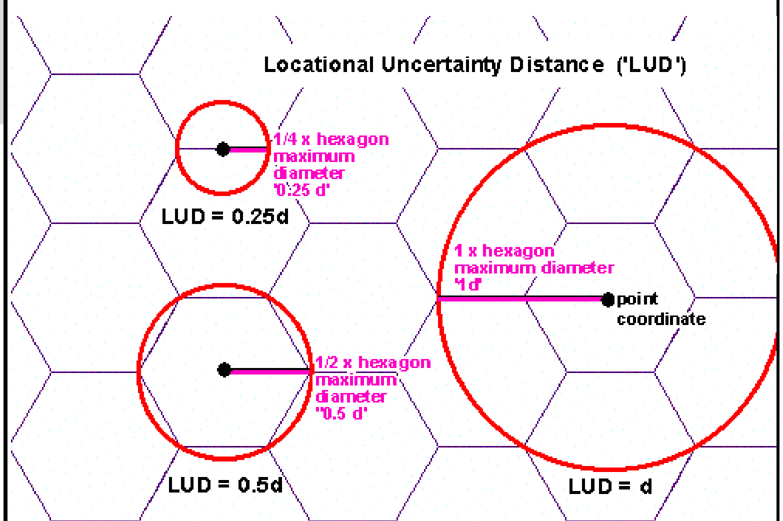
- Wide-ranging Animal Species: Wide-ranging animal species - or coarse-scale and regional-scale animal target occurrences as described by Comer (2003) - may require additional data screening steps, such as selecting habitat use areas or sub-EOs (non-contiguous patches within one element occurrence distinguished by distinct behaviors/life history functions, composition, density, quality, or conservation concern) such as nest sites, dens, etc. to be used in assessment.

- Imprecise locations: Mapped occurrences with high locational uncertainty should be disqualified.

Figure 15.

Locational Uncertainty is the estimated inaccuracy of any mapped location. This can be expressed as 'Locational Uncertainty Distance', in meters. Users can judge how locational uncertainty of occurrence data will affect spatial modeling performed by MARXAN, by comparing this measure can to the size of the analysis units surface used for modeling. In general, a data point coordinate mapped with a locational uncertainty distance less than the maximum diameter of the analysis unit (LUD<1d) may be suitable for use in modeling, while less accurately-mapped data (LUD>1d) are not. Data points mapped with LUD>0.25d should be used only with appropriate decision rules applied. These are discussed in Step II.

Hexagonal AU Area	Hexagonal AU maximum diameter 'd'
250 ha	1960 m
500 ha	2660 m
750 ha	3260 m



Locational uncertainty of three data points. Thresholds of LUD<0.25 d, and (0.25d<LUD<1d) are referred to in Step II.

Figure 16.

To scale point or small polygon-based occurrences to the analysis surface used for modeling, estimate the locational uncertainty of the data and compare this to the size of the AU. Point occurrence data acquired from NatureServe Biotics, BCD, CDC or other sources include codes or values which may be translated into locational uncertainty distance in meters. The table below categorizes data by locational uncertainty, and relates these to the modeling treatments described in Step II.

Locational Uncertainty Distance (LUD) of data (m) *- NatureServe* *- TNC EA Data Standard 1.0*	Other values used to express LUD			Occurrence modeling categorized by Locational Uncertainty Distance (LUD) of data relative to size of AU.
	Precision Code *- BCD, NatureServe*	Township Range Section *- U.S.*	COORD Code *- WA DFW*	LUD of data relative to diameter ('*d*') of 500-ha hexagon AU
100	S	¼ ¼ section	-	LUD < 0.25d
400	-	¼ section	C or U	LUD < 0.25d
1000 - 1300	M	section	N	0.25d < LUD < 0.5d
1300 - 2600	M	multiple sections	N	0.5d < LUD < 1d
> 4000	G	township +	G	LUD > 1d

Step II. Populating MARXAN with fine-filter target occurrence data

Automated modeling of a conservation portfolio is accomplished through MARXAN by subdividing the planning region into analysis units equal or smaller in size than the size desired to represent portfolio sites. The conservation site portfolio is determined by selecting those analysis units to be included or excluded from the portfolio. The scale of modeling is best described by referencing the size of analysis unit surface used.

Practitioners of automated portfolio assembly should consider the scale accuracy and extents of the spatial representations of target occurrences used for modeling in relation to the scale of spatial analysis units to which these occurrences will be assigned to build portfolio scenarios. A simple use of MARXAN will allow all fine filter occurrences to be represented as point locations modeled against large hexagonal analysis units, but this is likely to result in an automated portfolio of sites with a large and poorly-defined portfolio footprint. Modeling with smaller analysis units may produce a smaller-footprint portfolio in which these units agglomerate into sites which better represent the spatial extents of target habitats. In this case, the spatial extent of some individual occurrences may be significantly larger than the analysis unit size, and representation of larger occurrences would utilize multiple units. This provides an opportunity to improve the efficiency and spatial accuracy of the automated portfolio.

An adequate method should result in high probability of capturing sites which circumscribe viable occurrences and habitats, while enabling efficient solutions (reducing the footprint size of the portfolio/scenario). Achieving this balance through modeling commonly available fine-filter data presents some challenges, particularly in cases where occurrences are imprecisely located but are needed for capture in the portfolio/scenario, or where occurrences are represented by multiple point-observation records (rather than element occurrence records, or population-based, records). In refining this method, these rules of thumb were observed:

> Comparability across the spatial extent of the data: Represent occurrences scaled to the analysis unit (hexes/hucs) used for modeling such that any subset of analysis units are likely to provide target presence and abundance results comparable to any other subset of analysis units. Similar methodology used in adjacent sections of ecoregions should yield comparable results.
>
> Comparability of measures: Seek comparability of occurrence measures (count, abundance, extent, and viability) within each target. Establish one measurement for all occurrences of a target whenever possible. Insure that populations which spatially occupy multiple analysis units are counted and captured as single populations.

Five treatments for modeling fine-filter data based on spatial data type and locational uncertainty:

Below, five different treatments are described to achieve fine-filter target representation in the populated analysis units used for modeling in MARXAN. Each treatment is designed to optimize the representation a common spatial type of occurrence data. Each of these treatments is designed to populate the SPECIES.DAT and PUVSPR.DAT data files.

1. Area Occurrences
2. Single Point Occurrences
3. NatureServe Multi-polygon Element Occurrences
   or Precisely-Mapped Species Population Polygon Occurrences
4. Multi-point Occurrences
5. Imprecise Occurrences

The first two treatments should be familiar to MARXAN practitioners, while the 3rd, 4th, and 5th treatments represent innovations which were tested using the Okanagan and North Cascades Ecoregional Assessments. These methods should be applicable for modeling using analysis units ranging from 250 – 750 hectares or so. The examples below assume a 500-hectare analysis unit.

Abbreviations:

TGT=Target, TO=Target Occurrence, LUD=Locational Uncertainty Distance, AU=Analysis Unit, S = side length of hex.

Definitions: (following TNC Ecoregional Data Standard 1.0)

<u>Locational Uncertainty</u>: The estimated inaccuracy of any mapped point, expressed in meters. Locational uncertainty distance associated with a point represents a potential area

of land/water surrounding that point where the occurrence may exist, and so represents an area which must be captured if the occurrence is to be considered captured.

This area of uncertainty corresponds to the scale at which the point data are accurate. Use of this term in our data standard conceptually follows the NatureServe Element Occurrence standard (specifically, the "point areal estimated uncertainty" definition), but since ecoregional assessment occurrence data are managed only to support coarse-scale modeling, target occurrences *are not* managed to meet the NatureServe standard.

<u>TO Abundance</u>: "Target Occurrence Abundance": Known or estimated amount of the target represented in an occurrence, as expressed in number of occurrences, number of hectares in size, number of kilometers in length, etc.

Modeling Treatments:

1. <u>Polygon-mapped data representing populations, habitats, or systems which are delineated and measured as areas</u>.

Identify targets whose occurrences must be measured as areas. Examples include system targets for which patches may be aggregated to represent a minimum dynamic area of the system, polygon-mapped data representing habitat areas used by a species and which must be measured by area, or large polygon-mapped community element occurrences which span many AUs.

<u>Occurrences GIS Layer</u>:

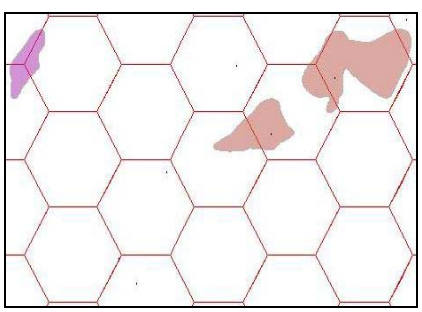
- Use polygon element occurrences or habitat areas mapped with high precision (LUD < 0.25d)

<u>MARXAN PUVSPR.DAT[14]</u>:

- Intersect TO polygons with AUs. For each Target, the sum of TO Abundance in AU (in area) = 'Amount'.

<u>MARXAN SPECIES.DAT</u>:

- Set TGT Minimum Area in hectares (MARXAN SPECIES.DAT Target2 = '#') to insure that adjacent AUs are selected until the entire occurrence area is captured.



[14] See end of Appendix 13 for how MARXAN applies the fine filter targets to the SPEC.dat and PUVSPR.dat.

2. Single Point Occurrences: (Single-point observation, polygon, or EO, with locational uncertainty distance and extent both < 0.5d):

Fine-filter target occurrences which are represented in source data as single point locations with low locational uncertainty can be modeled in MARXAN by simply intersecting the point layer with the AU layer. Source data of this type may include point data originating from NatureServe member program data in the old BCD format for Element Occurrence Records (representing populations or sub-populations), or from other sources of single point observations deemed representative of extant populations.

In some cases, polygon or multi-point representations of populations may be reduced to the single-point occurrence type for modeling, but this treatment sacrifices the ability to represent the full spatial extents of target habitats at the scale of the model. Appropriate treatments for those data types are discussed below.

Occurrences GIS Layer:

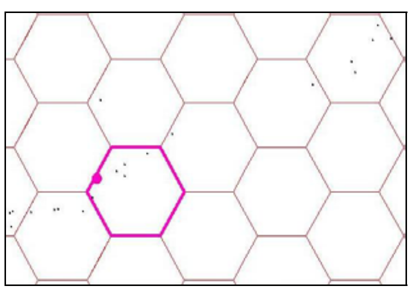
- One point per occurrence record
- For each target, separation distance (as standardized by current NatureServe element specification) between observations is examined, and point observations within separation distance should be represented as multi-point observations (see #4).

MARXAN PUVSPR.DAT:

- Intersect TO points with AUs. For each Target, 'Amount' = the sum of TO Abundance within AU (in number of occurrences).

MARXAN SPECIES.DAT:

- TGT Minimum Area not needed (MARXAN SPECIES.DAT Target2 = '0')



3a. Polygons representing populations and which incorporate locational uncertainty (e.g. NatureServe Biotics Multi-polygon Element Occurrences):

3a) Biotics EO spatial reps are polygons which include a measure of locational uncertainty incorporated in the polygons. To model these data at ecoregional scale, we must filter out those polygons which represent a level of uncertainty too coarse to inform our spatial model. This can be largely accomplished by identifying circular polygons larger than a given size - which represent point source data represented with added locational uncertainty

– and removing these data from our target occurrence spatial layer which will be intersected with AUs to populate PUVSPR.DAT.

Occurrences GIS Layer:

- Set a field in your occurrences table which represents each unique occurrence (EOCODE or EOID will work, or create a field from ELCODE+EO Number). Keep this attached to your data until ready to create the final PUVSPR.
- Identify and remove circular polygons > 1d in diameter (These represent point-sources with LUD>0.5d) (see Fig. 1). Remove only these polygons and not other polygons comprising those EOs. Do not remove polygons if they are not circular. These may be set aside in a separate data set and
- Each multi-polygon EO represents '1 occurrence', regardless of the numbers or sizes of polygons. The spatial rep includes a measure of uncertainty
- Intersect polygons with AUs. Calculate 'Proportional Amount' = proportion of area of the occurrence captured within an AU. (i.e., ½ area of polygons for one EO captured in an AU yields an Amount=0.5 occurrences for that Target.
- Note that some AUs containing a Proportional Amount are sliver polygons resulting from the GIS intersection of EO rep polygons (incorporating LUD) and AUs. These 'sliver amount' AUs have a low probability of target presence. Filter these from your data so that these AUs are not selected in your solution. To do this, delete the intersected AUxOccurrence records which contain the smallest Proportional Amount while preserving > 75% of the area of each occurrence. This will provide the PUVSPR with only the 'core areas' of these occurrences represented in AUs, and not force the model to select AUs which have low probability of target presence based on locational uncertainty of the source data.
- Since removing these 'sliver amounts' has reduced Proportional Amount to less than 1 for some occurrences, normalize all Proportional Amounts so that they sum to 1 for each occurrence. Use this new value for 'AMOUNT' in PUVSPR.
- This will now allow AUs representing the core 75% of 'mapped+uncertainty' areas to be captured by the model to satisfy goals, while representing the count of occurrences in PUVSPR data to remain equal to that represented in the original polygon data.

MARXAN SPECIES.DAT:

- Since not all occurrences occupy contiguous AUs (non-contiguous clumps of AUs will represent occurrences), we cannot use Target Minimum Area to force contiguous AUs to be captured intact. SPECIES.DAT Target2 must be left at 0.

Alternate method: For occurrences occupying contiguous AUs (contiguous clumps of AUs represent each occurrence), then:

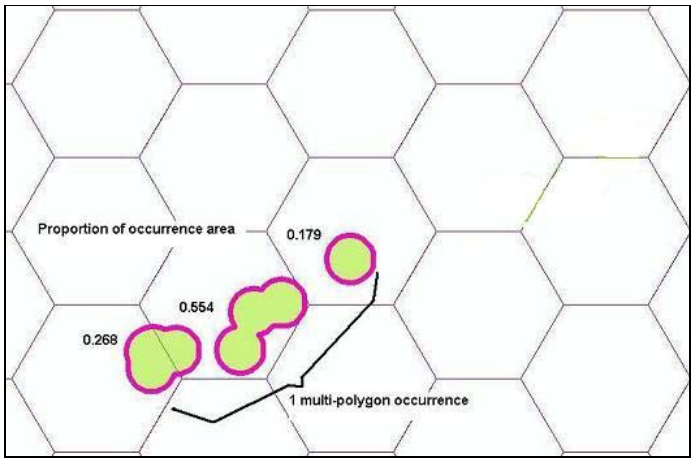
MARXAN PUVSPR.DAT:

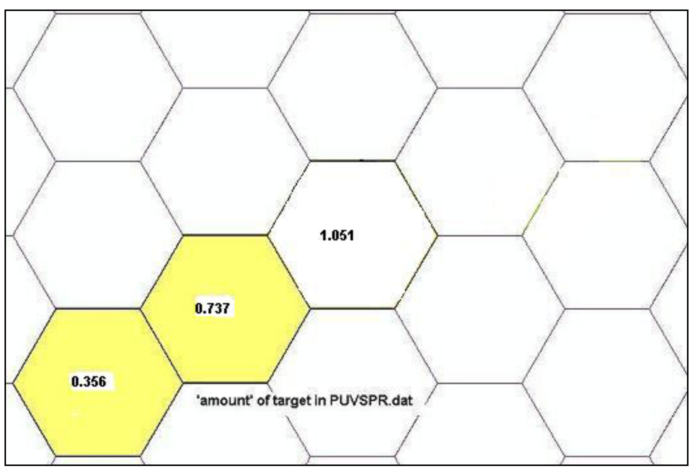
- Multiply These Proportional Amounts X 1.33 and use this value for 'AMOUNT'. This will allow AUs representing the core 75% of 'mapped+uncertainty' areas to be captured by the model to satisfy a '1 occurrence' goal. By using Target2 in

Spec.dat, the model will not be required to capture all of those slivers when capturing occurrence.

MARXAN SPECIES.DAT:

- Set the Target Minimum Area to '1 occurrence' (MARXAN SPECIES.DAT Target2 = 1) to force contiguous AUs representing one occurrence to be captured intact. Once MARXAN has captured AUs totaling 1 occurrence for the target. For targets in which single occurrences are represented by non-contiguous AUs, Target2 must be left at 0.





3b. Polygons representing populations which are precisely-mapped:

Polygons mapped with high precision and measured in 'occurrences' (instead of 'hectares') can be treated similarly to (a), minus the first step in which large LUC circular polygons were deleted. The key is to insure than intersected polygons are cumulatively counted as '1 occurrence', and the model is encouraged to clump these units to meet the minimum area requirement of 1.

Occurrences GIS Layer:

- Set TO Abundance of each multi-polygon EO = ‘1 occurrence’.

MARXAN PUVSPR.DAT:

- Intersect polygons with AUs. ‘Amount’ = proportion of area of the occurrence captured within an AU. (i.e., ½ area of polygons for one EO captured in an AU yields an Amount=0.5 occurrences for that Target.

MARXAN SPECIES.DAT:

- For any Target in which all occurrences are represented in PUVSPR as contiguous clumps of AUs, the modeling may be improved by setting the Target Minimum Area to ‘1 occurrence’ to force contiguous AUs representing one occurrence to be captured intact. Additionally, this value may be reduced to a value such as, for example, 0.90 occurrence (MARXAN SPECIES.DAT Target2 = ’0.90’) to allow the model to ignore slivers of area polygons comprising <10% of the occurrence, so that the model does not over-represent the extent of these occurrences by selecting AUs containing little Target amount. For targets in which single occurrences are represented by non-contiguous AUs, Target2 must be left at 0.

4. Multi-Point Occurrences (Multiple point-observations mapped within element separation distance):

Use this method to represent occurrences at scale when the occurrence is represented by a group of observation points (or EO source features) which represent the known location and extent of a population or subpopulation which has a spatial extent significantly greater than one AU. Occurrences are distinguished from one another based on the species-specific separation distance (as defined by NatureServe) and on the presence of movement barriers or intervening large gaps in suitable habitat, where this information is known.

Occurrences GIS Layer:

- Screen data for age, quality, viability.
- Use only low LUD data points, screen out LUD > 0.5d.
- Apply element separation distance between occurrences.
- Select points with locational uncertainty distance < 1 km, identify each point record belonging to one occurrence with the same occurrence number.

MARXAN PUVSPR.DAT

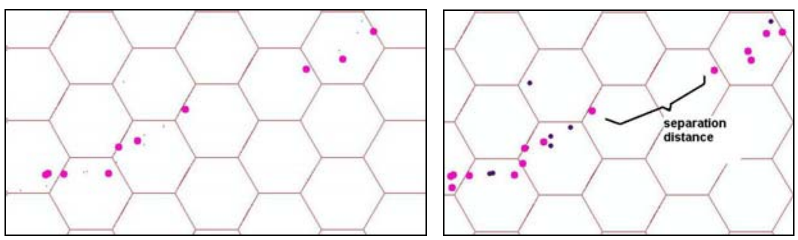
- Each multi-polygon EO represents ‘1 occurrence’, regardless of the numbers or sizes of polygons. The spatial rep includes a measure of uncertainty
- Intersect polygons with AUs. Calculate ‘Proportional Amount’ = proportion of area of the occurrence captured within an AU. (i.e., ½ area of polygons for one EO captured in an AU yields an Amount=0.5 occurrences for that Target.
- Note that some AUs containing a Proportional Amount are sliver polygons resulting from the GIS intersection of population-based polygons (incorporating negligible

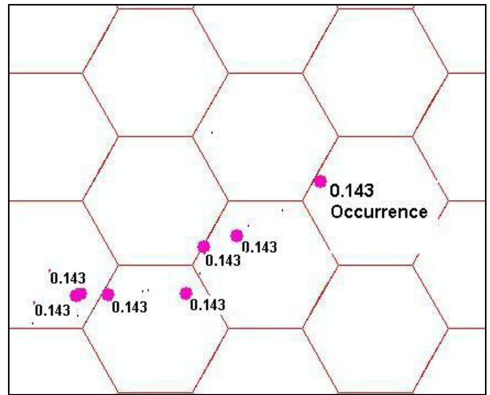
locational uncertainty) and AUs. These 'sliver amount' AUs have a low probability of target presence. Filter these from your data so that these AUs are not selected in your solution. To do this, delete the intersected AUxOccurrence records which contain the smallest Proportional Amount while preserving > 85% of the area of each occurrence. This will provide the PUVSPR with only the 'core areas' of these occurrences represented in AUs, and not force the model to select AUs which have low probability of target presence based on locational uncertainty of the source data.

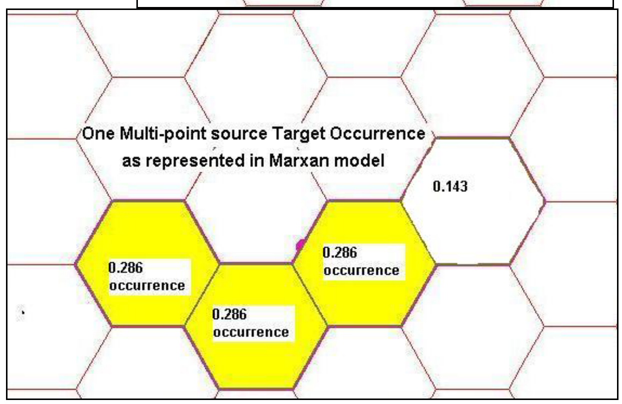
- Since removing these 'sliver amounts' has reduced Proportional Amount to less than 1 for some occurrences, normalize all Proportional Amounts so that they sum to 1 for each occurrence. Use this new value for 'AMOUNT' in PUVSPR.
- This will now allow AUs representing the core 85% of 'mapped population' areas to be captured by the model to satisfy goals, while representing the count of occurrences in PUVSPR data to remain equal to that represented in the original polygon data.

MARXAN SPECIES.DAT:

- For any Target in which all occurrences are represented in PUVSPR as contiguous clumps of AUs, the modeling may be improved by setting the Target Minimum Area to '1 occurrence' to force contiguous AUs representing one occurrence to be captured intact (MARXAN SPECIES.DAT Target2 = '1'). For targets in which single occurrences are represented by non-contiguous AUs, Target2 must be left at 0.







5. <u>Spatially Imprecise Point Occurrences - Single-point observation or EO, separation >= element separation distance, with location uncertainty distance (0.25d< LUD<1d) (e.g., NatureServe M precision EOs)</u>:

Some rare species have few or poorly-mapped data available. Yet, sometimes poorly-mapped data must be used to represent capture of a target to achieve a desired goal. In general, a data point coordinate mapped with a locational uncertainty distance less than the maximum diameter of the analysis unit (LUD<1d) may be suitable for use in SITES/MARXAN modeling, while less accurately-mapped data (LUD>1d) are not.

A simple intersection of data points mapped with (0.25d< LUD<1d) with AU polygons will result in a high probability of populating AUs with targets incorrectly in the PUVSPR.DAT.

To use data points mapped with (0.25d< LUD<1d), consider the footprint area of AUs which would be need to be captured for high probability of capturing the occurrence, and the likelihood of the occurrence being present in each of those AUs. Using these data in this model will require that portfolio sites intended to capture these occurrences may have a larger footprint which incorporates this locational uncertainty.

<u>Occurrences GIS Layer</u>:

- Data with higher locational uncertainty (0.25d to 1d, or 665 to 2660-m with 500-ha AU) should be used <u>only</u> where more precisely located occurrences are too few in number to meet the goal for the target.
- Occurrences with LUD>1d may be unsuitable for modeling.

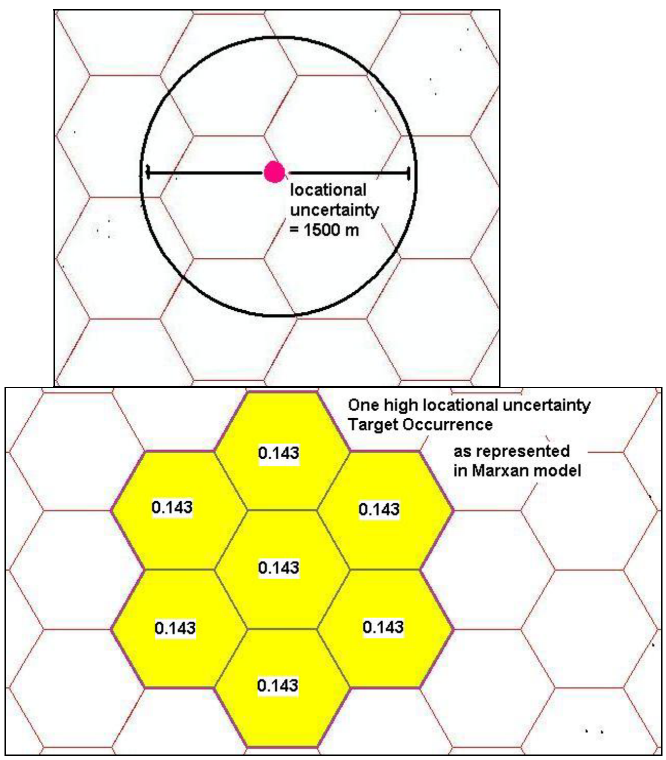
- Use only those imprecise points which pass rigorous data screening.
- Separation distance between occurrences should consider LUD.

MARXAN PUVSPR.DAT

- Intersect TO points with AUs. For each AU populated by one of these occurrences, populate the target's "Amount=0.143 occurrences" to represent the *probability* of the occurrence being present within that AU, then
- in the six AUs surrounding that AU, populate the target as "Amount'=0.143 occurrences" to represent the *probability* that the occurrence may be present in any of those 7 AUs.

MARXAN SPECIES.DAT:

- TGT Minimum Area = 1 occurrence (MARXAN SPECIES.DAT Target2 = '1') to insure that if the occurrence is captured, all AUs which have a probability of containing the occurrence are captured until it becomes likely that 1 occurrence has been captured.
- This spatial footprint of 7 AUs provides high likelihood that the automated portfolio will capture these rare and poorly mapped occurrences.



SPEC.dat and PUVSPR.dat in MARXAN

To design an optimal conservation portfolio/scenario through an automated and data-driven method, MARXAN examines each individual analysis unit for the abundance of targets represented within that geographic space. The model then selects and aggregate these units to meet the goals and minimum area requirements assigned to each target.

An understanding of how data are represented in the MARXAN model is necessary to understand the fine-filter modeling scenarios presented below. Target, and target occurrence data are represented in two files: SPECIES.DATA and PUVSPR.DAT.

The SPECIES.DAT file contains one record for every conservation target in each stratification unit. Each record identifies the stratified target, its goal, minimum clump size, and penalty factor. The goal represents the total abundance of the target desired for capture across a stratification unit, and is expressed as number of occurrences, hectares (area of system or habitat), or points (representing weighted occurrences or hectares) that should be captured by MARXAN analysis units selected in the automated portfolio. Minimum clump size ("Target2" field in SPECIES.DAT), refers to the minimum abundance of a target which must be captured by adjacent selected analysis units in order for those captured occurrences to count toward satisfaction of the target's goal for capture. Setting a minimum clump size for a target increases the likelihood that the portfolio will represent conservation areas which capture entire occurrences, and reduces fragmentation over the automated portfolio.

The PUVSPR.DAT file in MARXAN reports the abundance of any target represented in each analysis unit. To achieve this representation, GIS is used to intersect the spatial layer representing target occurrences must be intersected with the spatial layer of analysis units. This recompiles the occurrences at the scale of the analysis unit, and may cause occurrences of targets to be aggregated into analysis units or split between units, depending on their spatial arrangement and representation.

APPENDIX 13 – SUITABILITY INDICES

Appendix 13 – Suitability Indices

13.1. Terrestrial Suitability Index

The terrestrial cost suitability is expressed quantitatively as:

Terrestrial Suitability = A * management_status + B * land_use + C * road_density + D * future_urban_potential

A, B, C, and D are weighting factors, calculated from expert input and pairwise comparison, which collectively sum to 100%. The suitability index factors are shown in Map 11. Map 12 shows the combined terrestrial suitability index factors.

Weights, summing to 100% of the category, were also applied to sub-factors within management status and land use class. For example:

land_use = q * % urban + r * % agriculture + s * % mine + t * % timber harvest + u * % intensive recreation

Values for each factor (or sub-factor) are based on the percent area of that factor in the assessment unit. Values for each factor are normalized prior to applying the weights according to the following equation:

Normalized score = (score for that AU / highest score for all AU)

Weights were obtained through input from 16 people, consisting of 7 members of the core team and 9 outside experts. Eight of the respondents were from BC while 8 were from Washington. Outliers from respondents weights were discarded before finalizing the mean weights from the pairwise comparison in the tables below. Because the management status categories differ between BC and WA, responses from each jurisdiction were compiled separately then merged to finalize their mean weights.

Table 9. Components of the terrestrial suitability index.

Factor/Sub-factor		Weight / Sub-weight	Description
Management Status (Gap/Sub-gap code)		0.361	mean level of protection given biodiversity; based on all landowners or land managers within assessment unit
GAP 1	J	1.61	US or Canadian National Parks, designated wilderness areas, USFWS wildlife refuges, Provincial Ecological Reserves (IUCN 1a), Provincial Parks (IUCN Ib, II or III), most Conservation trust lands, Federal National Wildlife Area or Migratory Bird Sanctuary, Regional Park (conservation focus)
GAP 2	I	2.37	State or Provincial Protected Areas (Goal 2 PA), state or provincial wildlife management areas, Regional park (nature focus)
GAP 3 / Crown	K	8.89	Provincial Crown Lands (with or without TFLs), Provincial UREP, some Conservation trust lands, Research forests, BC Hydro Recreational Areas, Recreation camps, Regional/municipal park
GAP 3 / CW	L	8.67	Provincial Crown Lands or private lands with designated community watershed

Factor/Sub-factor		Weight / Sub-weight	Description
GAP 3 / OGMAs	M	10.64	Provincial Crown Lands with designated old growth management area, Conservation trust lands (farms), Provincial Park (designated mining/tourism), Provincial Protected Areas (IUCN VII), Regional park (recreation focus)
GAP 3 / fed / LSR	H	1.57	US National Forest late successional reserves under NW Forest Plan
GAP 3 / fed / AMA	G	2.38	US National Forest adaptive management areas under NW Forest Plan
GAP 3 / fed / Matrix	F	2.93	US National Forest managed as Matrix under NW Forest Plan
GAP 3 / fed	E	4.50	US National Forest NOT managed under NW Forest Plan
GAP 3 / state / HCP	D	6.23	Washington State forest lands with Federal habit conservation plan (HCP)
GAP 3 / state	C	10.58	Washington State forest
Gap 4 / HCP	B	14.77	Private or Tribal Lands with federal habitat conservation plan (HCP)
GAP 4 - BC	A	67.82	Private or Indian Reserves - BC
GAP 4 - WA	A	53.05	Private or Tribal Lands - WA

Maximum GAP sub-factor weights sum to 100 for BC and WA
BC GAP = A(BC) +I + J + K + L + M (sub-codes)
WA GAP = A(WA) +B + C + D + E + F + G + H + I + J (sub-codes)

Factor/Sub-factor	Weight / Sub-weight	Description
Converted Land Use	0.447	percent of area converted to agricultural, timer harvest, mining, intensive recreation and mining land uses
Agriculture	9.4	
Timber Harvest	7.7	
Mining	15.2	
Intensive Recreation	5.7	
Urban	62.0	
Road Density	0.09	road km/km^2 within assessment unit
Road Density value = 0.09 * road density (hex) / highest road density (hex) (note: one hexagon had a road density outlier of 176 km2 which was dropped to 28 km/km2)		
Future Urban Potential	0.102	potential for future residential development; based on urban growth modeling

Factor/Sub-factor	Weight / Sub-weight	Description
		Future Urban Potential value for = 0.102 * Future Urban Potential (hex) / highest Future Urban Potential (hex)

The initial factors for the terrestrial suitability index were identified through expert interview and the on-the-ground knowledge of team members. These factors were prioritized and we were only able to use the top priority ones which we had data for. Other factors considered, but ultimately not incorporated in the suitability index, include:

Table 10. Factors considered but not used in the terrestrial suitability index.

Factor	Comments
Dams	Used in freshwater. Could consider reservoirs and/or flooded landscapes in future iterations.
Pests and Disease	Forest health data available from BC MoF Southern Interior Region (1996-2003). Forest health and protection data, forest insect, and disease aerial surveys (1980-2003) available from US Forest Service. Data in differing formats and does not consistently/comprehensively cover the ecoregion.
Invasive / Alien Species	Many local datasets, differing resolution – lack of a comprehensive dataset. Different species have differing impacts on various elements of biodiversity.
Grazing	Lack of data.
Pollution	Level of emissions not equivalent to amount of impact to biodiversity. Difficult to correlate the two, so not considered for index.
Fire Condition	Departure from natural fire condition regime not a significant factor in the North Cascades. Lack of data for BC.
Climate Change	Macro factor – too broad for inclusion in an ecoregional context.

13.2. Freshwater Suitability Index

The freshwater cost suitability is expressed quantitatively as:

Freshwater Suitability = A * management_status_score + B * land_use_score + C * dams_score + D * water_extraction_score + E * fish_stock_score + F * road_density_>50%_gradient_score + G * road_stream_crossing_score + H * riparian_disturbance_logging_score

A, B, C, D, E, F, G and H are weighting factors, calculated from expert input and pairwise comparison, which collectively sum to 100%. Map 13 shows the combined freshwater suitability index factors.

Weights, summing to 100% of the category, were also applied to sub-categories within management status and land use class. For example:

land_use = q * %_urban + r * % agriculture + s * % mine

Values for each factor (or sub-factor) are based on the percent area of that factor in the assessment unit. Values for each factor are normalized prior to applying the weights according to the following equation:

Normalized score = (score for that AU / highest score for all AU)*100

Weights were obtained through input from 2 people, consisting of 1 member of the technical team and 1 outside expert. All of the respondents were from BC. Weights from BC respondents were assigned to the 8 assessment units in the Lower Fraser EDU which were located in Washington State. Since we did not have data for many of the factors in Washington State, the weights were prorated and adjusted to sum to 1 for the factors for which we had data.

Table 11. Components of the freshwater suitability index.

Factor/Sub-factor		Weight / Sub-weight	Description
Management Status (Gap/Sub-gap code)		0.053	mean level of protection given biodiversity; based on all landowners or land managers within assessment unit
GAP 1	J	7.5	US or Canadian National Parks, designated wilderness areas, USFWS wildlife refuges, Provincial Ecological Reserves (IUCN 1a), Provincial Parks (IUCN Ib, II or III), most Conservation trust lands, Federal National Wildlife Area or Migratory Bird Sanctuary, Regional Park (conservation focus)
GAP 2	I	9.0	State or Provincial Protected Areas (Goal 2 PA), state or provincial wildlife management areas, Regional park (nature focus)
GAP 3 / Crown or State	C/K	22.6	Provincial Crown Lands (with or without TFLs), Provincial UREP, some Conservation trust lands, Research forests, BC Hydro Recreational Areas, Recreation camps, Regional/municipal park, Washington State forest
GAP 3 / CW	L	4.5	Provincial Crown Lands or private lands with designated community watershed
GAP 3 / OGMAs	M	11.3	Provincial Crown Lands with designated old growth management area, Conservation trust lands (farms), Provincial Park (designated mining/tourism), Provincial Protected Areas (IUCN VII), Regional park (recreation focus)
GAP 4	A	45.1	Private or Indian Reserves – BC. Private or Tribal Lands - WA
Converted Land Use		0.195	percent of area converted to agricultural, timer harvest, mining and mining land uses
Agriculture		15.7	
Timber Harvest		10.8	
Mining		34.3	
Urban		39.2	
Dams		0.233	Presence of dams in watershed
Water Extraction		0.156	Volume of water licensed for extraction from watershed as a ratio of accumulative precipitation yield
Stock Enhancement		0.078	Presence of fish stock enhancement in watershed since 1950 expressed as a ratio of area of lakes stocked vs total area of lakes in the watershed.

Factor/Sub-factor	Weight / Sub-weight	Description
Road Stream Crossing	0.053	Total road-stream crossing density
Road Density – gradients > 50%	0.117	Road length density on a gradient >50%
Riparian Disturbance	0.117	% Recently Logged area within 30 m of stream

The initial factors for the freshwater suitability index were identified through expert interview and the on-the-ground knowledge of team members. These factors were prioritized and we were only able to use the top priority ones which we had data for. Other factors considered, but ultimately not incorporated in the suitability index, include:

Table 12. Factors considered but not used in the freshwater suitability index.

Factor	Comments
Hatcheries	Hatcheries are suggested to have adverse impacts on freshwaterecosystems. They were not included in the suitability index because the information on species raised and released was very unreliable. This problem is compounded by the common practice of trucking smolts to other drainages for release. Also, the effects of hatcheries vary with management and size of the hatchery. Partially captured through fish stocking data.
Water Quality/Pollution	No comparable dataset to 303 d in BC
Invasive / Alien Species	Lack of available data. Partially captured through fish stocking data.
Climate change	While climate change can have significant impacts of the freshwater environment, ranging from elimination of glaciers to altering the peak-flow, adequate modeling was not available.
Species extraction	Harvest of freshwaterspecies, both legal for recreational and commercial purposes and illegal, lack data.
Hydrographic changes	Alterations to peak flow have a significant impact on biodiversity, but could not be modeled for inclusion to the index at a suitable scale in the timeframe available for this project.

13.3. Suitability Index Inputs

Management Status

Management status is used to influence the selection of an assessment unit as part of the portfolio by steering the model to select areas already explicitly managed for conservation such as a park or wildlife management area. Although the existing network of conservation lands leaves several significant gaps in the representative coverage of biodiversity in the North Cascades ecoregion, they form a basis from which an adequate network of conservation areas can be built.

Allowing the model to preferentially select existing conservation lands is based on two assumptions. First, because these lands are actively managed for conservation values, they are likely to support viable species and ecosystems. Healthy and persistent species and ecosystems improve the likelihood of conservation success. Second, the financial and social costs of conservation are lessened if adequate conservation can be achieved on lands already managed for conservation, freeing other areas for alternate uses, such as development.

To integrate management status in the cost suitability index, we assigned one of four stewardship ranks, also know as Biodiversity Management Status Categories, to lands and waters across the ecoregion. Ranks were based on the scale developed by the Gap Analysis Program (GAP) designed by the US Department of Interior and the United States Geological Survey (USGS)15. The stewardship ranks were broken down to fourteen sub-codes to assign finer weights, as described above in the Tables 13 and 14.

In GAP, the land stewardship rank combines attributes of ownership, management, and a measure of intent to maintain biodiversity. The term "stewardship" is used because the legal owner of a piece of land is not necessarily the same as the land manager or management regime. It should be noted that management and ownership of lands and waters are complex and change rapidly – what has been created for this ERA is a small scale overview using the best information available at the time.

Using the above criteria, the four biodiversity management status categories can generally be defined as follows (Crist, 2000 - after Scott et al., 1993, Edwards et al., 1994, Crist et al., 1996):

Status 1: An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a natural state within which disturbance events (of natural type, frequency, intensity, and legacy) are allowed to proceed without interference or are mimicked through management.

Examples: national parks, wilderness areas, and nature preserves

Status 2: An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a primarily natural state, but which may receive uses or management practices that degrade the quality of existing natural communities, including suppression of natural disturbance.

Examples: state and provincial parks, wildlife refuges, and national recreation areas

Status 3: An area having permanent protection from conversion of natural land cover for the majority of the area, but subject to extractive uses of either a broad, low-intensity type (e.g., logging) or localized intense type (e.g., mining). It also confers protection to federally listed endangered and threatened species throughout the area.

Examples: national forests, wildlife management areas, and Bureau of Land Management lands.

Status 4: There are no known public or private institutional mandates or legally recognized easements or deed restrictions held by the managing entity to prevent conversion of natural habitat types to anthropogenic habitat types. The area generally allows conversion to unnatural land cover throughout.

Land management data was most difficult to obtain. Land ownership and management statuses are fairly fluid creating a difficult, moving target for the planner. Additionally,

[15] http://gapanalysis.nbii.gov/portal/server.pt

Canadian land management categories are very different from American, making a smooth dataset across the ecoregion even more difficult to create.

Land management for Washington was based on a managed land data layer created by TNC staff. This layer was based primarily on Washington Department of Natural Resources POCA[16] and MPL[17] data sets, updated with lands owned by TNC and other Land Trusts TNC staff assigned a GAP sub-codes for each parcel based on the management and/or manager of the land parcel.

Land management for BC was developed by merging the numerous data layers (listed below) together and following the procedure laid out by Crist (2000) to assign a GAP code for each parcel.

Table 15. Data sources for BC GAP.

Layer	Source	Date	Scale
Provincial Park	BC Gov't (Added IUCN rank) ftp://ftp.env.gov.bc.ca/dist/arcwhse/parks/	2005	1:20,000-1:250,000
Goal 2 PA	Central Coast LRMP G2 candidates Lillooet LRMP	July 2005 2004	1:20,000 1:20,000
Regional Park	Greater Vancouver, Fraser Valley, Sunshine Coast, Powell River BC Conservation Mapping Project	Circa 2005 April 2005	~ 1:20,000 1:20,000
Prov. tenures w/conservation value	BC Gov't	1999-2003	1:20,000
Trust Land	BC Conservation Mapping Project Includes lands owned by the Nature Conservancy of Canada, The Nature Trust and Ducks Unlimited	April 2005	1:20,000
Wildlife Mgt Areas	BC Conservation Mapping Project Includes National Wildlife Areas / Migratory Bird Sanctuaries DFO MPA and fishery closures mapped from http://www.pac.dfo-mpo.gc.ca/oceans/closure/sites.pdf	April 2005 Current to 1997. Mapped in 2003	1:20,000 various
Indian Reserve	BC Gov't (tir_bc)	2002	1:20,000
Private land	BC Gov't (qpri_bc)	Circa 1990s	1:250,000
Tree Farm Licenses	BC Gov't (ttfl_bc)	2002	1:20,000
Community Watersheds	BC Gov't ftp://ftp.env.gov.bc.ca/dist/arcwhse/water/	June 2005	1:20,000

Provincial parks and protected areas were assigned an IUCN code based on a preliminary assessment by provincial government staff. IUCN codes, their meaning and corresponding GAP code are as follows:

Table 16. IUCN code and GAP code equivalents.

[16] http://www3.wadnr.gov/dnrapp5/website/cadastre/links/other_dnr_gis_data/POCA.htm
[17] http://www3.wadnr.gov/dnrapp5/website/cadastre/links/other_dnr_gis_data/NonDNR_Major_%20Public_Lands.htm

IUCN Code	GAP Code	Description
Ia	1	Strict Nature Reserve: protected area managed mainly for science
Ib	1	Wilderness Area: protected area managed mainly for wilderness protection
II	1	National Park: protected area managed mainly for ecosystem protection and recreation
III	1	Natural Monument: protected area managed mainly for conservation of specific natural features
IV	2	Habitat/Species Management Area; protected area managed mainly for conservation through management intervention
V	2	Protected Landscape/Seascape: protected area managed mainly for landscape/seascape conservation and recreation
VI	3	Managed Resource Protected Area: protected area managed mainly for the sustainable use of natural ecosystems
VII	3	This additional Non-IUCN Land base Inventory Category employed by the Canadian Parks Council is to include parks/protected areas where the primary focus of management is on the provision of facility-based outdoor recreation opportunities (campgrounds, picnic sites, golf courses, public swimming beaches, etc.).

Data along the BC/WA border was adjusted to eliminate overlap between data sources, resulting from using data compiled from multiple scales. Resultant datasets were merged.

Potential improvements to the dataset would include incorporating additional datasets, including old growth management areas, ungulate winter range and wildlife habitat areas as well as more current information in private land ownership.

Land Use

Some landscapes, converted from native habitat by direct anthropogenic disturbance, have been identified as being less compatible for the conservation of natural biodiversity than others (Noss, 1995; Miller et al., 1998). Converted land represents, along with road density, habitat fragmentation. We mapped five types of converted land:

- Agriculture
- Mining
- Recently Harvested Timber
- Recreation
- Urban

In British Columbia these layers were extracted from the provincial Baseline Thematic Mapping (BTM), a 1:250,000 scale dataset interpreted primarily from 1990 to 1997 LANDSAT imagery.[18] Other ancillary data layers used to create the BTM include 1:70,000 aerial photographs, Ministry of Forests Mapgen age class information, Biogeoclimatic data, and structured digital 1:250,000 topography. For much of the North Cascades ecoregion and associated freshwater analysis BTM had been updated with LANDSAT imagery from 1998 (BTM2). Minimum mapped area for BTM2 is 10 hectares, while the minimum mapped area for the original BTM is 15 hectares. A full description of the mapping methods can be found at http://ilmbwww.gov.bc.ca/cis/initiatives/ias/btm/btm2specaug1.pdf

[18] http://ilmbwww.gov.bc.ca/cis/initiatives/ias/btm/

In Washington the layers were extracted from the National Land Cover Data (NLCD) 1992 product[19]. Derived from the 1992 Landsat Thematic Mapper (TM) satellite data with a spatial resolution of 30 meters, the NLCD is a 21-class land cover classification scheme applied consistently over the United States. NLCD was produced by the Multi-Resolution Land Characteristics (MRLC) consortium, consisting of the U.S. Geological Survey (USGS), Environmental Protection Agency (EPA), National Oceanic and Atmospheric Administration (NOAA), the U.S. Forest Service (USFS), the National Atmospheric and Space Administration (NASA) and the Bureau of Land Management (BLM). Other ancillary data layers used to create the NLCD included leaves-on TM, USGS 3-arc second Digital Terrain Elevation Data (DTED) and derived slope, aspect and shaded relief, Bureau of the Census population and housing density data, USGS land use and land cover (LUDA), and National Wetlands Inventory (NWI) data. A full description of the mapping methods can be found at http://landcover.usgs.gov/mapping_proc.php#explain

Recreation from the Washington consisted of a layer of major ski areas. These are all leased from Forest Service, so were identified by TNC staff using the USFS land-use allocation tracts that contain the ski resorts and hills. The land use corresponds very well with the resort areas based on comparing imagery with the land use allocations from the NW Forest Plan.

Datasets were mosaiced together to provide a continuous land use layer across the entire buffered ecoregion. The attributes were cross walked as per the following table:

Table 17. Cross-walk of converted land classes.

	BC - BTM	WA - NLCD
Agriculture	agriculture	pasture/hay row crops fallow orchards/vineyards/other small grains
Mining	mining	quarries/strip mines/gravel pits
Recently Harvested Timber	selectively logged recently logged	transitional
Recreation	recreation activities	*Layer developed by TNC*
Urban	residential/ agriculture mixtures urban	low intensity residential high intensity residential commercial/industrial/transportation urban/recreational grasses

We did not account for future or potential land conversion, only for current habitat conditions. Also, we did not consider restoration potential. This analysis could be improved by incorporating more recent information on converted land, particularly for timber harvest.

[19] http://landcover.usgs.gov/natllandcover.php

Road Density (Infrastructure)

Roads are known to have significant impacts on biodiversity and habitat. Summarized by Hawbaker and Radeloff (2004), these include:

- Direct habitat removal during construction
- Habitat fragmentation (leading to potential changes in species composition)
- Altered hydrology regime (interruption and redirection of surface and groundwater flows, altered peak flows)
- Introduction of heavy metals, salts and other by-products of vehicle operations and road management activities
- Dispersal corridors for invasive species
- Species mortality through collision
- Alteration in movement or migration patterns
- Access for human use of adjacent areas
- Influence on settlement and land-use patterns

In general, the higher the road density, the greater the habitat fragmentation, and the higher the suitability cost value.

Road density was calculated as the km of road per square km of land in the analysis unit. Area covered by lakes and large rivers were subtracted from the density calculation.

For British Columbia the roads were identified as any road or trail (based on FCODE) in the TRIM/TRIMII basemap.

For Washington there was no one comprehensive source of roads data. Hawbaker and Radeloff (2004) suggest many commonly available digital road data may miss up to 50% of the roads, primarily unimproved or secondary roads. To overcome this limitation we built a road density layer based on roads mapped by DNR, augmented by adding roads not included in the DNR data from other data sets. Road data sources included:

- Washington Department of Natural Resources (June 2005)
- US Bureau of Land Management (Aug. 2004)
- Tiger 2002 (downloaded from NRCS Gateway)
- GDT (circa 2002)
- Skagit County (July 2004)

Roads were not weighted by surface type or size – for the purposes of this assessment gravel resource roads, paved roads, multi-lane highways and lanes/alleys were all considered to have the same impact, although in reality each have differing impacts on an area's ability to support biodiversity and each should have differing weights. Future iterations could consider excluding alpine areas, including glaciated lands. Railway lines were included in the road density layer but trails were not. Further research should be conducted to determine if trails should be included as a factor in road density. Other linear man-made factors, such as power lines, pipelines and seismic lines, were not included in the road density calculation.

Urban Proximity

Residential development and urban growth leads to habitat fragmentation and is a leading cause of species imperilment (Theobald, 2003). Although urban areas were included in the converted land factor, future urban growth potential can have significant impacts on biodiversity and therefore was incorporated into the suitability index to move the selection of analysis units in the portfolio away from areas where there is a greater potential of impact due to expanding urban areas.

We assembled GIS data for urban growth areas (UGAs) in Washington and British Columbia. UGAs delineate the location of current urban areas and future urbanization. For BC the UGA data consisted of urban areas identified by Statistics Canada from the 2001 census. Some unpopulated Indian Reserves were included in the urban areas layer – these were removed prior to running the analysis below. In Washington the UGA data consisted of urban areas delineated by the Washington Department of Community, Trade, and Economic Development (CTED) (circa 2001) for the Management Act (GMA), and are loosely based on city limits created by the Washington State Department of Transportation[20].

UGAs within 10 km of the ecoregion were included in the base dataset to allow for the influence of any UGAs just outside the ecoregion whose growth might impact the ecoregion. Each UGA was buffered by 10 concentric rings. Width of the buffers was a function of the UGA area. The area of the first concentric buffer was approximately half the UGA's area. The next nine buffers had the same width as the first. Bigger UGAs had wider buffers because we would expect their negative influence to extend further out from their boundary. Inside the UGA, the cost was maximum (1,000,000,000), outside the ten concentric buffers the cost was zero, and the values assigned to each successive concentric buffer decreased linearly by a factor of 10. Where buffers from two or more nearby UGAs overlapped, the costs at that point were added to reflect the cumulative impacts of multiple UGAs on a conservation area. Large bodies of water and areas excluded from development [Gap 1, 2 and 3 (sub-gap C-J + L), any public lands in Washington and Garibaldi Civil Defense Zone] would constrain development and were therefore deleted from the final layer prior to intersection with the analysis units.

The size of the rings were based on the following formula:

area = 0.5 * UGA polygon area
where area = length * width;
and therefore, width of the first ring was:
width = (0.5 * UGA area) / (perimeter of UGA polygon);

and the width of all the other rings was the same as the first.

Attempts made to model Urban Growth Potential following the methods of Theobald (2003) were abandoned primarily due to complexities associated with translating 1996 and earlier data associated with Statistics Canada Census blocks to the new 2001 census blocks. The

[20] http://www.wsdot.wa.gov/mapsdata/geodatacatalog/Maps/24K/DOT_Cartog/city.htm

analysis could be improved through the inclusion of additional datasets depicting urban areas (e.g. BC TRIM built-up area, TRIM points depicting structures, regional district zoning information). The Statistics Canada urban growth base layer, in particular, had deficiencies as it was based on Stats Canada boundaries rather than actual areas of urban population concentration, and therefore included portions of municipalities or census areas which had minimal population because they were associated with areas of denser population.

Dams

Dams form a barrier to the natural flow of biodiversity (Kingsford, 2000; McAllister *et al*., 2001). Reservoirs created by dams alter the natural habitat, creating space for some species and activities while reducing opportunities for others. Dams effectively truncate the ranges of populations that may otherwise interbreed. Downstream populations may still receive breeding individuals from upstream habitats, but individuals above the blockage are, to varying degrees, isolated from the lower basin.

For British Columbia, we used latitude and longitude coordinates of dam locations provided by the Dam Safety Group, with some additional dam locations provided by BC Hydro, to create a layer of 146 dams, 21 of which were in the EDUs assessed. For Washington, we used a layer of dams compiled by *Streamnet*[21] containing 2,464 dams, none of which were in the EDUs assessed. Any watershed containing one or more dam was assigned the maximum dam value in the Suitability.

Generally, hydrologic impacts affect the assessment unit containing the dam and downstream AUs. Impacts tend to diminish with downstream distance from the dam as additional undammed streams contribute their flow. Fish passage impacts tend to affect the AU with the dam and upstream AUs in the basin. Passage impacts do not diminish with upstream distance from a dam as the blockage reduces the number of fish available to disperse throughout the entire upper basin. Mortality rates are also increased for juveniles coming downstream over a dam, reducing survival from the sub-populations from the blocked portion of the basin. Future iterations should consider adding measures to incorporate upstream and downstream impacts, such as each dam's impact to hydrology and fish passage. Instead of the number of dams, future iterations could consider weighting the dam impact by the size of the dam or of the reservoir the dam contains.

Water Extraction

Water extraction is widely recognized as one of the major impacts on both terrestrial and freshwaterbiodiversity, particularly when considering downstream and/or cumulative effects (Convention on Biological Diversity, 2005; Klaphake *et al*., 2001).

The water extraction value was based on the volume of water licensed by the province to be extracted from a watershed for any purpose, excluding storage and rediversion. Information on the volume of water licensed for extraction was obtained from the Ministry of Environment Water License Query Application in September 2005 http://www.elp.gov.bc.ca:8000/pls/wtrwhse/water_licences.input. The results of the query

[21] http://www.streamnet.org/

were a series of CSV text files, one for each water precinct located in the study area, which were converted to XLS for further processing.

Data was filtered so each record reflected the maximum volume of extraction allowed for each license, regardless of number of points of diversion associated the license (a license could have many points of diversion, each of which have a record in the database indicating the total volume of water allowed with the license as opposed to the volume allowed to extract at each point-of-diversion). Since the unit of measurement for water extraction varies depending upon the purpose, quantities were converted to a single unit of measurement (cubic meters).

Resultant databases were linked to a regularly updated provincial GIS dataset of points-of-diversion downloaded from ftp://ftp.env.gov.bc.ca/dist/arcwhse/water_licenses/. Prior to linking, the volume of water extracted was summed for each point-of-diversion (a single point could be used by multiple licensees for multiple purposes). After linking, a sum of all water extracted from each watershed was created. A ratio of this sum (volume of water licensed for extraction) versus the cumulative precipitation yield (FLOWMAX) was calculated. This value was then divided by the highest ratio value and multiplied by the expert assigned weight (0.156) to establish a value for water extraction for each watershed. Fourteen watersheds had ratios which exceeded 1 – these were assigned the highest weighting.

This analysis could be improved by calculating a value for the cumulative downstream extraction. The information available consisted of water licensed for extraction, so actual volume of water extraction may be less.

Fish Stock Enhancement

Stocking freshwater bodies with fish, often in response to human induced species loss through extraction or habitat degradation, can result in a number of ecological impacts (Einum and Fleming, 2001; Pearsons and Hopley, 1999). Stocking a restricted environment with a large number of fish may influence levels of food availability, response to predators and competitive interactions, all of which can negatively impact the growth and survival of wild fish. Hatchery fish may be genetically and/or phenotypically different from wild fish, and may therefore experience reduced rates of survival and reproduction (White *et al*., 1995; Skaala et al., 1996).

A database containing stocked species, date stocked and gazetteer name for the freshwater feature was downloaded from the BC provincial government in July 2005 (http://srmapps.gov.bc.ca/apps/fidq/). All records older than 1950 were deleted. The spreadsheet was then linked to the lakes GIS layer using the gazetteer name. Calculations were performed to determine the area of all lakes in each assessment unit and the area of stocked lakes in each assessment unit. These figures were used to determine a ratio stocked area to total area. This value was then divided by the highest ratio value and multiplied by the expert assigned weight (0.078) to establish a value for stock enhancement for each watershed.

Road Stream Crossing

Literature suggests that the number of road stream crossings inversely corresponds to the quality of water and volume of sediment movement in a watershed (Lane and Sheridan, 2002).

For the North Cascades, this value is calculated as the total road-stream crossing density for each assessment unit. Road-stream crossings include bridge crossings. The value was derived by dividing the total number of road-stream crossings by the land area of the watershed and was taken directly from the BC Ministry of Environment (2000) Watersheds BC Environmental Statistics Project. This value was divided by the value for the highest assessment unit and was then multiplied by the expert assigned weight (0.053) to establish a value for road stream crossing for each watershed.

Road Density (slopes > 50%)

The impacts of roads in a watershed is greatly increased on steep slopes through increased Gully incision, increased rates of surface erosion, landsliding, changes in peak flow magnitude, and attendant impacts on stream sedimentation and channel morphology (Wemple et al., 1996).

For the North Cascades, the value was derived by dividing the road length on a gradient greater than 50% by the land area of the watershed and was taken directly from the BC Ministry of Environment (2000) Watersheds BC Environmental Statistics Project. This value was divided by the value for the highest assessment unit and was then multiplied by the expert assigned weight (0.117) to establish a value for road density on slopes > 50% for each watershed.

Riparian Disturbance

The riparian zone links freshwater with its terrestrial catchment area. Disturbance in the riparian zone destabilizes stream ecosystem function through increased sedimentation, reduced bank stabilization, increased local water temperatures, alterations to organic input, and introduced biota to a freshwater system or adjacent vegetation (Henry et al., 1999; Osbourne and Kovacic, 1993; Dupuis and Steventon, 1999).

For the North Cascades, we focused on logging as the primary source of riparian disturbance and calculated this value as the percentage of recently logged land area within 30 metres of a stream. Recently logged areas are defined as having occurred within approximately 20 years previous to the BTM Land Use Vintage. The value was derived by dividing the recently logged land area within 30 metres of a stream by the land area of the watershed and was taken directly from the BC Ministry of Environment (2000) Watersheds BC Environmental Statistics Project. This value was divided by the value for the highest assessment unit and was then multiplied by the expert assigned weight (0.117) to establish a value for riparian disturbance for each watershed.

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APPENDIX 14 – THREATS ASSESSMENT

Appendix 14 – Threats Assessment

Refer to Maps 11, 12 and 13 for terrestrial and freshwater suitability indices.

Human disturbances have the potential to cause destruction, degradation, or impairment of biodiversity and can be characterized as "threats." The assessment of threats in ecoregional planning is a critical step in developing effective conservation strategies (Groves, 2003). Identifying and quantifying threats has been a part of site conservation planning at The Nature Conservancy for many years. At the scale of an ecoregion, however, the process for identifying threats has generally been subjective, difficult to standardize across the entire ecoregion, and has taken on a variety of forms, depending on the level of available information. Past efforts have largely relied on expert opinion and the ranking of a pre-determined suite of threats at each portfolio site within the ecoregion. As was noted in the Suitability Index discussion (Chapter 4), one input to the selection process is a quantitative index related to a place's suitability for conservation. The Suitability Index consisted of GIS datasets that spatially quantified some of the threats to biodiversity in the North Cascades ecoregion. While several other threats were identified by experts or project team members, there was either no comprehensive data to spatially portray the threat or the project team did not have the time or capacity to develop these datasets. As a result, this cursory threats assessment will discuss the threats to biodiversity included in the Suitability Index and expand to other threats that are present or emerging.

From a regional planning perspective, an assessment of threats to individual conservation areas serves two specific purposes: (1) identifying conservation areas that are in most urgent need of attention to abate a current or imminent threat; and (2) identifying threats that recur across multiple conservation areas and may best be addressed at a scale greater than the individual conservation area (Groves, 2003). Threats can be said to have both *stresses* and *sources* (Poiani et al., 1998, TNC 2000). It is unlikely that a regional assessment will ascertain all or even the most important sources of some stresses. These would emerge during more detailed planning at the scale of the conservation area (Groves, 2003). For purposes of this general ecoregional threats analysis, the team decided the most meaningful factor to evaluate threats to species, communities, and systems at conservation areas was the source of stress - the cause of destruction, degradation, fragmentation, or impairment of conservation targets at a conservation area. Understanding the threats to targets at specific conservation areas and patterns of threats across multiple areas helps to determine which conservation areas are in urgent need of conservation action, and to inform the development of multi-site strategies. Further work through site conservation planning is needed to update and refine threats to targets within portfolios.

Threats to biodiversity in the North Cascades ecoregion were compiled through assessment team members' experience and on-the-ground knowledge of the ecoregion, interviews with experts knowledgeable about the ecoregion, and through literature review. The major threats to biodiversity identified in the North Cascades Ecoregion include:

- Forestry practices
- Urban growth and associated land conversion
- Transportation and utility corridors
- Hydropower development
- Recreational development and use
- Invasive species, pests and pathogens
- Climate change

Dominant Land Uses

- Forestry
- Recreation
- Conservation of fish & wildlife habitat

Conservation Needs

- Protection and restoration of riparian floodplains
- Restoration of salmon habitat /populations
- Recovery of wide-ranging species
- Recovery of large carnivores

Human Development

The ecoregion in BC is undergoing rapid development in anticipation of the 2010 Winter Olympics being held in Vancouver and Whistler. Road building is occurring with the widening of the Sea-to-Sky highway linking the lower mainland to Squamish, Whistler and all points in between. This is already causing destruction of habitat. The area is also a popular tourist destination and is seeing increased recreation use of the area and the backcountry.

While population growth is a more direct threat in the BC portion of the ecoregion, associated habitat loss and degradation is still a concern in Washington. Growth not only increases development, it also increases recreational use and the associated impacts. This can lead to increased risk of invasive species introduction, as evidenced by infestations of reed canary grass (*Phalaris arundinacea*) at Ross Lake (http://www.biodiversity.wa.gov/ecoregions/n_cascades/n_cascades_status.html).

Roads, railroads, and utility corridors present a major challenge to wildlife species in the North Cascades Ecoregion. Because the ecoregion is relatively intact compared with most other ecoregions in Washington, and because it is connected to other less impacted areas to the north in British Columbia, in the North Cascades there is the possibility for wide-ranging species to exist, such as grizzly bear, wolves, wolverine and fisher. However, the growing transportation corridors and associated developments in the valley bottoms of the ecoregion increasingly form barriers to the movement of such wide-ranging animal species and gradually cause isolation of populations leading to extirpations. To some extent, the effects of this fragmentation can be addressed through identification and maintenance of habitat corridors and highway crossing structures for wildlife such as culverts and wildlife overpasses.

Hydropower dams in the Washington portion of the ecoregion have altered the natural hydrological regime in major ways, including changes to the quantity, quality and timing of water flows that have effects on well-known species like salmon, but also for the entire aquatic system salmon depend upon, including riparian and downstream habitats. Most importantly, however, dams on the larger rivers like the Skagit, Stillaguamish, Snohomish and Nooksack present physical barriers to the migration of anadromous species, and may not have adequate fish ladders or paths for downstream migrations through dam turbines.

Human development factors were spatially quantified in the Suitability Index through such factors as roads and road density, current condition, land management status, presence of dams, and urban proximity.

Forestry

Forest covers roughly 75% of the North Cascades ecoregion, and is a major component of British Columbia and Washington's economy (http://www.biodiversity.wa.gov/ecoregions/n_cascades/n_cascades_status.html). Forest harvest and related activities have in many cases had a profound effect on species and habitats in BC and WA through simplification of forest structure and species composition, removal of cover, soil disturbance and erosion. The future condition of forests outside of park and wilderness areas depends on how intensively they are managed for timber and other values. Major improvements in forest management for biodiversity are reflected in WA in the Northwest Forest Plan on federal lands and the Washington Forest and Fish Agreement on private lands. Still, significant historical impacts on biodiversity from timber harvest call for the need of long-term forest and riparian restoration.

In British Columbia logging continues in the ecoregion. Forestry operations are having major impacts to habitat for wide-ranging species such as the Northern Spotted owl, Grizzly bears, and salmon.

In British Columbia the Mountain pine beetle is projected to impact lodgepole pine in the northeast portion of the ecoregion.

Invasive/Exotic Species

Invasive species have the potential to alter the structure, composition, and function of ecological communities and are known to directly eliminate native species from an ecosystem. Although the long-term ecological impact of many invasive species is unknown, there is great concern with the increased number and distribution of species in our ecoregion. The scientific study of invasion is in its infancy. We know enough, however, to be confident that aggressive action is warranted to slow the flow of new invaders and to reduce the impacts of established, habitat-altering species. Many impacts are poorly understood, and these include the long-term impacts of some control methods (e.g., chemical, mechanical, or biological methods) that may themselves pose a threat to native systems. Of the many non-native species that may be introduced to a native ecosystem, some act as competitors, predators, pathogens, or disrupters of key ecological processes (nutrient cycling, flood or fire regimes, etc.). Others exhibit no clear negative impacts, or may enhance the habitat for certain native species while harming other native components.

Climate Change

Many scientists are convinced that our climate will change over the next century due to global increases in greenhouse gas emissions. Global climate models, however, are still quite variable with regard to predicted temperature increases and the seasonality of weather patterns. Most models generated for the Pacific Northwest show a rise in temperature of approximately 3.5 °F (2 °C) and an increase in winter precipitation (Mote et al. 1999). Some models predict wetter summers and others predict drier summers. Climates will also continue to be modified by the El Niño-Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO) and the result of interactions between climate change and recurring climatic variations is largely unknown. In general, the greatest changes are expected to occur at lower and higher elevations where ecotones between some natural systems are sharply defined. Potential impacts include glacial melting, shifts in floral and faunal ranges, and a reduction in winter snowpacks (http://www.biodiversity.wa.gov/ecoregions/n_cascades/n_cascades_status.html).

The team addressed potential climate change impacts in this assessment by ensuring that the portfolio as a whole spanned the full range of climatic gradients in the ecoregion and that individual conservation areas spanned the greatest possible altitudinal range within contiguous natural areas. This was accomplished by: 1) classifying terrestrial and freshwater ecosystems and mapping their current distributions in a near-comprehensive manner; 2) establishing minimum size thresholds for each system type to account for a wide potential range of variation in natural disturbance regimes; 3) using sections and Ecological Drainage Units to ensure sub-ecoregion-scale climatic variation was well represented among both terrestrial and freshwater systems; and 4) using Ecological Land Units (ELU) to represent local-scale variability within and among ecological systems in contiguous portfolio areas. The ELU and freshwater classification models address factors of elevation, slope/aspect, hydrologic gradient, stream size, landscape position, geologic substrate, and soil moisture regime. This ensured the inclusion of contiguous ecological gradients, and likely habitat "refugia" with climate changes we have yet to measure. Additionally, as evidenced by major vegetation types, most portfolio areas include wide elevational gradients, many from alpine to foothills.

APPENDIX 15 – PRIORITIZATION OF ASSESSMENT UNITS

Appendix 15 – Prioritization of Assessment Units

A conservation portfolio could serve as a conservation plan to be implemented over time by nongovernmental organizations, government agencies and private land owners. In reality, however, an entire portfolio cannot be protected immediately and some conservation areas in the portfolio may never be protected (Meir et al. 2004). Limited resources and other social or economic considerations may make protection of the entire portfolio impractical. This inescapable situation can be addressed two ways. First, we should narrow our immediate attention to the most important conservation areas within the portfolio. This can be facilitated by prioritizing conservation areas. Second, we should provide organizations, agencies and land owners with the flexibility to pursue other options when portions of the portfolio are too difficult to protect. Assigning a relative priority to all AUs in the ecoregion will help planners explore options for conservation.

The prioritization of potential conservation areas is an essential element of conservation planning (Margules and Pressey 2000). The importance of prioritization is made evident by the extensive research conducted to develop better prioritization techniques (e.g., Margules and Usher 1981, Anselin et al. 1989, Kershaw et al. 1995, Pressey et al. 1996, Freitag and Van Jaarsveld 1997, Benayas et al. 2003). Consequently, many different techniques are available for addressing the prioritization probelm. We used the optimal site selection algorithm MARXAN to assign a relative priority to every AU in the ecoregion. The relative priorities were expressed as two indices – irreplaceability and utility.

AUs were prioritized for the terrestrial and freshwaterrealms. A more extensive analysis was done for the terrestrial realm only because: (1) the terrestrial data have a greater influence on the portfolio than the freshwater data; (2) terrestrial environments and species have been more thoroughly studied, and therefore, our assumptions about terrestrial biodiversity are more robust than for freshwater biodiversity; and (3) the terrestrial portfolio has the greatest potential influence on land use planning and policy decisions affecting private lands.

Methods

Irreplaceability

Irreplaceability is an index that indicates the relative conservation value of a place. Irreplaceability has been defined a number of different ways (Pressey et al. 1994, Ferrier et al. 2000, Noss et al. 2002, Leslie et al. 2003, Stewart et al. 2003). However, the original operational definition was given by Pressey at al. (1994). They defined irreplaceability of a site as the percentage of alternative reserve systems in which it occurs. Following this definition, Andelman and Willig (2002) and Leslie et al. (2003) each exploited the stochastic nature of the simulated annealing algorithm to calculate an irreplaceability index.

Simulated annealing is a stochastic heuristic search for the global minimum of an objective function. Since it is stochastic, or random, simulated annealing can arrive at different answers for a single optimization problem. The algorithm may not converge on the optimal solution, i.e., the global minimum, but it will find local minima that are nearly as good as the global minimum (McDonnell et al. 2002). The random search of simulated annealing enables it to find multiple nearly-optimal solutions, and an AU may belong to many different nearly-optimal solutions.

The number of simulated annealing solutions that include a particular AU is a good indication of that AU's irreplaceability. This is the assumption made by Andelman and Willig (2002) and Leslie et al. (2003) for their irreplaceability index. The index of Andelman and Willig (2002) was:

$$I_j = (1/n) \sum_{i=1}^{n} s_i \qquad (1)$$

where I is relative irreplaceability, n is the number of solutions, and s_i is a binary variable that equals 1 when AU_j is selected but 0 otherwise. I_j have values between 0 and 1, and are obtained from a running the simulated annealing algorithm n times at a single representation level.

Irreplaceability is a function of the desired representation level (Pressey et al. 1994, Warman et al. 2004). Changing the representation level for target species often changes the number of AUs needed for the solution. For instance, low representation levels typically yield a small number of AUs with high irreplaceability and many AUs with zero irreplaceability, but as the representation level increases, some AUs attain higher irreplaceablity values. The fact that some AUs go from zero irreplaceabilty to a positive irreplaceability demonstrates that Willig and Andelman's index is somewhat misleading – at low representation levels, some AUs are shown to have no value for biodiversity conservation when they actually do. We created an index for relative irreplaceabilty that addresses this shortcoming. Our global irreplaceability index for AU_j was defined as:

$$G_j = (1/m) \sum_{k=1}^{m} I_{jk} \qquad (2)$$

where I_{jk} are relative irreplaceability values as defined in equation (2) and m is the number of representation levels used in the site selection algorithm. G_j have values between 0 and 1. Each I_{jk} is relative irreplaceability at a particular representation level. We ran MARXAN at ten representation levels for coarse and fine filter targets. At the highest representation level nearly all AUs attained a positive irreplaceability.

Many applications of "irreplaceability" have implicitly subsumed some type of conservation efficiency (e.g., Andelman and Willig 2002, Noss et al. 2002, Leslie et al. 2003, Stewart et al. 2003). Efficiency is usually achieved by minimizing the total area needed to satisfy the desired representation level. All AUs were 500 ha hexagons, and therefore, MARXAN minimized area by minimizing the total number of AUs.

Conservation Utility

We extended upon the concept of irreplaceability with *conservation utility (*Rumsey et al., 2004). Conservation utility is defined by equation (2), but the optimization algorithm is run with the AU costs incorporating a suitability index. To generate irreplaceability, AU "cost" equals the AU area. To create a map of conservation utility values, AU "cost" reflects practical aspects of conservation – current land uses, current management practices, habitat condition, etc. (see Suitability Index discussion). In effect, conservation utility is a function of both biodiversity value and the likelihood of successful conservation.

Representation Levels

Each representation level corresponds to a different degree of risk for species extinction. Although we cannot estimate the actual degree of risk, we do know that risk is not a linear function of representation. It is roughly logarithmic.

Coarse Filter

We based the assumption that there is a logarithmic relationship between the risk of species extinction and the amount of habitat on the species-area curve. The species-area curve is arguably the most thoroughly established quantitative relationship in all of ecology (Conner and McCoy 1979, Rosenzweig 1995). The curve is defined by the equation $S=cA^z$, where S is the number of species in a particular area, A is the given area, c and z are constants. The equation says that the number of species (S) found in a particular area increases as the habitat area (A) increases. The parameter z takes on a wide range of values depending on the taxa, region of the earth, and landscape setting of the study. Most values lie between 0.15 and 0.35 (Wilson 1992). An oft cited rule-of-thumb for the z's value is called Darlington's Rule (MacArthur and Wilson 1967, Morrison et al. 1998). The rule states that a doubling of species occurs for every 10 fold increase in area, hence z = log(2) or 0.301. We used this relationship to derive representation levels that roughly correspond to equal increments of biodiversity – i.e., each increase in coarse filter area captured an additional 10% of species.

Coarse filter representation levels specify a minimum area, i.e., hectares, of each habitat type to be captured within a set of conservation areas. Other ecoregional assessments have used representation levels that increased linearly. For instance, Rumsey et al. (2004) set levels at 30, 40, 50, 60, 70 percent of the currently extant area of each habitat type. Each of these representation levels captured the same incremental area of habitat, but from the species-area curve we know that each of these representation levels captures successively smaller increments of total biodiversity. That is, the step from 10 to 20 percent may capture 12 percent of all species but the step from 60 to 70 percent may capture about only 4 percent (assuming z = 0.301). In effect, the first 10 percent of habitat is more important than the last 10 percent.

We used the species-area relationship to create representation levels that correspond to equal increments of risk. The coarse filter representation levels did not increase linearly but rather according to a power function: $S = A^z$. To derive the coarse filter levels, the desired amount of biodiversity was increased linearly (10, 20, 30, . . ., 100 percent) and the corresponding area was calculated for each (Table 18).

Table 18. Coarse filter representation levels derived from the species-area curve with z = 0.301.

Percent species	10	20	30	40	50	60	70	80	90	100
Representation Level (percent extant area)	0.05	0.5	1.8	4.8	10	18	31	48	70	100

Fine Filter

Fine filter representation levels specify the number of species occurrences to be captured within a set of conservation areas. The relationship between species survival and number of isolated populations is also a power function:

$$\text{Species Persistence Probability} = 1 - [\,1 - pr(P)\,]^n$$

where pr(P) is the persistence probability of each isolated population and n is the number of populations. This equation says, in effect, that the first population (i.e., occurrence) is more important than the second population and much more important than the tenth population. According to this relationship, if we want representation levels to correspond to equal degrees of risk, then fine filter representation levels should not increase linearly but logarithmically. However, the above equation won't work for our purposes. We don't know pr(P), but even if we did, pr(P) is not equal across all populations.

Luckily, other relationships were available to us. The Natural Heritage programs use many criteria to determine G and S ranks. These criteria indicate the degree of imperilment, i.e., the risk of extinction. One such criterion relates the number of occurrences to degree of imperilment (Table 19) (Master et al., 2003)[22]. This system expresses the idea that the first 5 occurrences make about the same contribution toward species rank as the next 21 to 80 occurrences.

If we assume equal imperilment intervals and equate A, B, C (a nominal scale) with 1, 2, 3 (an ordinal scale), then the relationship in the above table can be modeled as a power function. We used the function to interpolate between 1, 2, and 3 to yield multiple regularly spaced steps for the fine filter levels. We did this to give 10 representation levels; the same number as for the coarse filter.

Table 19. Categories for the known occurrences ranking criterion used by NatureServe and Natural Heritage Programs to assign species S-ranks and G-ranks.

Condition Status	Number of Known Occurrences
A	1 to 5
B	6 to 20
C	21 to 80
D	81 to 300
E	>300

Table 20. Representation levels for target occurrences that roughly correspond to populations, subpopulations, or populations segments.

Condition Status	A			B			C			D
regular steps within condition status	⅓	⅔	1	1⅓	1⅔	2	2⅓	2⅔	3	3⅓ - 4
Representation Level (number of occurrences)	2	3	5	8	13	20	31	49	80	all occurrences

[22] Table 19 is a modification of the older system (Master 1994) for species ranking, where G1/S1 equaled 1 to 5 occurrences, G2/S2 equaled 6 to 20 occurrences, and G3/S3 equaled 21 to 100 occurrences.

Table 20 is to be used for species for which target occurrences (TOs)[23] roughly correspond to populations, subpopulations, or populations segments. Fine filter representation levels are complicated because the TOs currently in our databases do not have consistent meaning. Some TOs roughly represent a population or population segment (e.g., plant, invertebrates, amphibians). Other TOs may simply represent a nest, a concentration of nests, or a territory (e.g., raptors, marbled murrelets). TOs of this type must be dealt with somewhat differently. We followed the same approach as above but used a different G/S rank criterion that relates the number of individuals in a population to degree of imperilment (Table 21) (Master et al., 2003).

We converted the number of individuals to number of nests simply by dividing by 2. Again, if we assume equal imperilment intervals and equate A, B, C with 1, 2, 3, then the relationship in the above table can be modeled as a power function. We used the function to interpolate between 1, 2, and 3 to yield multiple regularly spaced steps for the fine filter levels and created 10 representation levels (Table 22).

Table 21. Categories for the number of individual ranking criterion used by Natural Heritage Programs to assign species S-ranks and G-ranks.

We derived the maximum number of nests or from the number of individuals.

Condition Status	Number of Individuals	Maximum Number of Nests or Dens
A	1 to 50	25
B	51 to 250	125
C	251 to 1000	500
D	1001 to 2500	1250
E	2501 to 10000	5000

Table 22. Representation levels for target occurrences that correspond to nests, den, or territory.

Condition Status	A				B				C	
regular steps within condition status	¼	½	¾	1	1¼	1½	1¾	2	2¼	2½ - 3
Representation Level (number of nests)	8	12	18	25	38	55	80	125	170	all occurrences

Species-specific habitat maps were used to represent the spatial distribution of three wide-ranging carnivores – grizzly bear, lynx, fisher – and two wide-ranging ungulates – elk and mountain goat. The social organization of the carnivores and ungulates is quite different. The carnivores often live alone on territories and the ungulates often form herds. Hence, the two species groups were dealt with in different ways. Representation levels had to be set for the amount of each species' habitat. For the wide-ranging carnivores, Table 22 was used to set the number of territories needed at each representation level. The mean exclusive home range size of each species was multiplied by the number of territories to

[23] Target occurrence (TO) roughly corresponds to an element occurrence (EO). However, since many of our TOs did not meet the NatureServe species-specific EO definitions we used different terminology.

yield the amount of habitat needed. Mean home range sizes were 8288 ha for grizzly bear (USFWS 1993), 2835 ha for lynx (Brittell et al. 1989, Koehler 1990), and 2495 ha for fisher (Lewis and Hayes, 2004). Grizzly bear home range size was based on population density estimates which should account for territory overlap. Values for lynx and fisher were female home ranges. Exclusive home range size for female lynx was adjusted using territory overlap estimate given by Koehler and Aubrey, 1994; p. 91). Powell and Zielinski (1994; p. 59) state that female fisher territories overlap little.

For herd animals, representation levels were based on Table 21, but the number of individuals was used (Table 23). The amount of habitat needed at each level was calculated by dividing the number of individuals needed by an observed population density. Population densities used were the midpoint of a range of values given by Verts and Carraway (1998): 1.55 individuals/ 100 ha for mountain goat (p. 494) and 3.2 individuals/ 100 ha for elk (p. 466).

Table 23. Representation levels for target occurrences that correspond to number of individuals in a herd.

Condition Status	A	B		C		D		E		F
regular steps within condition status	1	1½	2	2½	3	3½	4	4½	5	5½ - 6
Representation Level (individuals)	50	113	250	420	1000	1562	2500	5801	10,000	all occurrences

The targets for bald eagles were nests and communal roosts. The representation levels for nests were those in Table 22. Each communal roost was represented as the typical number of eagles observed using the roost. Hence, each representation level captured a certain number of individuals and the levels were those in Table 23. Marbled murrelets were represented as TOs in Washington and hectares of habitat in British Columbia. In Washington, representation levels were those in Table 20. In British Columbia the representation levels were based on Table 21 (see Table 24). The amount of habitat needed at each level was calculated by dividing the number of pairs needed by an observed active nest density (assuming 1 pair per nest). Active nest density 0.13 nest/ha (McShane et al. 2004, p. 4-60)

Table 24. Representation levels for number of individual marbled murrelets.

Condition Status	A	B	C	D		D		E		F
regular steps within condition status	1	2	3	3½	4	3½	4	4½	5	5½ - 6
Representation Level (individuals)	50	250	1000	1775	2500	7403	15,120	30,880	63,067	all occur.

We emphasize that even though we used natural heritage program criteria for imperilment, the representation levels should not be interpreted as levels of imperilment or conservation goals. The numbers are just a device for creating a map that shows the relative conservation priority of all AUs in an ecoregion. We used a power function in recognition of the fact that the relationship between the number of occurrences (or of individuals) protected and the risk of extinction exhibits a law of diminishing returns. We did not have the resources needed to estimate the actual shape of this relationship, but we believe that our representation levels yielded a prioritization of AUs that reflects the nonlinear nature of conservation priorities.

Comparing Utility and Irreplaceability

We would like to know how the suitability index influences the relative priority of assessment units. We compared the utility and irreplaceability maps several ways. First, three similarity measures were calculated: mean absolute difference, Bray-Curtis similarity measure, and Spearman rank correlation (Krebs 1999; pp 379-386). The Bray-Curtis similarity measure normalizes the sum absolute difference to a scale from 0 to 1. Because utility and irreplaceability will be used for prioritizing AUs, rank correlation is a particularly informative because it told us how the relative AU priorities changed. We were especially interested in how the ranks of the most highly ranked AUs would change. To examine this, we also calculated a weighted Spearman rank correlation using Savage scores (Zar 1996, pp. 393-395).

Second, we determined whether the difference between utility and irreplaceability was significantly different. This was done by testing the following hypothesis for mean absolute difference:

- **H_{01}:** the mean absolute difference between utility and irreplaceability maps equals zero.
- **H_{A1}:** the mean absolute difference between utility and irreplaceability maps is greater than zero.

and for the Bray-Curtis similarity measure and Spearman rank correlation, this hypothesis:

- **H_{02}:** similarity between the utility and irreplaceability maps equals one.
- **H_{A2}:** similarity between the utility and irreplaceability maps is less than one

The hypotheses were tested using a randomization test (Sokal and Rohlf 1995, pp. 808-810). Pairs of random maps were generated by lumping together all scores from the original utility and irreplaceaiblity maps, reshuffling the scores, and then assigning half the scores to one random map and the other half to a second random map (i.e., random sampling of utility and irreplaceability scores without replacement). The four measures of similarity were calculated for 1000 random map pairs. The proportion of times that the mean absolute difference between the random map pairs is smaller (or the similarity is larger) than the difference between the utility map and irreplaceability maps equals the probability that utility map and irreplaceability map are significantly different. This was a one-tailed test of significance with $\alpha = 0.05$. Since we were using a randomization test, the hypotheses could be restated as follows:

- **H_{01}:** the mean absolute difference between the utility map and the irreplaceability map is equal to or less than the mean absolute difference between random map pairs;
- **H_{A1}:** the mean absolute difference between the utility and the irreplaceability maps is greater than the mean absolute difference between random map pairs;

- **H_{02}:** similarity between the utility map and the irreplaceability map is equal to or greater than the similarity between random map pairs;
- **H_{A2}:** similarity between the utility map and irreplaceability map is less than the similarity between random map pairs.

If the observed similarity measure is significantly less than (or the distance is significantly greater than) that expected from chance, then the null hypothesis is false, and we can state that the utility and irreplaceability maps are different. For Spearman rank correlation, the alternative hypothesis is equivalent to $r \leq 0$. This test is similar to that done by Warman et al. (2004)

Third, a contingency table analysis was done to compare the utility values and irreplaceability values of paired AUs. The log-likelihood ratio method (Zar 1996; pp. 502-503) was used to test the following hypotheses:

> **H_{03}:** AU selection is independent of cost index
> **H_{A3}:** AU selection is dependent on cost index

Paired AUs were considered to be significantly different for P <= 0.05.

Running the Selection Algorithm

MARXAN produces an output that is equivalent to nI_j, i.e., the number of times an AU was selected out of n replicates. We ran 25 replicates at each representation level. Hence, the product m•n equaled 250 for both irreplaceability and conservation utility. The irreplaceability and conservation utility values were normalized such that 250 equaled 100. For the terrestrial and freshwater analyses, BM was set to zero. When BM is set to zero, neighboring AUs have no influence on the selection frequency of an AU.

We set a minimum clump size for grizzly bear, lynx, fisher, bighorn sheep, and mountain goat habitats and some ecological systems. For the large mammals, the minimum clump size equaled the mean exclusive home range size of each species. Hence, an "occurrence" for each of these species was a cluster of hexagons that encompassed an amount of habitat equal to the minimum clump size. The clump sizes for ecological systems were those described in Section 3.1.1.

MARXAN has three options for clump type (Ball and Possingham 2000; pp. 13-14). We used option 0 – clumps less than the minimum size are not counted toward meeting the representation level. Clumping was done for the first eight representation levels only. At the ninth level, clumping became impractical because of extremely long computer processing times, and at the tenth level, the representation level was 100% of all habitat so clumping was meaningless.

The algorithm's objective function says, in effect, minimize cost (or unsuitability) subject to T constraints, where T equals the number of targets. All T constraints are the same – the amount captured must be greater than or equal to the target's desired representation level. The third term in the objective function imposes these constraints, however, they are soft constraints. "Soft" means that the constraints can be violated. Each constraint's "hardness" is determined by the penalty factors (PFs) set for each target – the larger the PF, the firmer the constraint. Hard constraints can be established by setting an arbitrarily large PF. However, very large PFs can create ill-conditioned objective functions exhibiting sharp peaks or valleys, both of which make optimization more difficult, i.e, requiring many more iterations to find the optimal solution (Gottfried and Weisman 1973). The best set of PFs is problem dependent.

Clearly, setting PF values is tricky. To address this problem, we used an iterative search to set PF values. We began the search with PF equal to 1 for every target. We ran MARXAN (5 replicates, 1 million iterations per replicate) and then checked the results of the best solution. MARXAN reports how much of the representation level was met for each target. If a target's representation level was not met, we used the bisection method to converge on a PF value. We repeated these steps until the representation level was met for all targets. The iterative search was done at each of the ten representation levels. Hence, a target could have a different PF at each representation level. For the vast majority of targets, this process found the PF value in a reasonable amount of time. However, finding the PF value that yields 100 % of the desired representation level for every target took too much processing time. Hence, we terminated the PF search when only 98% of a target's representation level was met. On average, about 87 % of targets (both ecoregional and eco-sectional) had PF values equal to 1. Other details about running MARXAN are summarized in Table 25.

The spatial representation of TOs was different than that used for generating the portfolio. For the portfolio, each TO was represented as a circle with a radius corresponding to the assumed locational uncertainty of the target. For the irreplaceability analysis, TOs were represented as points.

Freshwater Analysis

The generation of freshwaterutility and irreplaceability maps followed the same methods as the terrestrial maps except for the following:

- The analysis was done separately for each of the three ecological drainage units (EDUs) that intersect the ecoregion.
- Assessment units were watersheds not hexagons. Watersheds ranged in size from 37 to 197,600 ha with mean and median sizes being 6600 and 3700 ha, respectively.
- Representation levels were linear not logarithmic. We set representation levels at 10, 20, 30, . . ., 90, and 100 percent of the total amount available for each target in the EDU. The nature of freshwatersystems and EDT, which were much different than any terrestrial targets, did not allow us to develop logarithmic relationships.
- There was no minimum clump size for any freshwatersystems or salmon habitats.

Table 25. Values for MARXAN parameters used for irreplaceability and utility analyses.

Parameter	Function	terrestrial		aquatic	
		irreplaceability	utility	irreplaceability	utility
Algorithm	Type of optimization routine	simulated annealing		simulated annealing	
Replications	Number of times to repeat optimization per representation level	25		25	
Iterations	Number of times to create new combination of AUs	2,000,000		2,000,000	
Boundary modifier	Weighting factor for "cost" of AU perimeter. Encourages clusters of AUs	0		0	
Target penalty factor	"cost" of not meeting a target's represen-tation level	determined with bisection method search		determined with bisection method search	
AU status	Initial selection state of each AU	0 for all hexagons (no "lock-ins")		0 for all hexagons	

Parameter	Function	terrestrial		aquatic	
		irreplaceability	utility	irreplaceability	utility
Suitability Index	Indicates likelihood of successful conservation at AU	1 hexagon = 100	equation XXX	1 watershed = 100	equation YYY

Results

Terrestrial Analysis

The utility and irreplaceability maps for the terrestrial only analysis are shown in Maps 14 and 15. The categories on these maps correspond to deciles. That is, the statistical distribution of utility and irreplaceability scores were each divided into 10% quantiles. The decile map depicts the location of AUs with a selection frequency (or score) in the top 10 or 20 percent of all AUs. Scores at the 90th percentile were 60 for both replaceability and utility. The percentage of AUs with a score greater than 90 was 2.1 % and 2.7 % for irreplaceability and utility, respectively (Table 26).

AUs with scores equal to 100 are those selected in every replicate at every representation level – 1.4% had irreplaceability equal to 100, 1.7 % had utility equal to 100, and 1.3 % AUs had both scores equal to 100 (Table 26).

At the lowest representation level, the best solutions for irreplaceability and utility consisted of 2.2 % and 2.3 % of AUs, respectively. Scores greater of 100 were attained by 64 percent of AUs in the irreplaceability best solution and the 75 percent of AUs in utility best solution, which demonstrates that few options existed for meeting the lowest representation level. That is, rare targets could only be captured at the high scoring AUs. This also shows how incorporating suitability into the analysis narrows the number of options.

Freshwater Analysis

The utility and irreplaceability maps for the freshwater only analysis are shown in Maps 16 and 17. A score greater than 90 was attained by 76 AUs for irreplaceability and 92 AUs for utility. Twenty-three AUs had an irreplaceability score of 100, 33 had a utility score of 100, and 19 AUs had both scores equal to 100 (Table 26). The number AUs attaining perfect utility scores is greater than the number attaining perfect irreplaceability scores because when the optimization involved suitability, the higher suitability scores of some AUs causes them to be selected in every replicate.

Table 26. Percentage of AUs with high selection frequencies for both terrestrial and freshwateranalyses.

realm	number of AUs	selection frequency	irreplace-ability	utility	both
Terrestrial	9587	100 %	1.4	1.7	1.3
		≥ 95%	1.8	2.0	1.6
		≥ 90 %	2.1	2.7	2.0
Freshwater: Puget Sound EDU	442	100 %	1.4	1.6	1.4
		≥ 95%	3.6	3.8	3.2

		≥ 90 %	7.0	7.2	6.8
Freshwater: Lower Fraser River and Southern Coastal EDUs	909	100 %	1.9	2.9	1.4
		≥ 95%	3.0	4.7	2.3
		≥ 90 %	5.0	6.6	3.6

Utility versus Irreplaceability

By all similarity measures, the utility and irreplaceability maps from the terrestrial analysis were similar to a statistically significant degree (Table 27). The values for weighted Spearman rank correlation show that differences between maps at high scores are less than differences at low scores.

As demonstrated in Table 27, the overall patterns of utility and irreplaceabilty scores are very similar. That is, a side-by-side comparison shows that the maps generally agree. If examined AU by AU, we find that about 72 percent are different and that 28 percent have a significant difference between utility and irreplaceability. However, very few significant changes occur at high utility scores. Of all the AUs with significant differences between utility and irreplaceability, only 1.1 percent had utility scores equal to 100. Eighty percent of the significant changes were for AUs with utility scores less than or equal to 50.

On terrestrial maps, 130 AUs had a irreplaceability score of 100, 159 had an utility score of 100, and 126 AUs had both scores equal to 100. The overlap between utility and irreplaceability at the highest possible score is evident in Maps 14 to 17. The large overlap indicates that suitability had a small influence on which AUs attained scores equal to 100. In other words, target locations greatly determined which AUs attained a perfect score. Such AUs contained rare targets, targets for which we had very little occurrence data, occurrences of multiple targets, or a large number of occurrences per target.

Table 27. Similarity measures for comparison of terrestrial irreplaceability and conservation utility maps.

There was no significant difference between the irreplaceability and utility maps for any of the similarity measures (alpha = 0.05).

	value
mean absolute difference	14.3
Bray-Curtis measure	0.906
Spearman rank correlation	0.861
weighted Spearman rank correlation	0.923

Discussion

The irreplaceability and conservation utility indices were constructed by running MARXAN at ten representation levels. The first level captured a very small amount of each target and the last level captured all known occurrences of all targets. The first representation level is the amount of biodiversity captured in an initial set of reserves, the second level is an additional amount to be captured by an enlarged set of reserves, and the third level is an even greater additional amount, and so on. At each level, MARXAN's output indicates the relative necessity of each AU for efficiently capturing that particular amount of biodiversity. When the outputs from each level are summed together, the result specifies the most efficient sequence of AU protection that will eventually capture all biodiversity. The sequence in which AUs should be protected is one way to gauge their relative importance. AUs that have the highest irreplaceability or utility scores should be protected first, and therefore, are the most important AUs for biodiversity conservation.

The selection algorithm generates a set of AUs corresponding to a local minimum of the objective function. AUs are included in a solution because they serve to minimize the objective function. Therefore, AUs with high irreplaceability or high utility scores are those that (1) contain one or more rare targets and/or (2) contain a large number of target occurrences. High utility scores are also attained by AUs with high suitability. AUs with scores of 100 are those that were selected in every replicate at every representation level. To be chosen in every replicate the AU must contain target occurrences found in no other AU, contain a substantially larger number of occurrences than other AUs, or contain targets and have a substantially higher suitability than other AUs.

Table 28 shows the main targets for the selection of some AUs with high utility scores. In some cases, the AU had the only occurrence in the ecoregion (e.g., AUs 109394, 109340, 106991), and consequently had perfect scores for utility and irreplaceability. Because it had the only occurrence of a target, AU 109340 had high utility score despite its rather high unsuitability value. In several of these examples, the AU had one of only two occurrences in the entire ecosection, and because the minimum representation level equaled two occurrences per ecosection, these AUs had a selection frequency of 100 (e.g., AUs 109537, 106861, 106795). Many examples have utility scores between 90 and 100. In each case the optimal selection algorithm had other AUs where targets could be captured, however, these AUs attained high scores because they were more efficient places to capture the targets (e.g., AUs 109408, 107100, 106568).

The differences between utility and irreplaceability scores in Table 28 demonstrates the influence of the suitability index. The irreplaceability score of AU 107100 is much lower than its utility score. It has a relatively high suitability, and hence, is selected much more frequently than other AUs with similar biological contents (the main target being bald eagle nests). When the unsuitability index is removed from the optimization, other AUs are as good or better than AU 107100 for minimizing the objective function, and hence, its irreplaceability score. A comparison of AUs 109408 and 109421 also shows the influence of the unsuitability index. Both AUs have the same amount of a rare plant community type, but AU 109408 has a much higher suitability value, and hence, a much higher utility score. When unsuitability is removed from the optimization, these two AUs attain about the same irreplaceability score. Comparison of AUs 106568 and 106881 shows how the number of targets influences selection frequency. Both AUs contain the same amount of goshawk and spotted owl occurrences. AU 106568 is twice as unsuitable as AU 106881, but it attains a higher utility score because it also contains a marbled murrelet occurrence.

Table 28. Examples of main targets for selection of AUs with high utility scores.

AU number	Utility Score	irreplace-ability score	un-suitability	Number of Targets	Main Targets for Selection	Amount per Ecosection	Amount per Ecoregion
Ecosection: Northwestern Cascades Ranges							
109394	100	100	9.8	8	Cassiope lycopodioides	1/1	1/1
109340	100	100	32.1	5	Spiraea douglasii / Carex aquatilis var. dives Shrubland	1/1	1/1
109537	100	100	6.1	6	*Schistostega pennata* *Sphyrapicus ruber*	1/2 1/10	1/3 1/10
106329	100	96	0.86	6	Aster sibiricus var. meritus	1/3	1/3
109408	100	87	3.6	6	*Picea sitchensis / Polystichum munitum Forest*	1/6	1/6
107100	100	61	2.1	8	*Haliaeetus leucocephalus nests*	1/45	1/45
106568	99	96	1.6	12	*Aquila chrysaetos* *Strix occidentalis caurina* Brachyramphus marmoratus	2/19 2/142 1/77	2/19 2/169 1/77
109010	99	96	4.2	11	*Ranunculus cooleyae* *Lycopodium dendroideum*	1/3 1/11	1/3 1/13
108713	99	95	1.5	7	Deschampsia caespitosa Herb. Veg. *Tsuga mertensiana - Abies amabilis / Elliottia pyroliflorus Woodland*	1/3 1/6	1/3 1/6
109341	96	99	30.8	6	*Lobelia dortmanna*	2/5	2/5
106881	96	85	0.8	7	*Aquila chrysaetos* *Strix occidentalis caurina*	2/19 2/142	2/19 2/169
107065	96	75	1.5	6	Chaetura vauxi	1/7	1/7
108718	90	95	6.3	6	Ranunculus cooleyae	1/3	1/3
109342	90	84	12.4	5	Columba fasciata	1/5	1/5
108870	82	89	5.0	9	Coptis aspleniifolia	1/4	1/4
109421	82	85	15.7	7	Picea sitchensis / Polystichum munitum Forest	1/6	1/6
109361	82	76	0.9	6	Campanula lasiocarpa	1/7	1/7
109498	80	81	9.6	9	Canis lupus	1/8	1/12
109206	80	79	10.6	10	Aquila chrysaetos Brachyramphus marmoratus	1/19 1/77	1/19 1/77
108782	76	76	1.7	6	Tsuga mertensiana - Abies amabilis / Elliottia pyroliflorus Woodland	1/6	1/6

Table 28 (continued). Examples of main targets for selection of AUs with high utility scores.

AU number	Utility Score	irreplace-ability	un-suitability	Number of Targets	Main Targets for Selection	Amount per Ecosection	Amount per Ecoregion
Ecosection: Southeastern Pacific Ranges							
106991	100	100	0.8	12	Lycaena cuprea henryae	1/1	1/1
107328	100	100	2.3	9	Schistostega pennata	1/1	1/3
106608	100	100	0.9	7	Accipiter gentilis laingi	3/3	3/32
106861	100	100	0.8	7	Botrychium ascendens	1/2	1/4
106795	100	100	0.9	7	Lycopodium dendroideum	1/2	1/13
107048	100	100	3.8	6	Gavia immer	1/4	1/13
106401	94	88	0.9	8	Strix occidentalis caurina	2/22	2/169
107086	90	90	0.8	8	Agriades glandon megalo	1/3	1/4
106370	90	85	0.9	4	Canis lupus	1/4	1/12
105909	88	90	4.7	4	*Smelowskia ovalis*	1/4	1/5
106060	81	90	2.0	3	Castilleja rupicola Elmera racemosa var. racemosa	2/6 1/4	2/6 1/4
107511	80	89	2.3	6	*Bufo boreas*	1/5	1/13
107419	80	88	2.1	9	*Canis lupus*	1/4	1/12
105819	80	97	3.5	5	*Strix occidentalis caurina*	3/22	3/169
105997	77	84	7.5	7	*Aplodontia rufa rufa* *aggregate lower elevation forest*	1/7 ---	1/13 0.02%
105483	76	86	7.3	3	*Aplodontia rufa rufa* *aggregate lower elevation forest*	1/7 ---	1/13 0.01%

Utility and irreplaceability scores are different ways to prioritize places for conservation. Irreplaceability has been the most commonly used index (e.g., Andelman and Willig 2002, Noss et al. 2002, Leslie et al. 2003, Stewart et al. 2003), and it assumes that land area is the sole consideration for efficient conservation. Utility incorporates other factors that can effect efficient conservation such as land management status and current condition. In our analysis, many AUs attained scores of 100 for both utility and irreplaceability. These results demonstrate that for scores at or near 100 the cost had little influence on selection frequency; occurrence data drove the results. More importantly, it demonstrated that the results are robust. Under two different assumptions about efficiency (area versus unsuitability), the highest priority AUs were very similar.

Utility and irreplaceability scores were significantly different for many individual AUs at the middle and low end of the utility score range. This is useful information for prioritization. AUs at the low end of utility (or irreplaceabilty) typically are unremarkable in terms of biodiversity value. They contribute habitat or target occurrences, but they are interchangeable with other AUs. For these AUs, prioritizing on the basis of suitability rather than biodiversity value makes most sense. If an AU can be distinguished from other AUs because conservation there will be cheaper or more successful, then that AU should be a higher priority for action. For these AUs, the utility score should be used for prioritization.

APPENDIX 16 – PORTFOLIO PRIORITIZATION

Appendix 16 – Portfolio Prioritization

Calculating Conservation Value and Vulnerability for Site Prioritization.

Terrestrial and freshwater portfolios were prioritized separately using identical methodology. The first step was to define our measures of conservation value and vulnerability. For this analysis, our measures were a function of readily available GIS data compiled through the ecoregional assessment process. We based conservation value on irreplaceability measures, an output from running the MARXAN model; for vulnerability we used the suitability index that was an input to our model.

Conservation Value - For this analysis we define places of highest conservation value as those areas of critical importance due to their biodiversity or landscape values. We based conservation value on two factors:

1. Mean Irreplaceability (C_1) – The MARXAN algorithm output was used to measure the irreplaceability of a conservation area. We ran 10 replicates of MARXAN without the suitability index and with increasing goal levels (Appendix 9). The number of times a hexagon was selected corresponded to its relative importance, or irreplaceability. The irreplaceability value for a conservation area was the mean of all the hexagons intersecting the conservation area. Without the suitability index, MARXAN will preferentially select hexagons that have imperiled species and/or many targets over hexagons with common species and fewer targets.

2. Count of Maximum Irreplaceability (C_2) - Each site is made up of one or more assessment units. A site made up of many planning units might contain areas of high irreplaceability along with areas of moderate irreplaceability, giving the site a moderate average score. This factor represents a count of assessment units in a site that achieved the maximum irreplaceability score (in our case 250), and gives a higher value to sites that may have a moderate average score but include areas of high importance.

These two factors were combined as follows:

$$\text{Conservation value} = Ai\ Bi\ C_1 + Ai\ Bi\ C_2$$

where Ai is a subjective weight that expresses certainty or confidence in GIS data, Bi is a subjective weight that expresses the importance of the factor, C_1 is normalized mean irreplaceability, and C_2 is normalized count of maximum irreplaceability score for each site. When determining the subjective weights, the factor considered the most important was given a weight of 1 for Bi, and the factor with the highest quality GIS data was given a weight of 1 for Ai. See Table 29 for the weightings used for conservation value. These factors were put into the prioritization tool to calculate conservation value for each of the 155 terrestrial sites and 121 freshwater sites.

Table29. Conservation Value weightings for both terrestrial and freshwater prioritization schemes.

Conservation Value	Count Max SS	Mean SS
CERTAINTY	1.00	1.00
IMPORTANCE	0.50	1.00
Weight	0.50	1.00

Vulnerability- We define vulnerability as a measure of threat to the conservation value of a site. We based vulnerability on two factors:

1. mean suitability index score (V_1) – Indicates the relative likelihood of successful conservation at a site and is measured by human impacts such as land use, land management and distance from urban areas. This factor is derived by calculating the mean suitability index score from in the MARXAN model.

2. max suitability score (V_2) – Indicated toe score of the least suitable assessment unit for a given site.

Suitability index mean and maximum values at each site were combined into vulnerability ratings as follows:

$$\text{Vulnerability} = \text{Ai Bi } V_1 + \text{Ai Bi } V_2$$

where Ai is a subjective weight that expresses certainty or confidence in GIS data, Bi is a subjective weight that expresses the importance of the factor, V_1 is the normalized mean suitability index value for each site, and V_2 is normalized maximum suitability index value for each site. Table 30 displays the weightings used for calculating vulnerability.

Table 30. Vulnerability weightings for both terrestrial and freshwater prioritization schemes.

Vulnerability	Max Cost	Mean Cost
CERTAINTY	1.00	1.00
IMPORTANCE	0.50	1.00
Weight	0.50	1.00

APPENDIX 17 – INTEGRATION METHODOLOGY AND CHALLENGES

Appendix 17 – Integration Methodology and Challenges

Integration Methods
November 29, 2004

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Purpose:

To develop methods and recommendations for integration of freshwater, terrestrial and marine realms of ecoregional assessments. This method will be adopted by TNC, NCC and WDFW and all partners entering into agreement and used for the E/W Cascades, North Cascades and Okanagan Ecoregional Assessments. There is an underlying assumption in TNC's ecoregional assessment methodology, as described in Geography of Hope (TNC 2001): we want efficiency in selecting and working at sites to reduce the cost of conservation, and that minimizing portfolio area is one aspect of efficiency. This assumption applies to the integration of realms. There is particular interest in developing consistent methods so that different ecoregions can be joined together for multi-ecoregional as well as state or provincial analyses. We acknowledge that significant work is ongoing by others in the larger planning context as it relates to integrative analyses. This agreement provides a methodology for combining the separate realms into an integrated portfolio for all remaining first iteration assessments.

Limitations of Integration for Ecoregional Assessments:

This document prescribes a technical approach to integrate separate analyses for the purpose of portfolio development. We strongly recommend that integration be at the forethought of all assessment efforts. Subteams should discuss integration throughout the process. Decisions need to be made early on concerning targets that might be analyzed in multiple realms.

We make no claims, even implicitly, regarding the integration of "ecological function." While one could rightly assume that places selected for multiple realms would support functional ecological relationships among realms, we do not have adequate resources to analyze ecological function at the ecoregional scale. Post-assessment analysis at the sub-ecoregional scale is necessary to assess ecological function.

Proposed Methods

I. Analyses of Areas of High Biodiversity Value for Terrestrial, Freshwater, and Marine Realms are done separately. Each team is responsible for coordinating with the technical team for the completion of these tasks.

1. Each ecological realm analysis will be conducted across an appropriate spatial extent: terrestrial = ecoregion; freshwater = ecological drainage unit; nearshore marine = marine ecoregion.

2. Appropriate assessment units (AUs) are chosen for terrestrial, freshwater, and nearshore marine realm. These are determined by the realm subteams with Core Team input, e.g., terrestrial = hexagons, freshwater = watersheds, nearshore marine = shoreline units, nested grids, or hexagons. Different realms may have the same assessment unit.

3. Where targets cross realms, they can be addressed in both realms. For example, targets in estuaries might be included in both marine and freshwater analyses, or targets on marine shorelines could be included in both terrestrial and marine analyses.

4. Develop separate suitability indices for each realm based on realm subteam decision with core team input. There may be considerable overlap in suitability indices among realms.

5. Create selected AU sets of priority areas for each realm for the mid-level goals as described in Phase 3.

II. Data Integration

An integrated portfolio is created by populating all of the target data from the separate realms into a single MARXAN model. Purpose of core AUs: These areas are selected by concurrence of portfolio sites from more than one of the separate realm portfolios. Concurrence across multiple realms suggests that conservation effort in these areas will benefit multiple realms.

1. All target data is input into one set of MARXAN tables.

2. Assessment units with portfolio sites from two or more overlapping realms are locked into the model using the input.dat file. This represents “core areas” which will be included in the final integrated portfolio. Additional AU selection is thus built upon these core areas.

3. Protected areas are NOT locked into the integrated MARXAN models. If protected areas were chosen to be locked into the separate realm portfolios, then this will already be reflected by the “core” lock-ins.

4. The purpose of locking in core areas of concurrence is to insure the integrated portfolio includes areas of concurrence across realms. However, some of the important sites selected by the individual realm may be absent from the final portfolio for the sole sake of “efficiency.” Therefore, technical teams should conduct a sensitivity analysis comparing models run with and without core lock-ins to understand the extent that core areas drive the portfolio, as related in section IV, 3.

III. Integrated Contour Maps

1. The technical team will develop a suitability index for the integrated assessment units. All factors used in the separate realms should be considered as potential factors and the index should use the same underlying data as the individual analyses

2. The technical team creates Contour maps using the integrated assessment unit that incorporates all realms as described in Phase 2b of the Agreement. These should first be run with core AUs locked in.

IV. Integrated Portfolios

1. Mid-risk portfolio - use core AUs to drive mid-level (30% goal) portfolio. Because freshwater realm analysis is done by EDU, goals for freshwater targets will generally need to be adjusted to capture the correct proportion of EDU goals within the ecoregion. For instance, if the goal for the EDU was 30% of FW system A, and 40% of that target's goals were met within the ecoregion (i.e. 12% of FW system A is captured in the area where the freshwater portfolio overlaps the ecoregion), than the goal for the ecoregional analysis should be 12% of System A occurrences.
2. Use minimum clump size and boundary modifier parameter variable in MARXAN to create connectivity among stream segments.
3. A sensitivity analysis should be done to determine how much the core units are driving the portfolio and to test the efficiency of the resultant portfolio. Use of core area lock-ins can be modified if core areas drive the model to an inefficient portfolio.
4. For the higher risk solution (18% goal) lock out everything outside mid-level portfolio and select from assessment units within the mid-level portfolio to reach high risk goals as described in the Agreement.
5. For the lower risk solution (48% goal) lock in the mid-level portfolio and add to it to reach lower risk goals as described in Phase 3 of the Agreement.
6. Review the mid-level integrated portfolios paying particular attention to connectivity of systems. Address by comparing results to individual realm portfolios. If the draft integrated portfolio is deemed unacceptable for any reason (fragmentation, efficiency, etc.), core teams can use a variety of techniques necessary to refine the portfolio. This could include expert review, manual editing and additional analysis. This is not intended to create a new portfolio, but to refine the current portfolio until it meets expectations of the core team.

V. Products.

The mid-risk integrated portfolio is the TNC preferred portfolio and is displayed as the "portfolio." We display contour maps of irreplaceability for integrated assessment. Low and high-risk portfolio maps will be displayed in conjunction with the mid-risk portfolio. In addition to the integrated results as described in agreement (conservation portfolio, utility map, etc.), every ecoregional assessment will also present the expert-reviewed mid-level analysis for each individual realm with the integrated portfolio.

VI. Terms Used

Conservation utility map – Internal tern for a contour map displaying results of combined "sum solutions" model runs with multiple goal scenarios, with a suitability index

Contour map – short-hand name for both irreplacibility and conservation utility maps.

Core portfolio - The locked in set of IAUs in the integrated MARXAN runs. These units represent concurrence areas from individual realm priority areas

Ecological realm –different physical environments consisting of terrestrial, freshwater, and marine.

Irreplaceability map – Contour map displaying results of combined “sum solutions” model runs, potentially with multiple goal scenarios, multiple boundary modifiers, and alternative suitability indices.

APPENDIX 18 – DETAILED METHODOLOGY ON SENSITIVITY ANALYSIS

Appendix 18 – Detailed Methodology on Sensitivity Analysis

A sensitivity analysis is necessary whenever there is considerable uncertainty regarding modeling assumptions or parameter values. It determines what happens to model outputs in response to a systematic change of model inputs (Jorgensen and Bendoricchio 2001, pp. 59-61). Sensitivity analysis serves two main purposes: (1) to measure how much influence each parameter has on the model output; and (2) to evaluate the potential effects of poor parameter estimates or weak assumptions (Caswell 1989). Through a sensitivity analysis, we can ascertain the robustness of our results and judge how much confidence we should have in our conclusions.

Chapters 2 to 4 explain the inputs to the site selection algorithm. The input with the greatest uncertainty is the suitability index. The suitability index was not a statistical model – variable selection and parameter estimates for the index were based on professional judgment. For this reason, the sensitivity analysis focused on the index. Other assessments have incorporated a suitability index or something similar into an optimal site selection algorithm (Davis et al. 1996, Nantel et al. 1998, Stoms et al. 1998, Davis et al. 1999, Lawler et al. 2003). Only Davis et al. (1996) and Stoms et al. (1998) investigated the sensitivity of site selection to changes in their index.

The sensitivity analysis was done only for the terrestrial portion of the conservation utility maps because: (1) the terrestrial data have a greater influence on the portfolio than the freshwater data; (2) terrestrial environments and species have been more thoroughly studied, and therefore, our assumptions about terrestrial biodiversity are more robust than for estuary or freshwater biodiversity; and (3) the terrestrial portfolio has the greatest potential influence on land use planning and policy decisions affecting private lands.

Methods

We explored sensitivity to the suitability index by altering the index's parameter values, running the selection algorithm with the new index, and then quantifying the resulting changes in the conservation utility map. Recall that the suitability index equation is a weighted linear combination of factors:

$$\text{suitability} = A \bullet \text{management status} + B \bullet \text{\%converted land} + C \bullet \text{road density} + D \bullet \text{\%urban growth area} \quad (1)$$

where A + B + C + D = 1; and management status, %converted land, road density, %urban growth area, and fire condition class were each normalized to a maximum value of 1. Also, recall that MARXAN tries to minimize the "cost" of AUs. Therefore, the suitability index is actually formulated as an "unsuitability" index.

The values for parameters A, B, C, and D were determined by averaging expert opinion using the Analytic Hierarchy Process (AHP; Saaty 1980). The values for of A, B, C, and D used to produce the utility maps were 0.361, 0.447, 0.090, and 0.102, respectively. All parameters were changed by +0.1 and parameters A and B were also changed by -0.1. After changing a parameter value, the other parameters were adjusted so that they all still summed to 1. For instance, if A was changed to A", then:

$$B'' = B \cdot (1\text{-}A'') / (B + C + D)$$
$$C'' = C \cdot (1\text{-}A'') / (B + C + D)$$
$$D'' = D \cdot (1\text{-}A'') / (B + C + D) \quad \text{or} \quad D'' = 1 - A'' - B'' - C''$$

Only the suitability index parameters were changed; none of other inputs to the selection algorithm used to produce the original utility map were changed.

Resulting changes in the algorithms output were quantified several ways. First, three similarity measures were calculated to compare the conservation utility maps generated: mean absolute difference (also known as mean Manhattan metric), Bray-Curtis similarity measure, and Spearman rank correlation (Krebs 1999; pp 379-386). The Bray-Curtis similarity measure normalizes the sum absolute difference to a scale from 0 to 1. Hence, mean absolute difference and the Bray-Curtis similarity measure give the same result but on different scales. Because utility will be used for prioritizing AUs, the rank correlation is particularly informative. Rank correlation tells us how the relative AU priorities change in response to changes in the suitability index. Because we were interested in prioritizing AUs, we also calculated and the mean absolute difference in rank. We were especially interested in how the ranks of the most highly ranked AUs (i.e., AUs with highest utility scores) would change. To examine this, we also calculated: (1) a weighted Spearman rank correlation using Savage scores (Zar 1996, pp. 392-395) with highly ranked AUs contributing more heavily to the rank correlation value; and (2) the mean absolute change in rank for only AUs with original rank equal to 1. When calculating rank correlation, AUs that had tied ranks were given the mean of the ranks that would have been assigned had they not been tied (Zar 1996, p. 150). When calculating mean absolute difference in rank, all AUs that had tied ranks were assigned the lowest rank and the next highest rank was assigned to the next AU that was not tied to these AUs. Each similarity measure gives a single number that indicates the degree of change. They can be used to determine which suitability index parameter has the most influence on the utility. Parameters with more influence will cause a larger change in the similarity measures.

Second, we determined whether the difference between utility and irreplaceability was significantly different. This was done by testing the following hypothesis for mean absolute difference:

H_{01}: the mean absolute difference between utility and irreplaceability maps equals zero.
H_{A1}: the mean absolute difference between utility and irreplaceability maps is greater than zero.

and for the Bray-Curtis similarity measure and Spearman rank correlation, this hypothesis:

H_{02}: similarity between the utility and irreplaceability maps equals one.
H_{A2}: similarity between the utility and irreplaceability maps is less than one

The hypotheses were tested using a randomization test (Sokal and Rohlf 1995, pp. 808-810). Pairs of random maps were generated by lumping together all scores from the original utility and irreplaceaiblity maps, reshuffling the scores, and then assigning half the scores to one random map and the other half to a second random map (i.e., random sampling of utility and irreplaceability scores without replacement). The four measures of similarity were calculated for 1000 random map pairs. The proportion of times that the mean absolute difference between the random map pairs is smaller (or the similarity is larger) than the difference between the utility map and irreplaceability maps equals the probability that utility map and irreplaceability map are significantly different. This was a one-tailed test of significance with α = 0.05. Since we were using a randomization test, the hypotheses could be restated as follows:

H_{01}: the mean absolute difference between the utility map and the irreplaceability map is equal to or less than the mean absolute difference between random map pairs;
H_{A1}: the mean absolute difference between the utility and the irreplaceability maps is greater than the mean absolute difference between random map pairs;

H_{02}: similarity between the utility map and the irreplaceability map is equal to or greater than the similarity between random map pairs;
H_{A2}: similarity between the utility map and irreplaceability map is less than the similarity between random map pairs.

If the observed similarity measure is significantly less than (or the distance is significantly greater than) that expected from chance, then the null hypothesis is false, and we can state that the utility and irreplaceability maps are different. For Spearman rank correlation, the alternative hypothesis is equivalent to $r \leq 0$. This test is similar to that done by Warman et al. (2004)

Third, a contingency table analysis was done to compare the utility values and irreplaceability values of paired AUs. The log-likelihood ratio method (Zar 1996; pp. 502-503) was used to test the following hypotheses:

H_{03}: AU selection is independent of cost index
H_{A3}: AU selection is dependent on cost index

Paired AUs were considered to be significantly different for $P <= 0.05$.

Running the Selection Algorithm

MARXAN produces an output that is equivalent to nI_j, i.e., the number of times an AU was selected out of n replicates. We ran 25 replicates at each representation level. Hence, the product m•n equaled 250 for both irreplaceability and conservation utility. The irreplaceability and conservation utility values were normalized such that 250 equaled 100. For the terrestrial and freshwater analyses, BM was set to zero. When BM is set to zero, neighboring AUs have no influence on the selection frequency of an AU.

We set a minimum clump size for grizzly bear, lynx, fisher, elk, and mountain goat habitats and some ecological systems. The social organization of the carnivores and ungulates is quite different. The carnivores often live alone on territories and the ungulates often form herds. Hence, the two species groups were dealt with in different ways. For the wide-ranging carnivores, typical territory sizes were used to set representation levels. For herd animals, representation levels were based on observed population densities. The clump sizes for ecological systems were those described in Chapter 3. MARXAN has three options for clump type (Ball and Possingham 2000; pp. 13-14). We used option 0 – clumps less than the minimum size are not counted toward meeting the representation level. Clumping was done for the first eight representation levels only. At the ninth level, clumping became impractical because of extremely long computer processing times, and at the tenth level, the representation level was 100% of all habitat so clumping was meaningless.

The algorithm's objective function says, in effect, minimize cost (or unsuitability) subject to T constraints, where T equals the number of targets. All T constraints are the same – the amount captured must be greater than or equal to the target's desired representation level.

The third term in the objective function imposes these constraints, however, they are soft constraints. “Soft” means that the constraints can be violated. Each constraint’s “hardness” is determined by the penalty factors (PFs) set for each target – the larger the PF, the firmer the constraint. Hard constraints can be established by setting an arbitrarily large PF. However, very large PFs can create ill-conditioned objective functions exhibiting sharp peaks or valleys, both of which make optimization more difficult, i.e, requiring many more iterations to find the optimal solution (Gottfried and Weisman 1973). The best set of PFs is problem dependent.

Clearly, setting PF values is tricky. To address this problem, we used an iterative search to set PF values. We began the search with PF equal to 1 for every target. We ran MARXAN (5 replicates, 1 million iterations per replicate) and then checked the results of the best solution. MARXAN reports how much of the representation level was met for each target. If a target’s representation level was not met, we used the bisection method to converge on a PF value. We repeated these steps until the representation level was met for all targets. The iterative search was done at each of the ten representation levels. Hence, a target could have a different PF at each representation level. For the vast majority of targets, this process found the PF value in a reasonable amount of time. However, finding the PF value that yields 100 % of the desired representation level for every target took too much processing time. Hence, we terminated the PF search when only 98 % of a target’s representation level was met. On average, about 87% of targets (both ecoregional and eco-sectional) had PF values equal to 1. Other details about running MARXAN are summarized in Table 31.

The spatial representation of TOs was different than that used for generating the portfolio. For the portfolio, each TO was represented as a circle with a radius corresponding to the assumed locational uncertainty of the target. For the irreplaceability analysis, TOs were represented as points.

Table 31. Values for MARXAN parameters used in all sensitivity analyses of the terrestrial conservation utility map.

Parameter	Function	value
Algorithm	Type of optimization routine	simulated annealing
Replications	Number of times to repeat optimization per representation level	25
Iterations	Number of times to create new combination of AUs	2,000,000
Boundary modifier	Weighting factor for “cost” of AU perimeter. Encourages clusters of AUs	0
Target penalty factor	weighs “cost” of not meeting a target’s representation level	bisection method search
Representation level	amount of target the algorithm must capture	10 levels, same as section XXXX
AU status	Initial selection state of each AU	0 for all hexagons
Suitability Index	indicates likelihood of successful conservation at AU	equation 1

Results

In general, changes to suitability index parameters result in changes in AU utility scores (Figure 1). For example, when parameter A is changed by 0.1, a linear regression shows a significant ($p < 0.0001$) but weak relationship ($r^2 = 0.02$) between change in suitability index and change in utility scores – as the AU "unsuitability" decreases the utility score increases. The relationship is weak because in this example, 49 percent of AUs did not change utility score in response to the change in parameter A, and 15% of AUs did not follow the general trend between change in utility and change in unsuitability. That is, unsuitability increased and utility increased, or unsuitability decreased and utility decreased. This counter-intuitive result occurs because AU selection is based on relative suitability. Change in unsuitability and utility can have the same sign if many AUs with the same targets have a much greater change in unsuitability.

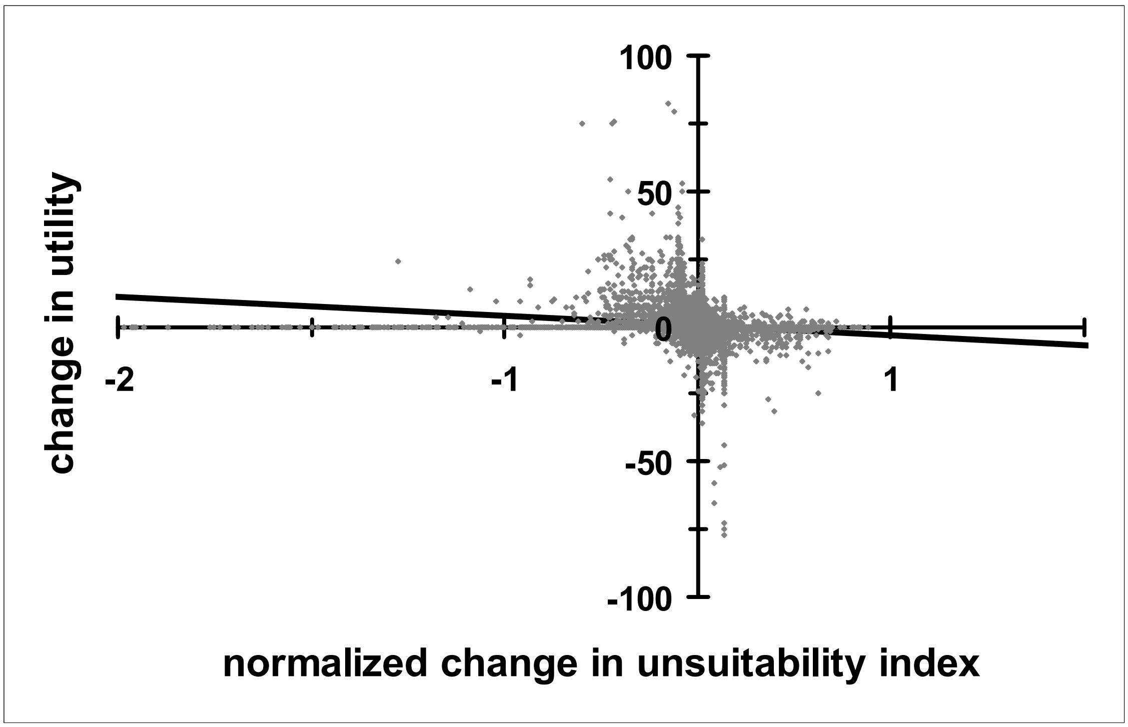

Figure 1. Relationship between change in unsuitability index and change in utility score for parameter A+0.1. One point represents one AU; 9587 total points. Line shows results of linear regression ($r^2 = 0.02$, $p < 0.0001$).

Positive changes to all four parameters resulted in approximately the same values for mean absolute difference, Bray-Curtis similarity measure, and Spearman rank correlation. (Table 32). However, amongst positive parameter changes, parameter C caused the greatest effect on similarity measures. Negative changes to parameters A and B resulted in larger values for mean absolute difference than those resulting from positive changes to A, B, C, and D. The sensitivity of utility to changes in parameters A and B was nonlinear. That is, negative changes to the parameters caused larger changes in utility than did positive changes (Table 32). For changes to all parameters, the null hypothesis was accepted for all similarity measures. That is, none of the changes to index parameters resulted in significant changes to the overall utility map. All values for weighted Spearman rank correlation were larger than those for unweighted Spearman rank correlation, which demonstrates even greater similarity among AUs with higher utility scores than lower scores.

Table 32. Similarity measures comparing original utility scores with scores obtained after changing parameter values in the suitability index.

	A		B		C	D
	-0.1	**+0.1**	**-0.1**	**+0.1**	**+0.1**	**+0.1**
mean absolute difference	3.3	3.0	3.4	2.8	3.1	3.0
Bray-Curtis Measure	0.979	0.981	0.978	0.982	0.980	0.981
Spearman Rank Correlation	0.986	0.990	0.990	0.990	0.987	0.989
Weighted Rank Correlation	0.992	0.994	0.993	0.993	0.993	0.993

According to the similarity measures there was little overall difference between the original and altered utility maps. However, many individual AUs did change and some showed statistically significant changes in utility (Figure 2). When each of the parameters was changed, about 50% of AUs changed utility score but only about 2 to 3.5% had a statistically significant change. Changes to parameter C, which modifies the relative influence of road density, caused the greatest number of significant changes.

Since utility will be used to prioritize AUs for conservation, the sensitivity of AU rank to changes in the suitability index is especially important. We restricted this analysis to AUs that were highly ranked. For AUs with rank greater than or equal to 100 (i.e., rank equal to 1, 2, 3, . . ., 100; 11% of AUs), changes to A, which modifies the relative influence of management status, caused the greatest mean absolute difference in rank, followed by D, then B, and then C (Figure AX.3). For AUs with the rank equal to 1 (i.e., utility=100; n=159), parameter B caused the greatest mean absolute change in rank followed by parameter A. Overall, few AUs with rank equal to 1 changed rank in response to parameters changes. Changes to B caused only 2.5% of them to change rank.

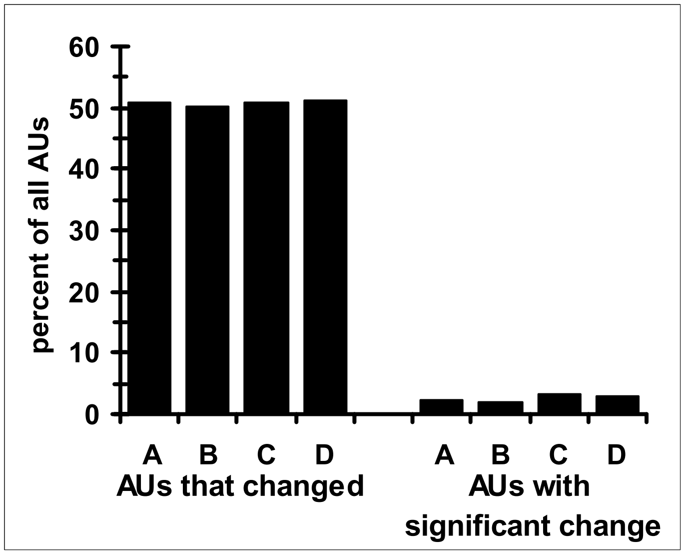

Figure 2. Percent of AUs with changed utility scores as a result of changing the suitability index parameters A, B, C, and D by+0.1. On left, percent of all AUs that changed. On right, percent of all AUs with a statistically significant change.

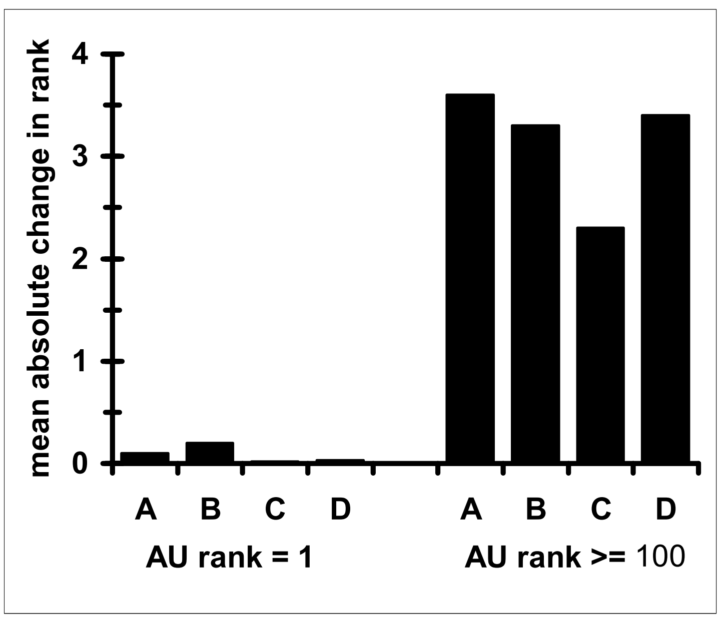

Figure 3. Mean absolute change in rank in response to changing each suitability index parameter by +0.1. On left, AUs with original rank equal to 1 (utility score = 100). On right, AUs with original rank greater than or equal to 100. Maximum rank equaled 224.

Discussion

The basic conclusion of the sensitivity analysis is that AU utility and rank change little in response to changes in the suitability index. Similarity measures that compare "before" and "after" utility maps of the entire ecoregion indicate that the overall map is relatively insensitive to changes in suitability index parameters. That is, the average change over all AUs is small. However, the utility and rank of many AUs did change and some exhibited significant changes. The number of AUs that changed significantly depended of which index parameter was changed.

We investigated the sensitivity of the utility map to changes in the suitability index because of our uncertainty about the index. The variable selection and parameter estimates for the index were based on best professional judgment. The sensitivity analysis considers how much utility scores would change if the subjective judgments were slightly different. The results of the sensitivity analysis have two implications for conservation planning. First, highest priority AUs (about ranks 1 through 10; the top 2% AUs) are rather robust to changes in the suitability index, i.e., robust to different subjective judgments about suitability. Therefore, regardless of the uncertainties in the suitability index, we can be confident about the most highly ranked AUs. These AUs were selected mainly for their relative biological value, not relative suitability. For similar reasons, the lowest ranked AUs (rank less than about 100), tend to be robust to changes in the suitability index – they maintain a low rank because they have relatively little biological value. Second, the utility of moderately ranked AUs (rank less than 10 and greater than 100; about 9% of AUs), is sensitive to changes in the suitability index. When choosing among AUs of moderate rank we must explore how our assumptions about suitability affect rank.

The results of the sensitivity analysis put extra emphasis on the proper use of MARXAN or any optimal site selection algorithm. AU priorities are influenced by the suitability index, but the suitability index relies heavily on subjective judgments. Software like MARXAN is often referred to as "decision support tools." Such tools can best support decisions by enabling us to explore the effect of various assumptions and differing opinions. Both Davis et al. (1996) and Stoms et al. (1998) did the equivalent of a sensitivity analysis for their suitability indices. However, they referred to their different indices as "model variations" or "alternatives"; an implicit recognition that different sets of assumptions may have equal validity. To address uncertainties in suitability indices, AU priorities, especially for moderately ranked AUs, should be derived from several different analyses using different indices. This will enhance the robustness of analytical results and lead to more confident decision making.

The other major source of uncertainty in this assessment was the biological data – both the ecological systems map and the target occurrence data. The potential consequences for optimal site selection of incomplete (Freitag and Van Jaarsfeld 1998, Gaston and Rodrigues 2003, Gladstone and Davis 2003) or inaccurate (Flather et al. 1997, Polasky et al. 2000) biological data have been investigated. Not surprisingly, each study found that inaccurate data will substantially alter the results of site selection. However, Gaston and Rodrigues found that incomplete species surveys, that is, surveys with low or zero survey effort in portions of a region, may not substantially alter the results of site selection. This is because biologists bias surveys toward places where they think species will be found and such places tend to have peaks in species abundance. While there is uncertain about the occurrence data, it is the best information we have. Survey data have errors, but recent data (less than about 5 years old) are more likely to have false negatives than false positives. False negatives are preferred over false positives, because we don't want to select places for conservation where targets don’t actually exist (Freitag and Van Jaarsveld 1996, Araujo and Williams 2000). In short, we have to work with the occurrence data we have, and unlike the suitability index, we cannot readily alter the occurrence data in a way that will give us greater confidence in AU prioritization.

APPENDIX 19 – COMER MEMOS

Appendix 19 – Comer Memos

MEMORANDUM

Conservation Science Division
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To: Ecoregional Planning Team Leaders - West
From: Pat Comer
CC: Leni Wilsmann, Jeff Baumgartner, Laura Valutis, Jonathan Higgins, Mike Beck, and others…

Re: Observations and recommendations for setting conservation goals in ecoregional plans
Date: January 8, 2001

Over the past few years we have made enormous progress in developing solid and defensible methods for ecoregional planning. Refinements in target identification, information gathering, and portfolio assembly have been impressive, but we have some tough issues yet to resolve. Notably, we have a way to go to develop consistent and defensible conservation goals for targets in our ecoregional plans. Given the critical importance of this issue, I hope to serve as a conduit to share the many good ideas that have come out of different planning efforts. This memo is intended to pass along some of the good ideas I've encountered in my experience with a wide variety of planning processes, including recent discussions with the Southern Rocky Mountains team. I have also taken a few liberties using some material developed on this issue by Steve Chaplin. First, I'll provide some background and primary lessons learned, then touch on a variety of core issues. I'll then dig a little deeper with ecological and technical decisions faced by each planning team. Finally, I propose some initial ecoregional goals for different types of conservation targets. Please let me know what you think.

Conservation Goals – Background

Conservation goals represent the end toward which we direct conservation efforts for targeted species, communities, and ecosystems. Goals provide the quantitative basis for identifying and prioritizing areas that contribute to the reserve network. Reserve design is appropriately dictated by target goals, thus creating a vision of landscape functionality at a regional scale. Establishing conservation goals is among the most difficult - and most important - scientific questions in biodiversity conservation (e.g., How much is enough? How many discrete populations and in what spatial distribution are needed for long-term viability?). As some have pointed out (e.g. Noss 1996, Soule and Sanjayan 1998), these questions can't really be answered by theory, but require an empirical approach, target-by-target, and a commitment to monitoring and continual re-evaluation over the long-term. We can, however, use our knowledge of conservation targets to develop some empirical generalizations to serve as guiding principles; and our own experience may provide some very important insights.

For our purposes, we define a **viable species** or **population** as one that has a high probability of continued existence[24] in a state that maintains its vigor and potential for evolutionary adaptation[25] over a specified period of time. Footnotes included, conservation goals should support the evolutionary pathway of target species in continually changing ecosystems, looking into the future at least 100 years or 10 generations. While that concept of viability could be said to apply to all targets, in practice we use several closely related, though distinct, groups of targets. It is important to distinguish "fine filter" (*species*) targets from "coarse filter" (*communities* and *ecosystems*) targets in terms of conservation strategies. Fine filter strategies appropriately emphasize recovery and evolutionary adaptation of individual species. In addition to species viability, coarse filter strategies emphasize the conservation of ecosystem services (e.g. air, water, nutrient cycling, etc.), perhaps better characterized as **ecological integrity** at an ecoregion scale (Pimentel, Westra, and Noss 2000). These differences may result in different approaches for setting conservation goals. While conservation goals for species correctly emphasize genetic fitness and the functional roles of species in ecosystems, coarse filter goals focus more strongly on representation of ecological variability and environmental gradients.

Lessons Learned

Primary lessons learned so far when setting conservation goals in ecoregional planning include:

1) As already mentioned, an **adaptive approach** to setting conservation goals is essential. We simply do not have sufficient knowledge or data while establishing goals and the environment supporting our targets will continue to change. This requires careful documentation and a long-term commitment to research and monitoring.
2) We should **set quantitative, measurable goals** for all targets. This is required to measure our success. In addition to quantitative goals, more "qualitative" or descriptive goals can be very useful.
3) Develop useful **target groupings** and establish **initial goals** to apply when lacking specialized knowledge, then **refine goals** as possible with target-by-target information.
4) **Err on the side of redundancy**. Errors in the other direction are, literally, fatal to our conservation targets.

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[24] 95% certainty of surviving 100 years and/or 10 generations

[25] Potential for adaptation implies that the species or population has sufficient genetic variation to adapt by natural selection to changing environmental conditions within a predicted range of frequency and amplitude of disturbance and change.

5) **Ecoregional goals should be rolled up into rangewide goals** for all targets. This means that targets must be clearly defined across ecoregions and we should always consult established goals from surrounding ecoregions. However, we have to acknowledge that we are working our way through our first iteration of ecoregional planning. Goals established by surrounding ecoregions should certainly be consulted, but first-iteration goals should not unduly constrain your approach to setting goals.
6) **Document assumptions** made in the goal-setting process. We'll surely need to revisit them, so documentation today is essential.

As a general rule, conservation of multiple examples of each target, stratified across its geographic range, is necessary to represent the variability of the target and its environment, and to provide some level of "replication." Replication is needed to ensure persistence in the face of environmental stochasticity and likely effects of climate change. It is also required to allow for comparative study – to better understand our targets! – and to reliably detect change.

Although information is limited, we should take existing knowledge of our targets as far as possible with a first-iteration ecoregion plan. The following issues and approaches might be considered in light of existing knowledge.

- ***Spatial Pattern and Biodiversity:*** Characteristic spatial patterns for ecosystems and species habitat often reflect key ecosystem processes and important life-history traits. Scaling of targets, as described by Poiani et al. (2000) can be quite useful and effects how we evaluate viability at an occurrence level (Figure 1). It can also effect the assumptions we make as we express conservation goals. It is therefore useful to categorize each target according to its presumed spatial character, as it has occurred in recent millennia without significant human alteration.

- ***Link Species Targets to Ecosystem targets*:** In many instances, habitat requirements for target species are well enough understood that one-several ecosystem targets could be said to encompass and/or characterize those requirements. Where this link can be made, it allows for better integration of "coarse filter" and "fine filter" targets. In some instances, critical habitat requirements for target species can be integrated into viability criteria for system occurrences. In other instances, mapped system occurrences may be used to characterize potential habitat for species targets.

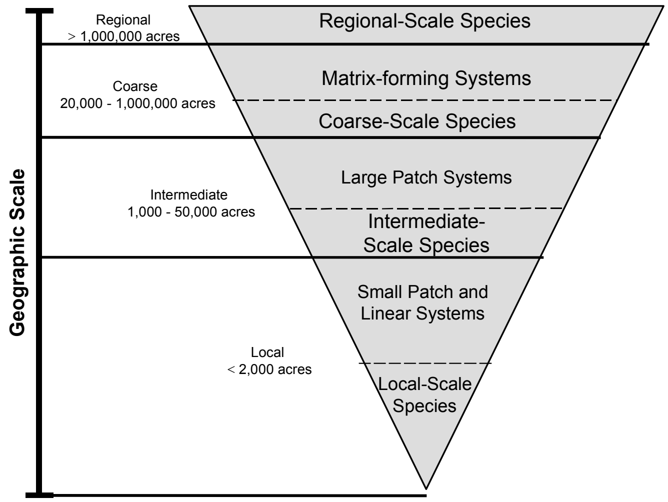

Figure 1: Categories representing geographic scale of conservation targets. Areal ranges are approximate and overlapping (Poiani et al. 2000).

- *Meta-population dynamics on real land/waterscapes underlie species viability.* In order to understand populations and simple models of metapopulation dynamics, we need information on: 1) number of habitat patches, 2) probability of patch (i.e. *local population*) extinction, 3) rate of movement between patches, and 4) correlation of fates of separate populations (Morris et al. 1999). Number four is the instance where, for example, stochastic events effect multiple populations simultaneously due to their proximity to each other. A sort of "dynamic tension" therefore exists between factors 3 and 4, in that we need to allow for dispersal between distinct populations, but if too many are clustered, their fates may be strongly correlated. Theory, at least, suggests a combination of clustered and isolated populations. These are very important considerations as they apply to setting conservation goals and reserve design. For example, if the fates of all populations are highly correlated, you don't gain very much from redundancy. If there is no correlation of fates and no movement, you can greatly reduce the overall chance of extinction by protecting best examples; but you gain little by adding poor quality examples (Morris et al. 1999; Chaplin 1999).

Unfortunately, available information tends to be limited to the first and second points above; e.g. locations of *occurrences* and some estimate of the *occurrence viability*. There are very few cases where we have any knowledge of points three and four. Even with the occurrence data we have, the relationship between populations and occurrences is not straightforward. We need to establish working assumptions about separation distances between extant occurrences so that clustered occurrences may be treated as one "meta-occurrence" counting towards conservation goals, if that is the likely biological reality. For species targets, knowledge of life history (e.g. home range, known dispersal distance) can form the basis for these assumptions. Similarly, knowledge of supporting processes and environments can inform these assumptions for local ecosystems.

- *Proportional Representation:* conservation goals should reflect the "natural" or historic range of distribution for the target. For example, if 50% of the known, natural range of the target falls within a given ecoregion, the goal for that ecoregion should reflect roughly 50% of a rangewide goal. In practical terms, we have used the target's distribution, *relative to the ecoregion* as a guide to establish numeric differentials in goal setting (higher with endemic, to lower with peripheral)

  endemic = >90% of global distribution in ecoregion,
  limited = global distribution in 2-3 ecoregions,
  disjunct = distribution in ecoregion quite likely reflects significant genetic differentiation from main range due to historic isolation; roughly >2 ecoregions separate this ecoregion from central parts of it's range
  widespread = global distribution >3 ecoregions,
  peripheral = <10% of global distribution in ecoregion

- *Spatial Stratification:* For domestic ecoregions, we have generally adopted USFS *Sections* (U.S. Forest Service 1999 draft) as primary stratification units for terrestrial targets. The Freshwater Initiative's ecosystem classification approach is spatially hierarchical, and *Ecological Drainage Units* (EDUs) are similarly scaled and serve the same purpose. Because much of our marine emphasis is on coastal-nearshore systems, or habitat for targeted marine species, terrestrial stratification can often be extended offshore. In a number of instances, however, additional information on nearshore currents, temperature regime, and population distributions are needed to establish a truly meaningful marine stratification. So in reality we apply *more than one stratification scheme* for a given ecoregional assessement. Because the freshwater EDU's overlap our terrestrial ecoregion boundaries, we are in effect using multiple ecoregions as well. This is not a problem. We simply need to apply spatial structures appropriate to the targets at hand. We will still arrive at a set of prioritized conservation areas within and across the ecoregions where we work.

  The spatial scale of stratification unit is another important consideration. For example, the USFS *Section* is one scale among several. They reflect broad variation in climate and physiography nested within our ecoregions. USFS *Subsections* are nested within *Sections*, reflecting more local patterns (*and less variability*) for climate, landform, soil, and potential vegetation. One might choose to establish goals that *represent,* or even *replicate* occurrences in each *Subsection* throughout the range of target, if in fact this level of environmental variation is thought to be significant to the target. However, we have tended to establish initial goals requiring *replication (2 or more) at the Section scale.* As we work in cross-border/ international settings where USFS *Sections* do not currently exist, we need to be cognisant of scale of variation represented by the stratification units we select. They should be comparable to units we use domestically.

- *The "Ecological Backdrop:"* As we formulate conservation goals, we make assumptions about the expected land use that will occur *outside* of the reserve network, i.e. the "ecological backdrop," or as Westra (1994) notes, the area "in the buffer." How might we address this? First, it's helpful to review trends in land use and our knowledge of effects on specific ecosystems. Are some ecosystems significantly more altered/degraded than others? Are these land-use effects from on-going development, or are they legacies from the past? Recent trends in land use, as well as projections of future land use, are important components of ecoregional plans. To the extent that we can identify ecosystem and species targets that are relatively more vulnerable to current and future land uses, we can *anticipate an increased probability of future losses*. It may then be prudent to build a greater degree of "redundancy" into goals for effected targets. We should also look to "the backdrop" as we develop ecoregion-wide conservation strategies. While our plan should provide us with appropriate focus on specific areas, it should also indicate where conservation could be strategically pursued across entire ecoregions.

- *Some Preliminary Numbers:* So where to we begin to establish overall numerical goals? In a limited number of cases, existing recovery plans have established explicit, numerical goals that address the continued recovery and long-term viability of target species. In many cases, however, goals have not been stated quantitatively, or are not true rangewide goals, but reflect political jurisdictions and compromises. They also can reflect bare-minimum numbers required for genetic fitness of individuals in populations, but do not truly address long-term viability and the functional roles of target species in ecosystems. Theoretical work on species viability (e.g. Quinn and Hastings 1987) has been applied to coarse-scale species in Florida (Cox et al. 1994), with apparent success. This suggests that 10 distinct populations of 200 individuals should be sufficient for survival over 10 generations/100 years. Though again, these are bare minimums for genetic fitness.

  Our own experience, and that of the Natural Heritage Network, in ranking the conservation status of each target might be a most useful place to look for establishing preliminary numbers. We have tended to use global ranks for species targets as categories for expressing conservation goals. However, we might more appropriately view global ranks as an indicator for the *urgency of conservation action*, and look to underlying ranking criteria to inform numerical goals. These criteria include factors such as number of occurrences, condition/occurrence viability, trends, threats, fragility, and degree of existing protection (Stein et al. 2000). In very general terms, a given community or species is ranked G3 by the NHP network when it is known from 21 – 100 occurrences, or 1,000 – 3,000 individuals, across its known range. A G3 rank signifies that, while the element remains quite rare, it is considerably less imperiled, due to its rarity and apparent threat, than those types ranked G1-G2. With this as a guide, we should seek to protect at least 25 examples rangewide within the reserve network (slight redundancy built in to partially account for other ranking factors). The ecological diversity that they represent is likely to be retained within each ecoregion over the next 100 years/10 generations. Again, lacking target-specific knowledge, this is a reasonable, and defensible, point of departure for many targets. It is based in our own and our partners' direct experience.

Species Targets

Given our limited knowledge of target viability and population dynamics, the following should serve a guide for representing species targets and developing replication goals in support of reserve design. These guidelines are organized by geographic scale, so categorizing targets in this way is strongly encouraged.

- ***Local scale:*** These typically include all/most plants, invertebrates, herps, and small mammals. They are often associated with "small patch" and "large patch" terrestrial ecosystems, and small lake/stream systems. Figure 1 suggests a habitat size <2,000 acres (800 hectares) may encompass much of the habitat for populations of several hundred individuals. These localized occurrences are efficiently represented on maps as *points*. Detailed review and calculation of home range size is helpful for animals, though likely not essential for this group of targets. A simple rule for establishing minimum distance between occurrences (i.e. we assume that closer occurrences are one "population") could be *3 times the diameter of a circular patch of the minimum area*. For the case of a patch size of 800 hectares, a 9675m, or roughly 10 km (6 miles) minimum distance between points would suffice. Botanists have commonly used a separation distance of roughly 5 km (3 miles) for plant targets. Because this group of targets may be more likely to be found in more specialized habitats, they may be benefit from replication at a *subsection* scale (or finer). Additional stratification of aquatic species targets in this group should be considered.

- ***Intermediate scale:*** These typically include small/medium-size mammals, birds, and fish, and some herps. They are often associated with "large patch" and "linear" terrestrial ecosystems, and medium-size lake and river systems. Review of home range size and habitat characteristics (e.g. link to system targets) is very useful with this group of targets. In most cases, we should aim to represent these targets as *polygons* of *"occupied habitat"* (*lines* for river-dwelling fish, etc.). In some instances, point locations may suffice. Lacking specific information on home range size, an initial assumption of 5,000 acres (2,000 hectares) could be used for terrestrial targets. Using our 3X rule, this gives a minimum distance of about 15 km (9 miles) between occupied habitat polygons. *Section*-scale (and *EDU*-scale) replication is appropriate for these targets.

- ***Coarse scale:*** These typically include medium-size mammals, birds, and fish. They are often associated with "matrix-forming" terrestrial ecosystems, large lakes and medium-large river systems. Review of home range size and habitat characteristics is very important with this group of targets. In all cases, we should aim to represent these targets as *polygons (or lines)* of *"occupied habitat."* Spatially explicit habitat models would be very useful for these targets. Lacking specific information on home range size, an initial assumption of 30,000 acres (12,000 hectares) could be used for terrestrial targets. Using our 3X rule, this gives a minimum distance of about 37 km (23 miles) between occupied habitat polygons. Because of home range size, some ecoregions may not support multiple occurrences of these targets within the same *Section*, so clusters of 2-3 *Sections* may form the appropriate stratification unit. While *Section*-scale *replication* is preferred, *representation* of *Sections,* and *replication* within *Section clusters* may be appropriate for this target group.

- ***Regional scale:*** These typically include large mammals and fish associated with diverse and extensive complexes of terrestrial, aquatic, and marine ecosystems. Review of home range size and habitat characteristics is essential with this group of targets. In all cases, we should aim to represent these targets as *polygons (or lines)* of *"potentially occupied habitat"* and where possible, *polygons* of *specific habitat components.* It may not be possible to identify discrete populations; indeed, there are many instances where only one population occurs across multiple ecoregions. In these cases, minimum patch sizes refer to areas of high-quality habitat components; e.g. breeding, feeding, over-wintering habitat, etc., and typically do not encompass enough area to support several hundred individuals. It is important to realize that, in some instances, the long-term persistence of these species in the ecoregion may be determined more by the in-migration of individuals from adjacent areas rather than productivity within the ecoregion. Our intent should be to provide enough high-quality core and connecting habitat to insure persistence across multiple ecoregions. In this sense, one could view setting conservation goals for regional species in much the same way we develop customized management goals for site conservation; the ecoregion is essentially "the site" for some of these targets.

Table 1 provides a summary of initial goals for species targets. Again, this could be used as a starting point when target-specific information is lacking. All additional knowledge could apply toward customizing beyond these numbers. Targets are grouped according to spatial pattern and distribution relative to the ecoregion. Numbers decrease as target endemism decreases, in rough proportion to the ecoregions share of the global distribution. Stratification implies a level of replication (>1 occurrence) is achievable at the given spatial scale (*e.g. Section*) throughout its natural distribution in the ecoregion. In most North American ecoregions, home range sizes for intermediate and coarse-scale species targets would preclude the possibility that 24 distinct occurrences could occur within one ecoregion (where they are endemic), so goals for these categories are decreased for these initial goals. However, they would never fall below 10 as a rangewide goal.

Table 1. Initial Ecoregional Conservation Goals for Species Targets

Spatial Pattern / Distribution	Regional[§]	Coarse[β]	Intermediate[ψ]	Local*
Endemic	Case-by-case, defining core and connecting habitat components	10	18	25
Limited		5	9	13
Disjunct		5	9	13
Widespread		3	5	7
Peripheral		1	2	3

[§] Target-by-target, rangewide (multi-ecoregional) goals are often required. Targets represented within each ecoregion by "potentially occupied" core and connecting habitat components.
[β] Ecoregional goal stratified by USFS Section/Ecological Drainage Unit, or by clusters of 2-3 USFS Sections/Ecological Drainage Units. Targets represented by "known occupied habitat."
[ψ] Ecoregional goal stratified by USFS Section/Ecological Drainage Unit. Targets represented by "known occupied habitat."
* Ecoregional goal stratified by USFS Section/Ecological Drainage Unit. Separation Distance for each target occurrence should be specified. An initial assumption of 10 km may be applied if lacking sufficient life history information. Many naturally rare and endemic G1-G2 species may have historically occurred with fewer than 25 populations. In these cases, the goal is 'all potentially viable occurrences up to 25.'

Communities

Above the species level, targets can be grouped as communities and ecological systems. Communities encompass "fine filter" targets such as species aggregations (bat caves, migratory bird stopover sites, etc.) where multiple species and their habitat can be efficiently targeted as a group. Throughout North America, terrestrial "coarse-filter" targets may be well represented in a two-tiered classification of 20-50 ecological systems with 10s -100s of nested, local communities defined by plant associations of the U. S. National Vegetation Classification (Grossman et al. 1998). Rare plant associations (typically ranked G1-G3) represent rare communities found in uncommon environments, and because they may not be adequately represented using the more broadly defined ecological systems, should be specifically targeted to ensure their representation within the reserve network.

Nearly all community targets can be categorized as *Intermediate* (large patch) or *Local* (small patch, linear), depending on the degree of habitat specificity and landscape-scale dynamics that characterize their occurrences in the ecoregion (Anderson et al. 1999); though occasionally community targets could be categorized at *Coarse* (matrix-forming) scales. These localized occurrences are efficiently represented on maps as *points* or *polygons*. In all cases, the same logic for goal setting applied to species targets can be applied to community targets, and the initial goals established in Table 1 are appropriate.

Ecological Systems

Ecological systems encompass diverse assemblages of communities that occur in similar environments and are driven by similar dynamic processes. While ecosystems can be defined and described from an infinite number of perspectives, we are defining terrestrial, freshwater, and coastal marine systems to reflect local landscape-scale composition and dynamics that will be useful for habitat modeling, management, and monitoring. As with species and community targets, conservation goals for ecological systems should consider the target's distribution relative to the ecoregion and their typical spatial pattern. The latter factor may effect how goals are expressed. For matrix, and most large patch and linear systems, occurrences should be mapped as *polygons* or *lines*, and conservation goals may be expressed as a percentage of historical extent (e.g. *circa* 1850) proportionally represented across all major physical gradients (e.g. using *Section*/*EDU* stratification and *Ecological Land Units* / *aquatic macrohabitats*). Goals for remaining large patch systems, small patch systems – or where landscape fragmentation precludes mapping and modeling – may be mapped as *polygons and points*, ands goals are best expressed as numbers of occurrences. Separation distances between system occurrences should be established target-by-target, but if needed, default separation distances as described for plant targets (3 miles) may be applied.

In the context of identifying a network of conservation areas, expressing "coarse filter" goals as areal extent has several advantages. Matrix-forming terrestrial ecosystems historically dominated the landscapes of each ecoregion. They, along with large patch systems, should also dominate interconnected reserve networks. There is little utility to artificially dividing up an interconnected network into discrete blocks in order to assess how well conservation goals were met. Areal measures have been commonly applied to reserve design goals at national scales using theory from island biogeography (MacArthur and Wilson 1967, Wilcox 1980) and working hypotheses on the role of species diversity in ecosystem function (e.g. see Hart et al. 2001). A well established (albeit quite general) relationship exists between habitat area and the number of species that an area can support (e.g. Wilcox 1980). Loss of habitat tends, over time, to result in the loss of species within an approximate range. This relationship formed the basis for international goals (12% of country area) set by IUCN for member countries (WCED 1987). However, one could argue that the goals set by IUCN were far too low. For instance, it is estimated that with an 88% decrease in habitat extent (e.g., conservation goal = 12%), one could expect a decrease over time of 27-50% of species supported by the habitat (Wilcox 1980) (Figure 2). Regardless of future land use outside of the reserve network, the species/area relationship suggests that our ecoregional goals should be set significantly higher than 12%.

IUCN goals were also expressed in terms of *current* extent of an entire country. Our conservation goals should be stated for each target, and establish some historic context wherever possible, by expressing the desired extent as a percentage of estimated area *circa* e.g. 1850, or the time period immediately prior to wide-spread European-American settlement of a given ecoregion. Ecosystems are dynamic, changing at varying rates, with short-term cycles, and long-term trajectories. However, in many places, short-term cycles *and* long-term trajectories have been abruptly altered through human land use, and have had obvious impact on native biodiversity (Wilson 1992). Our task is to understand natural dynamics, then evaluate our alterations and mitigate their effects. For example, in the Southern Rock Mountains, fire, water diversion, and hunting historically supported Native American cultures over millennia, but the most rapid change to the upland matrix of this ecoregion has been through mine-related wildfire, logging, over-grazing, road construction, fire suppression, and urbanization. The 1850 time period marks the beginning of rapid and transforming, human/technology-driven changes to ecosystems, but is recent enough to reflect vegetation patterns under modern climatic conditions (see e.g. Veblen and Lorenz 1991). It therefore, provides a useful and important reference point.

Establishing an estimate of historic extent for ecological systems is no simple task. In some highly altered ecoregions, it is nearly impossible. However, for purposes of establishing numerical conservation goals, a reasonable approximation will do. In the Southern Rocky Mountains example (Appendix), historic extent for linear riparian systems was modeled using riverine ecological systems and Ecological Land Units. For most other terrestrial systems, percent change for each ecological system was estimated within 10% intervals using current land use/land cover data, as well as specific studies (e.g. Miller and Wigand 1994, Kaufmann et al. in press). We then added (or subtracted) area from the current mapped extent to approximate extent *circa* 1850. Where change was estimated to be less than 10%, current extent was used.

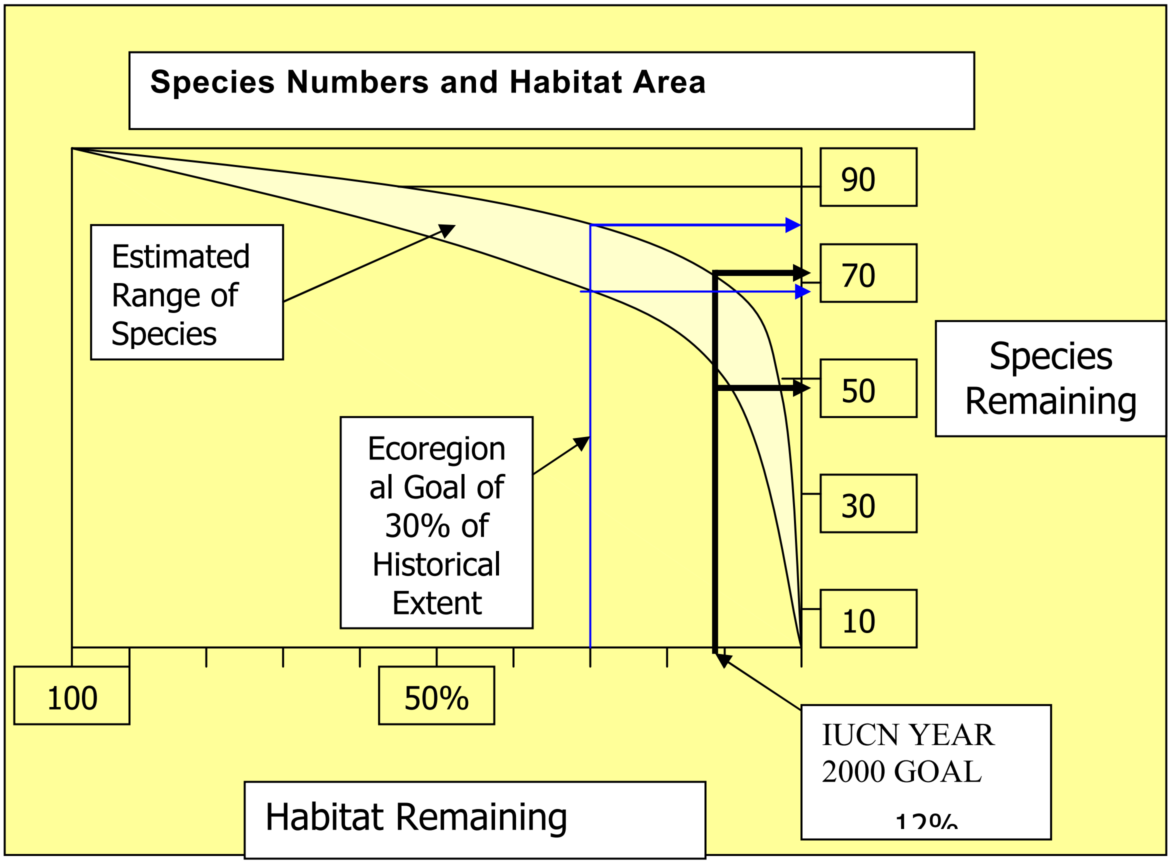

Figure 2: Estimated species loss with % area of habitat loss over time (curve taken from Dobson 1996).

In addition to a goal for areal extent, all Southern Rocky Mountain systems were represented proportionally across major biophysical gradients. Representation of major biophysical gradients helps to ensure that the reserve network represents native ecosystem diversity while providing a hedge against a changing climate. This was accomplished in two ways. First, all systems were represented in each of the ecoregional *Sections/EDUs* of their natural distribution. Second, for large patch, linear, and matrix forming systems that were reliably mapped, they were represented in combination with Ecological Land Units and aquatic macrohabitats to help represent ecological variability and gradients. The portfolio design software (SITES) was programmed to apply percent goals to vegetation/ELU and river system/macrohabitat combinations; ensured that the major biophysical gradients of each system would be represented in the portfolio in proportion to their occurrence for the ecoregion as a whole.

In order to establish an initial percent area goal, we should consider the species/area relationship (Figure 2), proportional representation of biophysical gradients, and the "ecological backdrop." In addition to this, we should consider the fact that several hundred of the most vulnerable and sensitive species are targeted either individually, or in communities. In the Southern Rocky Mountains, we selected an initial goal of 30% of historic extent (as estimated *circa* 1850) for each system in the ecoregion. This percentage, on its own, would suggest that we could lose between 15% and 35% of native species (Figure 2). But given the other targets and considerations, this 30% goal is an adequate point of departure. This should also be a reasonable starting point for most other North American ecoregions.

Table 2 provides a summary of recommended initial conservation goals for ecological systems. As noted, conservation goals for many "patch-forming" ecological systems are expressed as a number of occurrences. These goals follow similar assumptions and numerical estimates described by Anderson et al. (1999), as well as those applied to species and community goals in Table 1. Numerical estimates should be at the higher end of those ranges however, since not all component communities are likely to be represented in every system occurrence. In highly fragmented ecoregions where matrix, large patch, and linear systems must be addressed as the number of occurrences, teams should fall back to occurrence numbers established here in Table 2. Again, these numbers represent an initial goal for each system that should be tested and refined over time.

<table>
<tr><th colspan="3">Table 2. Initial Ecoregional Conservation Goals for Ecological Systems</th></tr>
<tr><td rowspan="3">Distribution Relative to Ecoregion</td><td colspan="2">Conservation Goals for selected large patch and small patch systems (expressed as a number of occurrences) and for remaining large patch, matrix and linear vegetation systems (expressed as a percentage of historic extent).</td></tr>
<tr><td colspan="2">Spatial Pattern in Ecoregion</td></tr>
<tr><td>Selected Large Patch and all Small Patch Systems</td><td>Matrix, Large Patch, and Linear Systems</td></tr>
<tr><td>Endemic</td><td>25 occurrences</td><td rowspan="4">30% [1]</td></tr>
<tr><td>Limited/Disjunct</td><td>13 occurrences</td></tr>
<tr><td>Widespread</td><td>7 occurrences</td></tr>
<tr><td>Peripheral</td><td>3 occurrences</td></tr>
<tr><td colspan="3">[1] 30% of estimated historic extent circa 1600-1850 (in the Americas)</td></tr>
</table>

I hope this provides a reasonable basis for establishing conservation goals, as well as a useful point of departure for discussions among technical teams. I anticipate continued evolution and refinement in our approaches to establishing initial goals, and making target-by-target refinements.

Again, any and all comments on this are most welcome!

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MEMORANDUM

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To: UT High Plateaus Ecoregional Assessment Team
From: Pat Comer, Chief Ecologist

Re: Conservation Goals and Scenario Building in the Utah High Plateaus Assessment
Date: June 2003

Introduction

For the Utah High Plateaus Ecoregional Assessment, we hope to provide an initial synthesis of biodiversity and conservation information that will inform subsequent management and land use planning. Indeed, there are likely to be perspectives and context for land management and land use that only become apparent through analysis at regional scales. In a document currently being prepared, we will describe aspects of land management scenario generation that use socioeconomic and land use data to create distinct conservation scenarios. This document approaches scenario generation from a different angle. Here I outline what one might call a "goal-based" approach to generating regional scenarios in support of biodiversity conservation.

This approach establishes overall conservation goals, and then develops explicit, numerical objectives for representing targeted species, communities, and ecological systems throughout the ecoregion. Objective setting forces us to address the "how much is enough?" questions in conservation. Objectives should provide the quantitative basis for identifying and prioritizing areas that substantially contribute to biodiversity conservation. These areas may still be managed for multiple uses, but biodiversity conservation would be a principle consideration. To make that consideration operational, management actions would need to be compatible with the ecological processes that support targeted biodiversity elements in each area. So for example, aspects of composition, structure, and dynamic processes supporting forest, riparian/wetland, and aquatic systems, and the habitat requirements of sensitive species, would be principle considerations in establishing compatible management regimes within these selected areas.

Here I provide background explanation, lessons learned, and recommendations for science-based objective setting. Since explicit conservation objectives are working hypotheses that, to a certain degree, reflect societal risk, alternative conservation scenarios may be developed by varying these numerical objectives; i.e. with low numerical objectives representing "high-risk" scenarios for conserving biodiversity, and higher numerical objectives representing "low-risk" scenarios.

Conservation Goals and Objectives – Background

It may be useful to describe this approach in terms of Conservation Goals and Conservation Objectives. Conservation Goals represent the end – or desired condition - toward which we direct conservation efforts for targeted species, communities, and ecosystems. These overarching goals differ among targeted elements. These differences are imbedded in our "coarse-filter/fine-filter" strategy and the purposes for which we targeted different groups of elements. For example, we have targeted a suite of imperiled, rare, and vulnerable species, and vulnerable species assemblages, as "fine-filter" conservation elements in the Utah High Plateaus. We have targeted them individually because we believe that is the only way we can ensure that their individual needs can be addressed. Our Conservation Goal focuses on the viability of these species within the ecoregion. For practical purposes, we can define a **viable species** as one that has a high probability of continued existence[26] in a state that maintains its vigor and potential for evolutionary adaptation[27] over a specified period of time. Footnotes included, conservation objectives should support the evolutionary pathway of targeted species in continually changing environmental settings, looking into the future at least 100 years or 10 generations. So our Conservation Goals for species might be stated as: *"targeted species remain invulnerable to loss of viability within the ecoregion.*" Importantly, this statement suggests that not only do we intend to maintain "minimum viable" populations, but *we also hope to specifically address the vulnerabilities they face*, due to habitat loss, habitat conversion, or direct exploitation.

Our "coarse-filter" elements include rare vegetation communities and both terrestrial and freshwater ecological systems. A "coarse-filter" strategy is aimed at maintaining the ecological processes that support the vast majority of species; thus permitting us to avoid targeting numerous species individually. In addition to maintaining non-target species, coarse-filter strategies emphasize the conservation of ecosystem services (e.g. air, water, nutrient cycling, etc.). This overall purpose for coarse-filter conservation may be best characterized as maintenance of **ecological integrity** at an ecoregion scale (Pimentel, Westra, & Noss 2000). While conservation goals for species correctly emphasize genetic fitness and the functional roles of individual species in ecosystems, coarse-filter goals focus on representation of ecological variability and environmental gradients. So our Conservation Goal for communities and ecological systems might be stated: *"essential ecosystem services are secure and non-target species remain invulnerable to the loss of viability*."

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[26] 90% certainty of surviving 100 years and/or 10 generations
[27] Potential for adaptation implies that the species or population has sufficient genetic variation to adapt by natural selection to changing environmental conditions within a predicted range of frequency and amplitude of disturbance and change.

Conservation Objectives are the explicit - and hopefully quantifiable - expressions of broader conservation goals. Objectives express the "how much?" "how many?" and "in what spatial distribution?" questions underlying element conservation. Regional conservation scenario building is appropriately dictated by these explicit, numerical objectives for each targeted species, community type, or ecological system type. By mapping out areas that contribute to these objectives, we create a vision of landscape functionality at a regional scale. Establishing conservation objectives is among the most difficult - and most important - scientific questions in biodiversity conservation. As some have pointed out (e.g. Noss 1996, Soule & Sanjayan 1998), these questions can't really be answered by theory, but require an empirical approach, element-by-element, and a commitment to monitoring and continual re-evaluation over the long-term. We can, however, use our knowledge of species, communities and ecosystems, and the collective experience of the international conservation community, to develop some empirical generalizations – or working hypotheses - to serve as guidance.

Lessons Learned

Some primary lessons learned in conservation objective-setting in regional assessments include:

1) As already mentioned, an *adaptive approach* to setting conservation objectives is essential. We simply do not have sufficient knowledge or data while establishing objectives and the ecosystems supporting our targeted elements will continue to change. All conservation objectives should use the best available knowledge, but should also be viewed as "working hypotheses." This requires careful documentation and a long-term commitment to research and monitoring.
2) We will always be dealing with both *uncertainty* and *risk*. This should be clearly acknowledged. Uncertainty results from our incomplete knowledge and our inability predict future events. Risk reflects the fact that conservation objectives are, in the end, social decisions, based upon societal willingness to accept the risk of biodiversity loss.
3) *Both risk levels and uncertainty should decrease with increasing element vulnerability*. For elements that are considered highly endangered due to rarity and current threats, we must urgently pursue necessary research to reduce uncertainty and set objectives that reduce the risk of loss.
4) *The spatial context of selected conservation lands is important*. That is, in setting objectives, one should not presume that the lands and water forming the "matrix" around selected conservation lands contribute no biodiversity value. In fact, land and water management throughout a given region will continue within a policy framework established by existing regulation, so considerable contributions of biodiversity values can be expected from surrounding lands.
5) We should *set quantitative, measurable objectives* for all targeted elements. This is required to develop conservation scenarios and to measure our success over time. However, in addition to quantitative objectives, more "qualitative" or descriptive objectives can be very useful.
6) Given the common circumstance where there is a high level of uncertainty, objectives may be best expressed within *a range of measurable values*.
7) *Ecoregional objectives should be placed in the context of rangewide objectives* for all targeted elements. This means that elements must be clearly defined across ecoregions (e.g. using standardized plant and animal taxonomies and classifications for communities and ecological systems), and any existing rangewide objectives should be evaluated to determine the appropriate contribution from within a given ecoregion.

8) *Use history as a guide to the future.* Wherever possible, use knowledge of element distribution and abundance over recent millennia to guide establishment of conservation objectives.
9) Where available, existing *recovery plans* for individual species should be fully utilized in the development of conservation objectives.
10) Develop useful *element groupings* and establish *initial objectives* to apply when lacking specialized knowledge, then *refine objectives* as possible with element-specific information.
11) *Use established guidelines* to describe the conservation status of species, especially to define a threshold of "vulnerable" status. IUCN "Vulnerable" criteria, along with those established by NatureServe (Global Ranks 3 thresholds), should be used as a guide for objective setting.
12) *Sub-regional geographic stratification* can be used as a practical tool to represent environmental variability supporting targeted elements; especially for communities and ecological systems. Stratification for terrestrial elements may differ fundamentally from aquatic elements. Subregional stratification is less important for rare-to-imperiled elements and wide-ranging species.
13) *State conservation objectives within set time frames.* All objectives could be stated within e.g. 25-100 year time frame. For highly threatened elements, objectives stated within shorter time frames (5-10 years) are appropriate.

As a general rule, conservation of multiple examples of each element, stratified across its geographic range, is necessary to represent the variability of the element and its environment, and to provide some level of "replication." Replication is needed to ensure persistence in the face of environmental stochasticity and likely effects of climate change. It is also required to allow for comparative study – to understand our targeted elements better – and to detect change reliably. Although information is limited, we should take existing knowledge of our targets as far as possible. The following issues and approaches might be considered in light of existing knowledge.

- *Proportional Range Representation:* conservation objectives should reflect the historic range of distribution (e.g. under climatic regimes of the past 2,000 years) for the targeted element. For example, if 50% of the known, historical range of the element falls within a given ecoregion, the goal for that ecoregion should reflect roughly 50% of a rangewide goal. In practical terms, we have used the target's distribution, *relative to the ecoregion* as a guide to establish numeric differentials in objective-setting (higher with endemic, to lower with peripheral). These categories may be assigned to all conservation targets.

  Endemic = >90% of global distribution in ecoregion,
  Limited = <90% of global distribution is with in the ecoregion, and distribution is limited to 2-3 ecoregions,
  Disjunct = distribution in ecoregion quite likely reflects significant genetic differentiation from main range due to historic isolation; roughly >2 ecoregions separate this ecoregion from other more central parts of it's range
  Widespread = global distribution >3 ecoregions,
  Peripheral = <10% of global distribution in ecoregion

- *Meta-population dynamics on real land/waterscapes underlie species viability.* In order to understand populations and simple models of metapopulation dynamics, we need information on: 1) number of habitat patches, 2) probability of patch (i.e. *local population*) extinction, 3) rate of movement between patches, and 4) correlation of fates of separate populations (Morris et al. 1999). Number four is the instance where stochastic events effect multiple populations simultaneously due to their proximity to each other. A sort of "dynamic tension" therefore exists between factors 3 and 4, in that we need to allow for dispersal between distinct populations, but if too many are clustered, their fates may be strongly correlated. Theory, at least, suggests a combination of clustered and isolated populations. These are very important considerations as they apply to setting conservation objectives and scenario building. For example, if the fates of all populations are highly correlated, we gain little from "replicating" multiple occurrences. If there is no correlation of fates and no movement, you can greatly reduce the overall chance of extinction by protecting best examples; but you gain little by adding poor quality examples (Morris et al. 1999; Chaplin 1999).

Unfortunately, available information tends to be limited to the first and second points above; e.g. locations of *occurrences* and some estimate of the *occurrence quality*. There are very few cases where we have any knowledge of points three and four. Even with the occurrence data we have, the relationship between populations and occurrences is not straightforward. NatureServe has established working assumptions about separation distances between extant occurrences so that clustered occurrences may be treated as one "meta-occurrence" counting towards conservation objectives, if that is the likely biological reality. For species targets, knowledge of life history (e.g. home range, known dispersal distance) forms the basis for these assumptions. Similarly, knowledge of supporting processes and environments can inform these assumptions for community types and ecological systems.

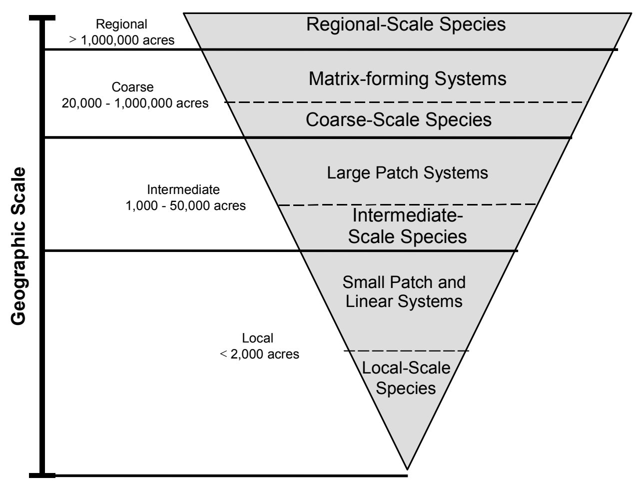
- *Spatial Stratification:* In the United States, USFS *Sections* (U.S. Forest Service 1999 draft) have commonly been adopted as primary stratification units for terrestrial elements. The TNC Freshwater Initiative's ecosystem classification approach is spatially hierarchical, and *Ecological Drainage Units* (EDUs) are similarly scaled and serve the same purpose for freshwater elements. So in reality we apply *more than one stratification scheme* for a given ecoregional assessment. In most instances, some degree of element occurrence replication should be provided within each *Section/EDU* of their historical range within the ecoregion.

- *Spatial Pattern and Targeted Elements:* Characteristic spatial patterns for ecosystems and species habitat (Figure 1) often reflect key ecosystem processes and important life-history traits. Scaling of elements, as

Figure 1: Categories representing geographic scale of conservation elements. Areal ranges are approximate and overlapping (Poiani et al. 2000).

described by Poiani et al. (2000) can effect the assumptions we make as we express conservation objectives. It is therefore useful to categorize each element according to its presumed spatial character, as it has occurred in recent millennia without significant human alteration. For matrix, and most large patch and linear systems, occurrences should be mapped as *large, continuous polygons* or *lines*, and conservation objectives may be expressed as a percentage of historical extent (e.g. *circa* 1850) proportionally represented across all major physical gradients. Objectives for remaining large patch systems, small patch systems – or where landscape fragmentation precludes mapping and modeling – may be mapped as *scattered polygons* and *points*, ands objectives are best expressed as numbers of occurrences

- *Specialized Objectives vs. Element Groupings:* Some entire categories of elements must be reviewed individually, and element-specific conservation objectives must be established for scenario building. For example, regional scale species tend to be wide-ranging mammals and birds. Individuals of these species may range across and beyond a given ecoregion. We typically represent these elements as *polygons (or lines)* of *"potentially occupied habitat"* and where possible, *polygons* of *specific habitat components.* In one case with the High Plateaus (grey wolf), we have a simulated population viability model that may be run under different regional scenarios. Analysis of their habitat requirements, especially identifying critical core habitats and landscape linkages is best assessed sequentially with each regional scenario developed using all other elements. That way, regional scenarios can be evaluated individually for their impact on these species; then modified accordingly.



Another class of elements requiring individual attention includes those that are extremely rare. Many naturally rare and endemic G1-G2 elements[1] have existed over millennia with very few distinct occurrences. In these cases, an objective of "all potentially viable occurrences" is appropriate.

A third class of elements includes Threatened and Endangered species with current recovery plans. Plans should be reviewed against agreed-upon goals to define explicit conservation objectives, and where applicable, these numbers should be applied to conservation scenario building.

Another, sometimes overlapping class includes elements for which conservation action is most urgent. These tend to be G1-G2 elements that occur in landscape where rapid land use conversion is taking place. For these elements, specific short-term (5-10 year) conservation objectives should be established.

- *Preliminary Numbers for Element Groupings*: The majority of species, communities, and ecological systems fall outside the categories where specialized objective setting is essential. For these numerous cases, we also lack specialized knowledge to create element-specific objectives. So where do we begin to establish objectives? Theoretical work on species viability (e.g. Quinn and Hastings 1987) has been applied to many species in Florida (Cox et al. 1994). This suggests that 10 distinct subpopulation of 200 individuals should be sufficient for survival of at least one subpopulation over 10 generations/100 years. Though again, these were intended to represent minimum-viability estimates for genetic fitness.

Guidelines for determining the conservation status of species have been established by NatureServe and Natural Heritage Network (Master et al. 2002), and by the IUCN (Mace et al. 1994). We can appropriately look to these published guidelines to inform our conservation objective setting. After all, our conservation goals state directly that we intend to either improve or maintain the conservation status of targeted elements. These criteria include factors such as total population size, number of sub-populations or occurrences, condition/occurrence viability, range extent, trends, threats (severity, scope, and immediacy), intrinsic vulnerability, environmental specificity, and current levels of protection. Both the NatureServe and IUCN systems definere "vulnerable" conservation status for species. Our Conservation Goals are to move species beyond "vulnerable" status. We want our coarse filter to prevent new species from becoming "vulnerable." So for example, in general terms, a given community type or species is ranked G3 ("Vulnerable") by NatureServe when it is known from 21 – 80 occurrences, or (for species) 2,500 – 10,000 individuals, measurable declines <10% over 10 years or 3 generations, and many (>40) occurrences under protective management across its known range.

These numbers of occurrences could form the basis for describing three distinct levels that depict "high risk" "moderate risk" and "low risk" scenarios for many elements; i.e. with low numerical objectives representing "high-risk" scenarios for conserving biodiversity, and higher numerical objectives representing "low-risk" scenarios.

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1 See Appendix 1 for explanation of NatureServe global ranks

“Fine-Filter” Objectives

Table 1 provides a summary of initial objectives for targeted species and species assemblages. Again, this could be used as a starting point when element-specific information is lacking. Here, elements are grouped according to distribution relative to the ecoregion. Numbers decrease as endemism decreases, in rough proportion to the ecoregion’s share of the global distribution. Within-ecoregion stratification is implied here with some degree of replication (>1 occurrence) in each stratification unit (*re: Section/EDU*) throughout its natural distribution in the ecoregion.

Table 1. Initial Conservation Objectives for Targeted Species and Species Assemblages, expressed as three levels for developing “High Risk” “Moderate Risk” and “Low Risk” conservation scenarios.

Distribution	“High Risk” Scenario	“Moderate Risk” Scenario	“Low Risk” Scenario
	Number of Occurrences		
Endemic	25	50	80
Limited	13	25	40
Disjunct	7	13	20
Widespread	7	13	20
Peripheral	3	7	10

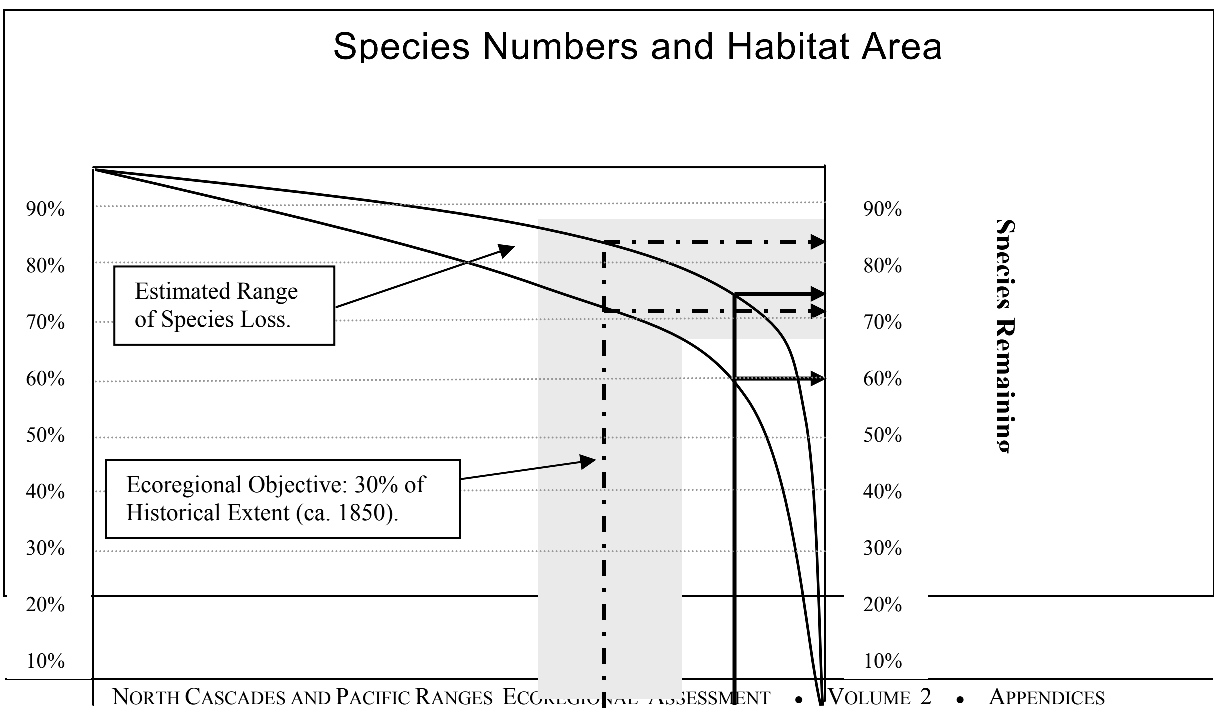
These estimates form a practical starting point for scenario building. Experience suggests that the number of available occurrences for many species elements will be a limiting factor in fleshing out scenarios that are based on these numbers.

“Coarse-Filter” Objectives

Conservation objectives for ecological systems and communities should also take into account the element’s distribution relative to the ecoregion, as well as differences in their typical spatial pattern. Coarse-filter objectives are commonly expressed as areal extent. Areal measures have been commonly applied to conservation objective-setting at national scales using theory from island biogeography (MacArthur and Wilson 1967, Wilcox 1992) and working hypotheses on the role of species diversity in ecosystem function (e.g. see Hart et al. 2001). A well-established (albeit quite general) relationship exists between habitat area and the number of species that an area can support (e.g. Wilcox 1992). Loss of habitat tends, over time, to result in the loss of species within an approximate range. This relationship formed the basis for international objectives (12% of country area) set by IUCN for member countries (WCED 1987). However, one could argue that the objectives set by IUCN were far too low. For instance, it is estimated that with an 88% decrease in habitat extent (e.g., conservation objective = 12%), one could expect a decrease over time of 27-50% of species supported by the habitat (Wilcox 1992). This idea is graphically represented below and was adapted from Cincotta and Engleman (2000) (Figure 2).

IUCN objectives were also expressed in terms of extent for an entire country. Our conservation objectives should be stated for each targeted element, and establish some historic context wherever possible, by expressing the desired extent as a percentage of estimated area *circa* e.g. 1850, or the time period immediately prior to wide-spread European-American settlement of a given ecoregion. Ecosystems are dynamic, changing at varying rates, with short-term cycles, and long-term trajectories. However, in many places, short-term cycles *and* long-term trajectories have been abruptly altered through human land use, and have had obvious impact on native biodiversity (Wilson 1992). Our task is to understand natural dynamics, then evaluate our alterations and mitigate their effects. For example, in the Utah High Plateaus, fire, water diversion, and hunting historically supported Native American cultures over millennia, but the most rapid change to the upland matrix of this ecoregion has been through mine-related wildfire, logging, intensive grazing, road construction, fire suppression, and urbanization. The 1850 time period marks the beginning of rapid and transforming, human/technology-driven changes to ecosystems, but is recent enough to reflect vegetation patterns under modern climatic conditions. It therefore, provides a useful and important reference point.

Establishing an estimate of historic extent for ecological systems is no simple task. In some highly altered ecoregions, it is nearly impossible. However, for purposes of establishing numerical conservation objectives, a reasonable approximation will suffice. Historic extent for linear riparian systems can be modeled using riverine ecological systems and Ecological Land Units. For most other terrestrial ecological systems, percent change for each system type can be estimated within 10% intervals using current land use/land cover data, as well as specific studies. We can then add (or subtract) area from the current mapped extent to approximate extent *circa* 1850. Where change was estimated to be less than 10%, current extent can be used.



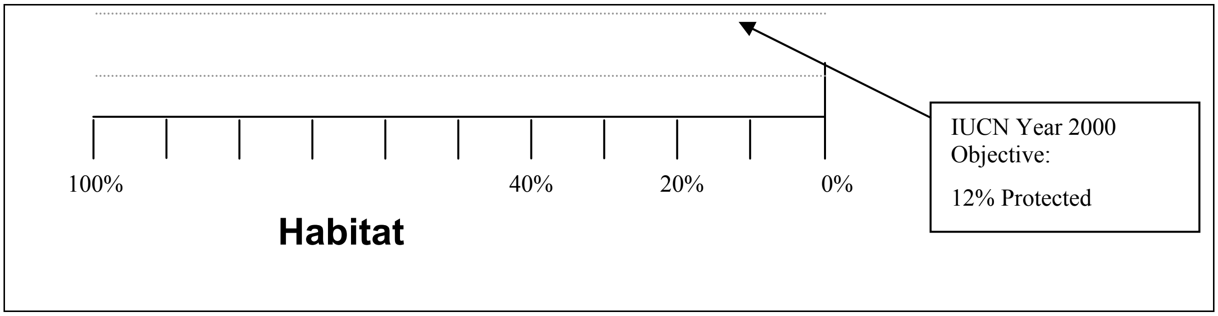


Figure 2: Estimated species loss with percent area of habitat loss over time (modified from Dobson 1996).

In addition to a goal for areal extent, all ecological systems should be represented proportionally across major biophysical gradients. Representation of major biophysical gradients helps to ensure that each regional scenario represents native ecosystem diversity while providing a hedge against a changing climate. This can be accomplished in two ways. First, as mentioned earlier, all systems should be represented in each of the ecoregional *Sections/EDUs* of their natural distribution. Second, for large patch, linear, and matrix forming systems that can be reliably mapped, they should be represented in combination with Ecological Land Units and aquatic macrohabitats to help represent ecological variability and gradients. The portfolio design software (SITES) can be programmed to apply percent objectives to vegetation/ELU and river system/macrohabitat combinations; ensuring that the major biophysical gradients of each system would be represented in proportion to their occurrence for the ecoregion as a whole.

In order to establish an initial percent area goal, we should consider the species/area relationship (Figure 2) and proportional representation of biophysical gradients. In addition to this, we should consider the fact that several hundred of the most vulnerable and sensitive species are targeted either individually, or in rare communities. In many ecoregions, we have selected an initial objective of 30% of historic extent (as estimated *circa* 1850) for each system in the ecoregion. This percentage, on its own, would suggest that we could lose between 15% and 35% of native species (Figure 2). But given the other targets and considerations, this 30% goal is an adequate point of departure. This should also be a reasonable "middle point" for developing three distinct scenarios; from " 20% = High Risk" to "30% = Moderate Risk" to "40% = Low Risk" scenarios.

Table 2 provides a summary of recommended initial conservation objectives for coarse-filter elements. As noted, conservation objectives for many "patch-forming" elements are expressed as a number of occurrences. These objectives draw on similar assumptions and numerical estimates used above for fine-filter elements as well as those described by Anderson et al. (1999). Again, as with fine-filter elements, Section/EDU scale stratification is implied in these numbers for the entire ecoregion. In addition to these numerical estimates, biophysical models should be used to "represent major biophysical variability and gradients" as described earlier.

Table 2. Initial Conservation Objectives for Ecological-System and Rare-Community Elements, expressed as three levels for developing “High Risk” “Moderate Risk” and “Low Risk” conservation scenarios.

<table>
<tr><th rowspan="4">Distribution Relative to Ecoregion</th><th colspan="6">Spatial Pattern of Occurrence</th></tr>
<tr><th colspan="3">Matrix, Large Patch and Linear
Ecological Systems</th><th colspan="3">Small Patch Ecological Systems and All Rare Communities</th></tr>
<tr><th colspan="3">Area or Length, per Section
or Ecological Drainage Unit</th><th colspan="3">Number of Occurrences</th></tr>
<tr><th>“High Risk” Scenario</th><th>“Moderate Risk” Scenario</th><th>“Low Risk” Scenario</th><th>“High Risk” Scenario</th><th>“Moderate Risk” Scenario</th><th>“Low Risk” Scenario</th></tr>
<tr><td>Endemic</td><td rowspan="4">20%</td><td rowspan="4">30%</td><td rowspan="4">40%</td><td>25</td><td>50</td><td>80</td></tr>
<tr><td>Limited</td><td>13</td><td>25</td><td>40</td></tr>
<tr><td>Widespread</td><td>7</td><td>13</td><td>20</td></tr>
<tr><td>Peripheral</td><td>3</td><td>7</td><td>10</td></tr>
</table>

Conclusions

For the Utah High Plateaus Ecoregional Assessment, we hope to provide an initial synthesis of biodiversity and conservation information that will inform subsequent management and land use planning. We plan to develop several distinct land management scenarios utilizing both “goal-based” biodiversity representation and socioeconomic/land use options. Here I outline background and numerical objectives for the “goal-based” approach to generating regional scenarios. Three distinct levels of biodiversity representation are presented for species, rare communities, and ecological system targets. These distinct levels allow us to express a range of societal risk and scientific uncertainty, forming the basis for distinct land management scenarios.

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APPENDIX 1. NATURAL HERITAGE NETWORK GLOBAL CONSERVATION STATUS DEFINITIONS

The Global (G) Conservation Status (Rank) of a species or ecological community is based on the *range-wide* status of that species or community. The rank is regularly reviewed and updated by experts, and takes into account such factors as number and quality/condition of occurrences, population size, range of distribution, population trends, protection status, and fragility. The definitions of these ranks, which are not to be interpreted as legal designations, are as follows:

GX	**Presumed Extinct**: Not located despite intensive searches and virtually no likelihood of rediscovery
GH	**Possibly Extinct**: Missing; known only from historical occurrences but still some hope of rediscovery
G1	**Critically Imperiled**: At high risk of extinction due to extreme rarity (often 5 or fewer occurrences), very steep declines, or other factors.
G2	**Imperiled**: At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.
G3	**Vulnerable**: At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.
G4	**Apparently Secure**: Uncommon but not rare; some cause for long-term concern due to declines or other factors.
G5	**Secure**: Common; widespread and abundant.

G(#)**T**(#): Trinomial (T) rank applies to subspecies or varieties; these taxa are T-ranked using the same definitions as the G-ranks above.

Variant Global Ranks

G#G#	**Range Rank**: A numeric range rank (e.g., G2G3) is used to indicate uncertainty about the exact status of a species or community. Ranges cannot skip more than one rank (e.g., GU should be used rather than G1G4).
GU	**Unrankable**: Currently unrankable due to lack of information or due to substantially conflicting information about status or trends. NOTE: Whenever possible, the most likely rank is assigned and the question mark qualifier is added (e.g., G2?) to express uncertainty, or a range rank (e.g., G2G3) is used to delineate the limits (range) of uncertainty.
GNR	**Not ranked**: Global rank not assessed.

Rank Qualifiers

?	**Inexact Numeric Rank**: Denotes inexact numeric rank.
Q	**Questionable taxonomy that may reduce conservation priority**: Distinctiveness of this entity as a taxon at the current level is questionable; resolution of this uncertainty may result in change from a species to a subspecies or hybrid, or inclusion of this taxon in another taxon, with the resulting taxon having a lower-priority (numerically higher) conservation status rank.

APPENDIX 20 – REFERENCES

Appendix 20 – References

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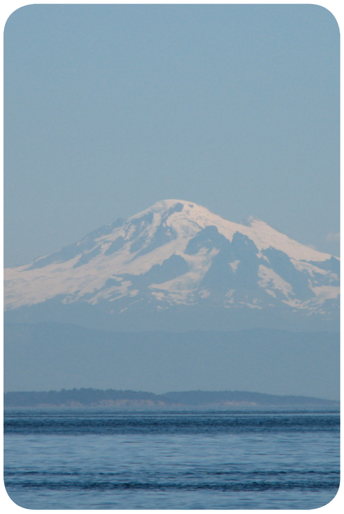

VOLUME

4

SITE

SUMMARIES

North Cascades and Pacific Ranges Ecoregional Assessment

November 2006

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SAVING THE LAST GREAT PLACES ON EARTH

Washington Department of FISH and WILDLIFE

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North Cascades and Pacific Ranges Ecoregional Assessment

November 2006

Prepared by
Nature Conservancy of Canada
The Nature Conservancy
And
The Washington Department of Fish and Wildlife

Alder Creek

Site No 1

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	0 %	US State:	75 %
Area:	4,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	11,115	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	25 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		213 ha	0.0%	0.9	0.1 %	259,308 ha	165 %
North Pacific Montane Massive Bedrock, Cliff and Talus		58 ha	0.1%	3.3	0.3 %	18,742 ha	118 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		257 ha	0.1%	3.5	0.3 %	78,777 ha	159 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		1,434 ha	0.8%	26.9	2.5 %	56,808 ha	131 %
North Pacific Lowland Riparian Forest and Shrubland		24 ha	0.0%	1.5	0.1 %	17,205 ha	171 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		77 ha	0.2%	6.6	0.6 %	12,529 ha	127 %
Montane composite		359 ha	0.4%	12.8	1.2 %	30,002 ha	123 %
Aggregate lower elevation		3,475 ha	0.2%	8.8	0.8 %	421,069 ha	138 %
Species							
Mammals							

Alder Creek

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Roosevelt elk *Cervus canadensis*	G5T4	2,877 ha	1.8%	63.3	5.9%	48,392 ha	147 %
Fisher *Martes pennanti*	G5	395 ha	0.1%		%	ha	%
<u>Vascular Plants</u>							
Bearded Sedge *Carex comosa*	G5	1 occ	25.0%	532.6	50.0%	2 occ	200 %

Alpine Lakes East

Site No 2

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	100 %
			Agriculture	0 %	GAP 1	99 %	BC Provincial:	0 %	US State:	0 %
Area:	7,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	17,290	ac	Open Water	3 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		58 ha	0.0%	0.7	0.1 %	56,808 ha	131 %
Aggregate higher elevation		4,387 ha	0.3%	6.1	0.9 %	496,454 ha	135 %
Aggregate lower elevation		211 ha	0.0%	0.3	0.1 %	421,069 ha	138 %
Alpine composite		0 ha	0.0%	0.0	0.0 %	8,126 ha	110 %
Montane composite		146 ha	0.1%	3.3	0.5 %	30,002 ha	123 %
North Pacific Lowland Riparian Forest and Shrubland		94 ha	0.2%	3.7	0.5 %	17,205 ha	171 %
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland		157 ha	0.1%	2.3	0.3 %	47,698 ha	104 %
North Pacific Maritime Mesic Subalpine Parkland		1,225 ha	0.8%	18.1	2.6 %	46,402 ha	112 %
North Pacific Montane Massive Bedrock, Cliff and Talus		537 ha	0.9%	19.6	2.9 %	18,742 ha	118 %

Alpine Lakes East

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Mountain Hemlock Forest		477 ha	0.3%	7.3	1.1 %	44,848 ha	127 %
Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest		812 ha	68.6%	1,566.5	228.8 %	355 ha	245 %
Northern Rocky Mountain Subalpine Dry Parkland		27 ha	0.1%	2.4	0.3 %	7,664 ha	109 %
Old Growth Forest		423 ha	0.0%	1.1	0.2 %	259,308 ha	165 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		15 ha	0.0%	0.8	0.1 %	12,529 ha	127 %
Species							
Amphibians							
Cascades frog *Rana cascadae*	G3G4	1 occ	2.3%	52.7	7.7 %	13 occ	210 %
Mammals							
Fisher *Martes pennanti*	G5	143 ha	0.0%		%	ha	%

Alpine Lakes West

Site No 3

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	69 %
			Agriculture	0 %	GAP 1	45 %	BC Provincial:	0 %	US State:	19 %
Area:	24,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	59,280	ac	Open Water	2 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	13 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Montane composite		1,419 ha	1.4%	9.4	4.7 %	30,002 ha	123 %
Old Growth Forest		9,809 ha	1.1%	7.6	3.8 %	259,308 ha	165 %
Alpine composite		6 ha	0.0%	0.1	0.1 %	8,126 ha	110 %
Aggregate higher elevation		11,372 ha	0.7%	4.6	2.3 %	496,454 ha	135 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		75 ha	0.2%	1.2	0.6 %	12,529 ha	127 %
North Pacific Lowland Riparian Forest and Shrubland		575 ha	1.0%	6.7	3.3 %	17,205 ha	171 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		635 ha	0.3%	2.2	1.1 %	56,808 ha	131 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		802 ha	0.3%	2.0	1.0 %	78,777 ha	159 %
North Pacific Mesic Western Hemlock - Silver fir Forest		117 ha	0.5%	3.2	1.6 %	7,191 ha	207 %

Alpine Lakes West

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Montane Massive Bedrock, Cliff and Talus		213 ha	0.3%	2.3	1.1 %	18,742 ha	118 %
North Pacific Montane Riparian Woodland and Shrubland		99 ha	0.5%	3.3	1.6 %	6,069 ha	158 %
North Pacific Mountain Hemlock Forest		1,226 ha	0.8%	5.5	2.7 %	44,848 ha	127 %
North Pacific Maritime Mesic Subalpine Parkland		286 ha	0.2%	1.2	0.6 %	46,402 ha	112 %
Aggregate lower elevation		8,556 ha	0.6%	4.1	2.0 %	421,069 ha	138 %
Species							
Amphibians							
Cascades frog *Rana cascadae*	G3G4	2 occ	3.4%	23.0	11.5 %	13 occ	210 %
Birds							
Peregrine falcon *Falco peregrinus anatum*	G4T3	1 nst	2.4%	9.5	4.8 %	21 nst	198 %
Red breasted sapsucker *Sphyrapicus ruber*	G5	1 occ	5.0%	19.8	9.9 %	10 occ	199 %
Marbled murrelet *Brachyramphus marmoratus*	G3G4	2 occ	1.3%	5.2	2.6 %	77 occ	194 %
Band-tailed pigeon *Columba fasciata*	G4	1 occ	10.1%	39.9	20.0 %	5 occ	199 %
Northern spotted owl Nests *Strix occidentalis caurina*	G3T3	1 nst	0.3%	1.2	0.6 %	169 nst	194 %
Common Loon *Gavia immer*	G5	3 nst	11.5%	46.1	23.1 %	13 nst	200 %
Mammals							
Mountain goat *Oreamos americanus*	G5	11,379 ha	1.8%	12.0	6.0 %	189,856 ha	135 %
Fisher *Martes pennanti*	G5	6,402 ha	1.3%		%	ha	%
Vascular Plants							
Alaska Harebell *Campanula lasiocarpa*	G5	1 occ	5.6%	22.5	11.3 %	7 occ	194 %
Clubmoss Cassiope *Cassiope lycopodioides*	G4	1 occ	50.0%	199.7	100.0 %	1 occ	200 %
Water Lobelia *Lobelia dortmanna*	G4G5	4 occ	37.0%	147.8	74.0 %	5 occ	194 %

Alpine Lakes West

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Few-flowered Sedge *Carex pauciflora*	G5	1 occ	5.7%	28.5	14.3%	7 occ	229 %
Plant Communities							
Picea sitchensis / Polystichum munitum Forest Community *Picea sitchensis / Polystichum munitum*	G4?	38 ha	18.1%	72.5	36.3%	104 ha	201 %

Anderson

Site No 4

Southeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	3,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	8,645	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		86 ha	0.0%	0.5	0.0 %	259,308 ha	165 %
North Pacific Montane Riparian Woodland and Shrubland		1 ha	0.0%	0.2	0.0 %	6,069 ha	158 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		321 ha	0.1%	5.6	0.4 %	78,777 ha	159 %
North Pacific Lowland Riparian Forest and Shrubland		89 ha	0.2%	7.1	0.5 %	17,205 ha	171 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		56 ha	0.1%	6.2	0.5 %	12,529 ha	127 %
East Cascades Mesic Montane Mixed Conifer Forest		319 ha	0.7%	30.4	2.2 %	14,376 ha	116 %
Aggregate lower elevation		2,782 ha	0.2%	9.0	0.7 %	421,069 ha	138 %
Species							
Birds							
Northern spotted owl Nests *Strix occidentalis caurina*	G3T3	1 nst	0.3%	8.1	0.6 %	169 nst	194 %

Anderson

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Northern spotted owl *Strix occidentalis caurina*	G3T3	0 occ	0.6 %	21.4	1.6 %	25 occ	204 %

Angie's Well

Site No 5

Northeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	99 %	US State:	0 %
Area:	3,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	1 %	US Local:	0 %
	7,410	ac	Open Water	1 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	1 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		649 ha	0.1%	4.0	0.3 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		94 ha	0.1%	3.4	0.2 %	44,848 ha	127 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		93 ha	0.0%	1.9	0.1 %	78,777 ha	159 %
North Pacific Lowland Riparian Forest and Shrubland		22 ha	0.0%	2.1	0.1 %	17,205 ha	171 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		87 ha	0.2%	11.0	0.7 %	12,529 ha	127 %
East Cascades Mesic Montane Mixed Conifer Forest		300 ha	0.6%	33.4	2.1 %	14,376 ha	116 %
Alpine composite		7 ha	0.0%	1.4	0.1 %	8,126 ha	110 %
Aggregate lower elevation		2,156 ha	0.2%	8.2	0.5 %	421,069 ha	138 %
Aggregate higher elevation		609 ha	0.0%	2.0	0.1 %	496,454 ha	135 %

Angie's Well

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Species							
Mammals							
Mountain goat *Oreamos americanus*	G5	152 ha	0.0%	1.3	0.1 %	189,856 ha	135 %
Other Ecological Features							
Hot Spring		1 occ	3.8%	122.9	7.7 %	13 occ	200 %

Arlecho Creek

Site No 6

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	5 %	BC Provincial:	0 %	US State:	48 %
Area:	4,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	9,880	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	47 %
									US NGO	5 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		129 ha	0.0%	0.6	0.0 %	259,308 ha	165 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		337 ha	0.1%	5.1	0.4 %	78,777 ha	159 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		439 ha	0.2%	9.3	0.8 %	56,808 ha	131 %
North Pacific Lowland Riparian Forest and Shrubland		137 ha	0.2%	9.5	0.8 %	17,205 ha	171 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		118 ha	0.3%	11.3	0.9 %	12,529 ha	127 %
Aggregate lower elevation		3,789 ha	0.3%	10.8	0.9 %	421,069 ha	138 %
Species							
Birds							
Northern goshawk *Accipiter gentilis laingi*	G5	3 occ	4.7%	112.3	9.4 %	32 occ	194 %
Marbled murrelet *Brachyramphus marmoratus*	G3G4	2 occ	1.2%	28.9	2.4 %	77 occ	194 %

Arlecho Creek

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Mammals							
Roosevelt elk *Cervus canadensis*	G5T4	2,550 ha	1.6%	63.1	5.3 %	48,392 ha	147 %
Fisher *Martes pennanti*	G5	260 ha	0.1%		%	ha	%

Baker Lake

Site No 7

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	88 %
			Agriculture	0 %	GAP 1	29 %	BC Provincial:	0 %	US State:	3 %
Area:	30,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	75,335	ac	Open Water	7 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	9 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Aggregate higher elevation		13,920 ha	0.8%	4.4	2.8 %	496,454 ha	135 %
Old Growth Forest		10,046 ha	1.2%	6.1	3.9 %	259,308 ha	165 %
Aggregate lower elevation		8,605 ha	0.6%	3.2	2.0 %	421,069 ha	138 %
Montane composite		2,628 ha	2.6%	13.8	8.8 %	30,002 ha	123 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		24 ha	0.1%	0.3	0.2 %	12,529 ha	127 %
North Pacific Lowland Riparian Forest and Shrubland		632 ha	1.1%	5.8	3.7 %	17,205 ha	171 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		1,576 ha	0.8%	4.4	2.8 %	56,808 ha	131 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		501 ha	0.2%	1.0	0.6 %	78,777 ha	159 %
North Pacific Mesic Western Hemlock - Silver fir Forest		210 ha	0.9%	4.6	2.9 %	7,191 ha	207 %

Baker Lake

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Montane Massive Bedrock, Cliff and Talus		806 ha	1.3%	6.8	4.3 %	18,742 ha	118 %
North Pacific Montane Riparian Woodland and Shrubland		192 ha	1.0%	5.0	3.2 %	6,069 ha	158 %
North Pacific Mountain Hemlock Forest		921 ha	0.6%	3.2	2.1 %	44,848 ha	127 %
North Pacific Maritime Mesic Subalpine Parkland		967 ha	0.6%	3.3	2.1 %	46,402 ha	112 %
Species							
Amphibians							
Western toad ts *Bufo boreas*	G4	1 occ	1.9%	11.2	7.1 %	7 occ	256 %
Birds							
Harlequin duck *Histrionicus histrionicus*	G4	2 occ	2.8%	19.3	12.3 %	13 occ	253 %
Golden Eagle *Aquila chrysaetos*	G5	3 nst	7.9%	24.8	15.8 %	19 nst	189 %
Marbled murrelet *Brachyramphus marmoratus*	G3G4	2 occ	1.3%	4.1	2.6 %	77 occ	194 %
Bald eagle nests *Haliaeetus leucocephalus*	G5	3 nst	3.3%	42.9	27.3 %	11 nst	473 %
Northern spotted owl *Strix occidentalis caurina*	G3T3	1 occ	1.5%	6.3	4.0 %	25 occ	204 %
Northern spotted owl Nests *Strix occidentalis caurina*	G3T3	2 nst	0.6%	1.9	1.2 %	169 nst	194 %
Vaux's swift *Chaetura vauxi*	G5	1 occ	3.6%	11.2	7.1 %	7 occ	171 %
Mammals							
Fisher *Martes pennanti*	G5	9,590 ha	1.9%		%	ha	%
Gray wolf *Canis lupus*	G4	0 occ	0.6%	1.8	1.2 %	12 occ	196 %
Roosevelt elk *Cervus canadensis*	G5T4	7,907 ha	4.9%	25.7	16.3 %	48,392 ha	147 %
Mountain goat *Oreamos americanus*	G5	5,560 ha	0.9%	4.6	2.9 %	189,856 ha	135 %
Vascular Plants							
Treelike Clubmoss *Lycopodium dendroideum*	G5	2 occ	7.7%	44.9	28.6 %	7 occ	286 %

Baker Lake

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Canyon Bog-orchid *Platanthera sparsiflora*	G4G5	1 occ	50.0%	157.2	100.0%	1 occ	200 %
Black Lily *Fritillaria camschatcensis*	G5	1 occ	4.5%	22.5	14.3%	7 occ	302 %

Baptiste Smith

Site No 8

Northeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	99 %	US State:	0 %
Area:	3,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	1 %	US Local:	0 %
	7,410	ac	Open Water	3 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	1 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		344 ha	0.0%	2.1	0.1 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		34 ha	0.0%	1.2	0.1 %	44,848 ha	127 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		137 ha	0.1%	2.8	0.2 %	78,777 ha	159 %
North Pacific Lowland Riparian Forest and Shrubland		34 ha	0.1%	3.1	0.2 %	17,205 ha	171 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		47 ha	0.1%	6.0	0.4 %	12,529 ha	127 %
East Cascades Mesic Montane Mixed Conifer Forest		525 ha	1.1%	58.4	3.7 %	14,376 ha	116 %
Aggregate lower elevation		2,177 ha	0.2%	8.3	0.5 %	421,069 ha	138 %
Aggregate higher elevation		455 ha	0.0%	1.5	0.1 %	496,454 ha	135 %
Species							
Birds							

Baptiste Smith

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Northern spotted owl *Strix occidentalis caurina*	G3T3	0 occ	0.7%	28.8	1.8 %	25 occ	204 %
<u>Mammals</u>							
Mountain goat *Oreamos americanus*	G5	41 ha	0.0%	0.3	0.0 %	189,856 ha	135 %

Beartooth - Eldred

Site No 9

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	13,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	32,110	ac	Open Water	1 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		1,898 ha	0.2%	2.7	0.7 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		590 ha	0.4%	4.8	1.3 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		82 ha	0.4%	5.0	1.3 %	6,069 ha	158 %
North Pacific Mesic Western Hemlock - Silver fir Forest		362 ha	1.5%	18.6	5.0 %	7,191 ha	207 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		99 ha	0.0%	0.5	0.1 %	78,777 ha	159 %
North Pacific Maritime Mesic Subalpine Parkland		2,065 ha	1.3%	16.4	4.5 %	46,402 ha	112 %
North Pacific Lowland Riparian Forest and Shrubland		0 ha	0.0%	0.0	0.0 %	17,205 ha	171 %
Alpine composite		221 ha	0.8%	10.0	2.7 %	8,126 ha	110 %
Aggregate lower elevation		99 ha	0.0%	0.1	0.0 %	421,069 ha	138 %

Beartooth - Eldred

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Aggregate higher elevation		10,748 ha	0.6%	8.0	2.2 %	496,454 ha	135 %
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	1,725 ha	0.6%	5.3	1.4 %	119,141 ha	200 %
Mammals							
Mountain goat *Oreamos americanus*	G5	1,558 ha	0.2%	3.0	0.8 %	189,856 ha	135 %

Big Silver

Site No 10

Northeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	19,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	46,930	ac	Open Water	2 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland		2,238 ha	1.4%	11.8	4.7 %	47,698 ha	104 %
Old Growth Forest		6,763 ha	0.8%	6.6	2.6 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		1,134 ha	0.8%	6.4	2.5 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		38 ha	0.2%	1.6	0.6 %	6,069 ha	158 %
North Pacific Montane Massive Bedrock, Cliff and Talus		6 ha	0.0%	0.1	0.0 %	18,742 ha	118 %
North Pacific Maritime Mesic Subalpine Parkland		2,394 ha	1.5%	13.0	5.2 %	46,402 ha	112 %
North Pacific Lowland Riparian Forest and Shrubland		9 ha	0.0%	0.1	0.0 %	17,205 ha	171 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		120 ha	0.3%	2.4	1.0 %	12,529 ha	127 %
Alpine composite		389 ha	1.4%	12.1	4.8 %	8,126 ha	110 %

Big Silver

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Aggregate lower elevation		3,705 ha	0.3%	2.2	0.9 %	421,069 ha	138 %
Aggregate higher elevation		10,154 ha	0.6%	5.2	2.0 %	496,454 ha	135 %
<u>Species</u>							
<u>Mammals</u>							
Mountain goat *Oreamos americanus*	G5	990 ha	0.2%	1.3	0.5 %	189,856 ha	135 %

Birkenhead

Site No 11

Northeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	97 %	US State:	0 %
Area:	2,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	6,175	ac	Open Water	0 %	GAP 3	0 %	Can Private:	3 %	US Indigenous:	0 %
					GAP 4	3 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland		312 ha	0.2%	12.5	0.7 %	47,698 ha	104 %
Old Growth Forest		243 ha	0.0%	1.8	0.1 %	259,308 ha	165 %
Northern Rocky Mountain Subalpine Dry Parkland		14 ha	0.1%	3.5	0.2 %	7,664 ha	109 %
North Pacific Mountain Hemlock Forest		14 ha	0.0%	0.6	0.0 %	44,848 ha	127 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		54 ha	0.0%	1.3	0.1 %	78,777 ha	159 %
North Pacific Lowland Riparian Forest and Shrubland		171 ha	0.3%	19.1	1.0 %	17,205 ha	171 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		7 ha	0.0%	1.1	0.1 %	12,529 ha	127 %
East Cascades Mesic Montane Mixed Conifer Forest		1,000 ha	2.1%	133.4	7.0 %	14,376 ha	116 %
Aggregate lower elevation		1,719 ha	0.1%	7.8	0.4 %	421,069 ha	138 %

Birkenhead

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Aggregate higher elevation		33 ha	0.0%	0.1	0.0 %	496,454 ha	135 %
Species							
Birds							
Northern spotted owl *Strix occidentalis caurina*	G3T3	1 occ	1.3%	69.0	3.6 %	25 occ	204 %
Mammals							
Mountain goat *Oreamos americanus*	G5	225 ha	0.0%	2.3	0.1 %	189,856 ha	135 %

Blaine

Site No 12

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	60 %	GAP 1	0 %	BC Provincial:	0 %	US State:	0 %
Area:	500	ha	Developed	38 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	1,235	ac	Open Water	0 %	GAP 3	0 %	Can Private:	74 %	US Indigenous:	0 %
					GAP 4	74 %	Can NGO:	0 %	US Private	26 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		2 ha	0.0%	0.4	0.0 %	56,808 ha	131 %
North Pacific Lowland Riparian Forest and Shrubland		11 ha	0.0%	5.9	0.1 %	17,205 ha	171 %
Aggregate lower elevation		2 ha	0.0%	0.1	0.0 %	421,069 ha	138 %
Species							
Birds							
Vaux's swift *Chaetura vauxi*	G5	1 occ	7.1%	1,369.6	14.3 %	7 occ	171 %
Other Ecological Features							
Karst SM		379 ha	0.4%	267.2	2.8 %	13,584 ha	233 %

Boston Glacier

Site No 13

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	100 %
			Agriculture	0 %	GAP 1	43 %	BC Provincial:	0 %	US State:	0 %
Area:	10,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	24,700	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		93 ha	0.2%	3.6	0.7 %	12,529 ha	127 %
Aggregate higher elevation		2,556 ha	0.2%	2.5	0.5 %	496,454 ha	135 %
Aggregate lower elevation		5,450 ha	0.4%	6.2	1.3 %	421,069 ha	138 %
Montane composite		779 ha	0.8%	12.5	2.6 %	30,002 ha	123 %
Old Growth Forest		3,376 ha	0.4%	6.2	1.3 %	259,308 ha	165 %
North Pacific Lowland Riparian Forest and Shrubland		316 ha	0.6%	8.8	1.8 %	17,205 ha	171 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		576 ha	0.3%	4.9	1.0 %	56,808 ha	131 %
North Pacific Maritime Mesic Subalpine Parkland		948 ha	0.6%	9.8	2.0 %	46,402 ha	112 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		432 ha	0.2%	2.6	0.5 %	78,777 ha	159 %

Boston Glacier

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Montane Massive Bedrock, Cliff and Talus		304 ha	0.5%	7.8	1.6 %	18,742 ha	118 %
North Pacific Montane Riparian Woodland and Shrubland		7 ha	0.0%	0.6	0.1 %	6,069 ha	158 %
North Pacific Mountain Hemlock Forest		290 ha	0.2%	3.1	0.6 %	44,848 ha	127 %
Alpine composite		83 ha	0.3%	4.9	1.0 %	8,126 ha	110 %
Species							
Birds							
Harlequin duck *Histrionicus histrionicus*	G4	1 occ	1.7%	36.9	7.7 %	13 occ	253 %
Northern spotted owl Nests *Strix occidentalis caurina*	G3T3	1 nst	0.3%	2.8	0.6 %	169 nst	194 %
Northern goshawk *Accipiter gentilis laingi*	G5	2 occ	3.1%	30.0	6.3 %	32 occ	194 %
Marbled murrelet *Brachyramphus marmoratus*	G3G4	1 occ	0.7%	6.2	1.3 %	77 occ	194 %
Mammals							
Gray wolf *Canis lupus*	G4	1 occ	4.2%	39.9	8.3 %	12 occ	196 %
Fisher *Martes pennanti*	G5	3,338 ha	0.7%		%	ha	%

Boulder - Pebble

Site No 14

Northeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	1,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	3,705	ac	Open Water	7 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland		748 ha	0.5%	50.1	1.6 %	47,698 ha	104 %
Old Growth Forest		355 ha	0.0%	4.4	0.1 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		10 ha	0.0%	0.7	0.0 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		31 ha	0.2%	16.3	0.5 %	6,069 ha	158 %
Aggregate higher elevation		389 ha	0.0%	2.5	0.1 %	496,454 ha	135 %
Species							
Mammals							
Mountain goat *Oreamos americanus*	G5	360 ha	0.1%	6.1	0.2 %	189,856 ha	135 %
Other Ecological Features							

Boulder - Pebble

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Karst TM		1,116 ha	16.8%	3,572.6	111.8%	998 ha	224 %

Boulder River

Site No 15

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	88 %
			Agriculture	0 %	GAP 1	57 %	BC Provincial:	0 %	US State:	8 %
Area:	6,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	14,820	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	4 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio

Terrestrial

Terrestrial Ecological Systems

North Pacific Lowland Riparian Forest and Shrubland		76 ha	0.1%	3.5	0.4 %	17,205 ha	171 %
Aggregate higher elevation		1,895 ha	0.1%	3.1	0.4 %	496,454 ha	135 %
Aggregate lower elevation		3,711 ha	0.3%	7.0	0.9 %	421,069 ha	138 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		70 ha	0.2%	4.4	0.6 %	12,529 ha	127 %
Old Growth Forest		3,472 ha	0.4%	10.7	1.3 %	259,308 ha	165 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		76 ha	0.0%	1.1	0.1 %	56,808 ha	131 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		381 ha	0.1%	3.9	0.5 %	78,777 ha	159 %
North Pacific Mesic Western Hemlock - Silver fir Forest		36 ha	0.2%	4.0	0.5 %	7,191 ha	207 %
North Pacific Montane Massive Bedrock, Cliff and Talus		21 ha	0.0%	0.9	0.1 %	18,742 ha	118 %

Boulder River

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Montane Riparian Woodland and Shrubland		3 ha	0.0%	0.3	0.0 %	6,069 ha	158 %
North Pacific Mountain Hemlock Forest		184 ha	0.1%	3.3	0.4 %	44,848 ha	127 %
Montane composite		96 ha	0.1%	2.5	0.3 %	30,002 ha	123 %
Species							
Birds							
Bald eagle roosts *Haliaeetus leucocephalus*	G5	0 rst	0.2%	14.2	1.8 %	9 rst	472 %
Northern spotted owl Nests *Strix occidentalis caurina*	G3T3	1 nst	0.3%	4.7	0.6 %	169 nst	194 %
Marbled murrelet *Brachyramphus marmoratus*	G3G4	2 occ	1.3%	20.6	2.6 %	77 occ	194 %
Mammals							
Fisher *Martes pennanti*	G5	2,887 ha	0.6%		%	ha	%

Bridge

Site No 16

Northeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	2,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	4,940	ac	Open Water	8 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland		248 ha	0.2%	12.5	0.5 %	47,698 ha	104 %
Old Growth Forest		54 ha	0.0%	0.5	0.0 %	259,308 ha	165 %
Northern Rocky Mountain Subalpine Dry Parkland		820 ha	3.2%	256.5	10.7 %	7,664 ha	109 %
North Pacific Mountain Hemlock Forest		1 ha	0.0%	0.1	0.0 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		3 ha	0.0%	1.0	0.0 %	6,069 ha	158 %
Aggregate higher elevation		118 ha	0.0%	0.6	0.0 %	496,454 ha	135 %

Buck Creek Pass

Site No 17

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	100 %
			Agriculture	0 %	GAP 1	100 %	BC Provincial:	0 %	US State:	0 %
Area:	9,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	23,465	ac	Open Water	2 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Montane composite		503 ha	0.5%	8.5	1.7 %	30,002 ha	123 %
Aggregate higher elevation		4,653 ha	0.3%	4.7	0.9 %	496,454 ha	135 %
Alpine composite		221 ha	0.8%	13.7	2.7 %	8,126 ha	110 %
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland		674 ha	0.4%	7.1	1.4 %	47,698 ha	104 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		8 ha	0.0%	0.3	0.1 %	12,529 ha	127 %
North Pacific Lowland Riparian Forest and Shrubland		5 ha	0.0%	0.1	0.0 %	17,205 ha	171 %
North Pacific Maritime Mesic Subalpine Parkland		2,615 ha	1.7%	28.4	5.6 %	46,402 ha	112 %
North Pacific Montane Massive Bedrock, Cliff and Talus		523 ha	0.8%	14.1	2.8 %	18,742 ha	118 %
North Pacific Montane Riparian Woodland and Shrubland		8 ha	0.0%	0.7	0.1 %	6,069 ha	158 %

Buck Creek Pass

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Mountain Hemlock Forest		120 ha	0.1%	1.4	0.3 %	44,848 ha	127 %
Northern Rocky Mountain Subalpine Dry Parkland		641 ha	2.5%	42.2	8.4 %	7,664 ha	109 %
Old Growth Forest		728 ha	0.1%	1.4	0.3 %	259,308 ha	165 %
Aggregate lower elevation		202 ha	0.0%	0.2	0.0 %	421,069 ha	138 %
Species							
Birds							
Golden Eagle *Aquila chrysaetos*	G5	1 nst	2.6%	26.6	5.3 %	19 nst	189 %
Northern goshawk *Accipiter gentilis laingi*	G5	1 occ	1.6%	15.8	3.1 %	32 occ	194 %
Mammals							
Wolverine *Gulo gulo*	G4	1 occ	5.0%	50.5	10.0 %	5 occ	198 %
Mountain goat *Oreamos americanus*	G5	3,658 ha	0.6%	9.7	1.9 %	189,856 ha	135 %
Gray wolf *Canis lupus*	G4	0 occ	1.0%	10.5	2.1 %	12 occ	196 %
Fisher *Martes pennanti*	G5	156 ha	0.0%		%	ha	%
Vascular Plants							
Smoky Mountain Sedge *Carex proposita*	G4	1 occ	50.0%	504.6	100.0 %	1 occ	200 %

Bunster Hills

Site No 18

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	5,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	13,585	ac	Open Water	1 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		1,559 ha	0.2%	5.2	0.6 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		2 ha	0.0%	0.0	0.0 %	44,848 ha	127 %
North Pacific Mesic Western Hemlock - Silver fir Forest		54 ha	0.2%	6.6	0.8 %	7,191 ha	207 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		1,705 ha	0.6%	18.9	2.2 %	78,777 ha	159 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		137 ha	0.1%	2.1	0.2 %	56,808 ha	131 %
Aggregate lower elevation		1,842 ha	0.1%	3.8	0.4 %	421,069 ha	138 %
Aggregate higher elevation		2,460 ha	0.1%	4.3	0.5 %	496,454 ha	135 %
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	901 ha	0.3%	6.6	0.8 %	119,141 ha	200 %

Bunster Hills

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Mammals							
Mountain goat *Oreamos americanus*	G5	281 ha	0.0%	1.3	0.1 %	189,856 ha	135 %

Callaghan - Soo

Site No 19

Northeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	26 %	BC Provincial:	100 %	US State:	0 %
Area:	9,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	23,465	ac	Open Water	2 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		5,549 ha	0.6%	10.8	2.1 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		128 ha	0.1%	1.4	0.3 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		374 ha	1.9%	31.1	6.2 %	6,069 ha	158 %
North Pacific Maritime Mesic Subalpine Parkland		1,207 ha	0.8%	13.1	2.6 %	46,402 ha	112 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		66 ha	0.2%	2.7	0.5 %	12,529 ha	127 %
Aggregate lower elevation		4,742 ha	0.3%	5.7	1.1 %	421,069 ha	138 %
Aggregate higher elevation		3,411 ha	0.2%	3.5	0.7 %	496,454 ha	135 %
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	1,315 ha	0.5%	5.6	1.1 %	119,141 ha	200 %

Callaghan - Soo

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Mammals							
Mountain goat *Oreamos americanus*	G5	301 ha	0.0%	0.8	0.2 %	189,856 ha	135 %
Vascular Plants							
Nodding Semaphoregrass *Pleuropogon refractus*	G4	1 occ	10.0%	100.9	20.0 %	5 occ	200 %

Cedar River

Site No 20

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	1 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	0 %	US State:	1 %
Area:	11,000	ha	Developed	0 %	GAP 2	98 %	Can Indigenous:	0 %	US Local:	97 %
	27,170	ac	Open Water	6 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	2 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Aggregate lower elevation		7,680 ha	0.5%	7.9	1.8 %	421,069 ha	138 %
Aggregate higher elevation		1,185 ha	0.1%	1.0	0.2 %	496,454 ha	135 %
Old Growth Forest		1,810 ha	0.2%	3.0	0.7 %	259,308 ha	165 %
Montane composite		72 ha	0.1%	1.0	0.2 %	30,002 ha	123 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		269 ha	0.6%	9.4	2.1 %	12,529 ha	127 %
North Pacific Lowland Riparian Forest and Shrubland		506 ha	0.9%	12.8	2.9 %	17,205 ha	171 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		1,992 ha	1.1%	15.3	3.5 %	56,808 ha	131 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		497 ha	0.2%	2.7	0.6 %	78,777 ha	159 %
North Pacific Montane Massive Bedrock, Cliff and Talus		7 ha	0.0%	0.2	0.0 %	18,742 ha	118 %

Cedar River

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Montane Riparian Woodland and Shrubland		30 ha	0.1%	2.2	0.5 %	6,069 ha	158 %
North Pacific Mountain Hemlock Forest		143 ha	0.1%	1.4	0.3 %	44,848 ha	127 %
Species							
Amphibians							
Western toad ts *Bufo boreas*	G4	1 occ	3.9%	62.3	14.3 %	7 occ	256 %
Birds							
Red breasted sapsucker *Sphyrapicus ruber*	G5	0 occ	0.8%	7.0	1.6 %	10 occ	199 %
Peregrine falcon *Falco peregrinus anatum*	G4T3	2 nst	4.8%	41.5	9.5 %	21 nst	198 %
Northern spotted owl Nests *Strix occidentalis caurina*	G3T3	1 nst	0.3%	2.6	0.6 %	169 nst	194 %
Northern goshawk *Accipiter gentilis laingi*	G5	2 occ	3.1%	27.2	6.3 %	32 occ	194 %
Common Loon *Gavia immer*	G5	1 nst	3.8%	33.5	7.7 %	13 nst	200 %
Barrow's goldeneye *Bucephala islandica*	G5	1 occ	50.0%	435.8	100.0 %	1 occ	200 %
Mammals							
Fisher *Martes pennanti*	G5	2,085 ha	0.4%		%	ha	%
Mountain goat *Oreamos americanus*	G5	569 ha	0.1%	1.3	0.3 %	189,856 ha	135 %

Cedarville (WPG #82)

Site No 21

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	6 %	GAP 1	0 %	BC Provincial:	0 %	US State:	0 %
Area:	500	ha	Developed	1 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	1,235	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	100 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		1 ha	0.0%	0.0	0.0 %	259,308 ha	165 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		190 ha	0.1%	32.1	0.3 %	56,808 ha	131 %
Montane composite		2 ha	0.0%	0.7	0.0 %	30,002 ha	123 %
Aggregate lower elevation		401 ha	0.0%	9.1	0.1 %	421,069 ha	138 %
Species							
Mammals							
Gray wolf *Canis lupus*	G4	1 occ	4.2%	798.9	8.3 %	12 occ	196 %
Fisher *Martes pennanti*	G5	4 ha	0.0%		%	ha	%

Cheam Peak

Site No 22

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	1 %	GAP 1	0 %	BC Provincial:	78 %	US State:	0 %
Area:	12,500	ha	Developed	1 %	GAP 2	1 %	Can Indigenous:	5 %	US Local:	0 %
	30,875	ac	Open Water	10 %	GAP 3	0 %	Can Private:	17 %	US Indigenous:	0 %
					GAP 4	22 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio

Terrestrial

Terrestrial Ecological Systems

Target	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Aggregate lower elevation		6,975 ha	0.5%	6.4	1.7 %	421,069 ha	138 %
Aggregate higher elevation		1,680 ha	0.1%	1.3	0.3 %	496,454 ha	135 %
Old Growth Forest		1,538 ha	0.2%	2.3	0.6 %	259,308 ha	165 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		612 ha	1.5%	18.7	4.9 %	12,529 ha	127 %
North Pacific Lowland Riparian Forest and Shrubland		1,292 ha	2.3%	28.8	7.5 %	17,205 ha	171 %
North Pacific Maritime Mesic Subalpine Parkland		50 ha	0.0%	0.4	0.1 %	46,402 ha	112 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		307 ha	0.1%	1.5	0.4 %	78,777 ha	159 %
North Pacific Mesic Western Hemlock - Silver fir Forest		18 ha	0.1%	1.0	0.3 %	7,191 ha	207 %
North Pacific Montane Riparian Woodland and Shrubland		72 ha	0.4%	4.5	1.2 %	6,069 ha	158 %

Cheam Peak

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Mountain Hemlock Forest		22 ha	0.0%	0.2	0.0 %	44,848 ha	127 %
Species							
Birds							
Great blue heron *Ardia herodius fannini*	G5T4	1 occ	4.2%	32.0	8.3 %	12 occ	200 %
Bald eagle roosts *Haliaeetus leucocephalus*	G5	1 rst	1.4%	42.6	11.1 %	9 rst	472 %
Mammals							
Mtn beaver rufa *Aplodontia rufa rufa*	G5T4?	2 occ	7.7%	58.7	15.3 %	13 occ	200 %
Mollusks							
Robust Lancetooth *Haplotrema vancouverens*	G5	1 occ	12.5%	95.9	25.0 %	4 occ	200 %
Oregon Forestsnail *Allogona townsendiana*	G3G4	1 occ	5.6%	42.6	11.1 %	9 occ	200 %
Conical Spot *Punctum randolphii*	G4	1 occ	2.6%	29.5	7.7 %	13 occ	231 %
Vascular Plants							
Cliff Paintbrush *Castilleja rupicola*	G2G3	1 occ	9.1%	63.9	16.7 %	6 occ	183 %
Short-fruited Smelowskia *Smelowskia ovalis*	G5	1 occ	10.0%	76.7	20.0 %	5 occ	200 %
Other Ecological Features							
Karst SM		2,335 ha	2.6%	65.9	17.2 %	13,584 ha	233 %

Cheam Ridge

Site No 23

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	1 %	GAP 1	0 %	BC Provincial:	93 %	US State:	0 %
Area:	6,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	14,820	ac	Open Water	0 %	GAP 3	0 %	Can Private:	7 %	US Indigenous:	0 %
					GAP 4	6 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Aggregate lower elevation		2,793 ha	0.2%	5.3	0.7 %	421,069 ha	138 %
Aggregate higher elevation		1,639 ha	0.1%	2.6	0.3 %	496,454 ha	135 %
Old Growth Forest		440 ha	0.1%	1.4	0.2 %	259,308 ha	165 %
Montane composite		158 ha	0.2%	4.2	0.5 %	30,002 ha	123 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		154 ha	0.4%	9.8	1.2 %	12,529 ha	127 %
North Pacific Lowland Riparian Forest and Shrubland		47 ha	0.1%	2.2	0.3 %	17,205 ha	171 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		208 ha	0.1%	2.1	0.3 %	78,777 ha	159 %
North Pacific Mesic Western Hemlock - Silver fir Forest		5 ha	0.0%	0.6	0.1 %	7,191 ha	207 %
North Pacific Montane Riparian Woodland and Shrubland		20 ha	0.1%	2.7	0.3 %	6,069 ha	158 %

Cheam Ridge

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Mountain Hemlock Forest		63 ha	0.0%	1.1	0.1 %	44,848 ha	127 %
Species							
Mammals							
Mtn beaver rufa *Aplodontia rufa rufa*	G5T4?	3 occ	12.6%	201.6	25.2 %	13 occ	200 %
Mountain goat *Oreamos americanus*	G5	802 ha	0.1%	3.4	0.4 %	189,856 ha	135 %
Vascular Plants							
Short-fruited Smelowskia *Smelowskia ovalis*	G5	1 occ	10.0%	159.8	20.0 %	5 occ	200 %
Kruckeberg's Holly Fern *Polystichum kruckebergii*	G4	1 occ	25.0%	399.5	50.0 %	2 occ	200 %
Cliff Paintbrush *Castilleja rupicola*	G2G3	1 occ	9.1%	133.2	16.7 %	6 occ	183 %
Cascade Parsley Fern *Cryptogramma cascadensis*	G5	1 occ	12.5%	159.8	20.0 %	5 occ	156 %
Tall Bugbane *Cimicifuga elata*	G2	2 occ	7.4%	122.9	15.4 %	13 occ	169 %
Other Ecological Features							
Karst PH		97 ha	1.6%	32.2	4.0 %	2,404 ha	201 %
Karst SM		2,780 ha	3.1%	163.5	20.5 %	13,584 ha	233 %

Chilliwack Lake

Site No 24

Southeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	83 %	BC Provincial:	100 %	US State:	0 %
Area:	4,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	11,115	ac	Open Water	7 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		1,039 ha	0.1%	4.3	0.4 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		84 ha	0.1%	2.0	0.2 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		7 ha	0.0%	1.3	0.1 %	6,069 ha	158 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		50 ha	0.0%	0.7	0.1 %	78,777 ha	159 %
North Pacific Maritime Mesic Subalpine Parkland		16 ha	0.0%	0.4	0.0 %	46,402 ha	112 %
North Pacific Lowland Riparian Forest and Shrubland		30 ha	0.1%	1.8	0.2 %	17,205 ha	171 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		286 ha	0.7%	24.3	2.3 %	12,529 ha	127 %
Aggregate lower elevation		1,980 ha	0.1%	5.0	0.5 %	421,069 ha	138 %
Aggregate higher elevation		1,937 ha	0.1%	4.2	0.4 %	496,454 ha	135 %

Chilliwack Lake

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Species							
Birds							
Northern spotted owl Nests *Strix occidentalis caurina*	G3T3	2 nst	0.6%	12.6	1.2 %	169 nst	194 %
Northern spotted owl *Strix occidentalis caurina*	G3T3	0 occ	0.4%	10.7	1.0 %	25 occ	204 %
Mammals							
Mtn beaver rainieri *Aplodontia rufa rainieri*	G5T4	1 occ	1.7%	81.9	7.7 %	13 occ	199 %
Mountain goat *Oreamos americanus*	G5	23 ha	0.0%	0.1	0.0 %	189,856 ha	135 %

Chilliwack River

Site No 25

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	84 %
			Agriculture	0 %	GAP 1	97 %	BC Provincial:	16 %	US State:	0 %
Area:	17,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	43,225	ac	Open Water	3 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		310 ha	0.7%	6.8	2.5 %	12,529 ha	127 %
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland		0 ha	0.0%	0.0	0.0 %	47,698 ha	104 %
Old Growth Forest		3,319 ha	0.4%	3.5	1.3 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		655 ha	0.4%	4.0	1.5 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		62 ha	0.3%	2.8	1.0 %	6,069 ha	158 %
North Pacific Montane Massive Bedrock, Cliff and Talus		918 ha	1.5%	13.4	4.9 %	18,742 ha	118 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		12 ha	0.0%	0.0	0.0 %	78,777 ha	159 %
North Pacific Lowland Riparian Forest and Shrubland		312 ha	0.5%	5.0	1.8 %	17,205 ha	171 %
Montane composite		597 ha	0.6%	5.4	2.0 %	30,002 ha	123 %

Chilliwack River Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Alpine composite		53 ha	0.2%	1.8	0.7 %	8,126 ha	110 %
Aggregate lower elevation		6,097 ha	0.4%	4.0	1.4 %	421,069 ha	138 %
Aggregate higher elevation		7,715 ha	0.5%	4.3	1.6 %	496,454 ha	135 %
North Pacific Maritime Mesic Subalpine Parkland		1,776 ha	1.1%	10.5	3.8 %	46,402 ha	112 %
Species							
Birds							
Northern spotted owl *Strix occidentalis caurina*	G3T3	2 occ	2.4%	17.5	6.4 %	25 occ	204 %
Mammals							
Gray wolf *Canis lupus*	G4	0 occ	0.6%	3.2	1.2 %	12 occ	196 %
Fisher *Martes pennanti*	G5	2,347 ha	0.5%		%	ha	%
Vascular Plants							
Short-fruited Smelowskia *Smelowskia ovalis*	G5	1 occ	10.0%	54.8	20.0 %	5 occ	200 %
Cliff Paintbrush *Castilleja rupicola*	G2G3	1 occ	9.1%	45.7	16.7 %	6 occ	183 %
Cascade Parsley Fern *Cryptogramma cascadensis*	G5	1 occ	12.5%	54.8	20.0 %	5 occ	156 %
Freshwater							
Species							
Amphibians							
Pacific Giant Salamander *Dicamptodon tenebrosus*	G5	11 occ	49.7%	22.6	87.8 %	13 occ	96 %
Red-legged frog *Rana aurora*	G4	4 occ	19.0%	5.4	21.1 %	19 occ	95 %
Coastal tailed frog *Ascaphus truei*	G4	15 occ	13.4%	29.3	113.8 %	13 occ	400 %
Western toad *Bufo boreas*	G4	5 occ	45.5%	11.7	45.5 %	11 occ	100 %
Fishes							
Kokanee *Oncorhynchus nerka*	G5	24 km	17.0%	8.7	33.7 %	71 km	116 %

Chilliwack River

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Western Brook Lamprey *Lampetra richardsoni*	G4G5	9 km	6.2%	5.3	20.5 %	42 km	234 %
Threespine stickleback *Gasterosteus aculeatus*	G5	16 km	2.3%	2.0	7.7 %	215 km	246 %
Steelhead Salmon (no run info) *Oncorhynchus mykiss*	G5	50 km	7.5%	3.9	15.1 %	330 km	121 %
Sockeye Salmon (Cultus Lake) *Oncorhynchus nerka*	G5	13 km	100.0%	25.4	98.4 %	13 km	98 %
Sockeye Salmon *Oncorhynchus nerka*	G5	11 km	1.5%	0.8	3.0 %	383 km	148 %
Pink Salmon, no run info (SALMON ECOREGION) *Oncorhynchus gorbuscha*	G5	58 km	7.2%	3.7	14.4 %	399 km	149 %
Dolly Varden *Salvelinus malma*	G5	34 km	4.7%	4.1	15.8 %	217 km	185 %
Cutthroat Trout, Clarkil Subspecies *Oncorhynchus clarkil clarkil*	G4	57 km	3.9%	3.3	13.0 %	442 km	215 %
Chinook Salmon (NO RUN INFO.) *Oncorhynchus tshawytscha*	G5	45 km	5.5%	2.8	11.0 %	414 km	149 %
Salish Sucker *Catostomus sp. 4*	G1	9 km	11.5%	10.0	39.0 %	23 km	215 %
Bull Trout *Salvelinus confluentus*	G3	29 km	5.1%	2.6	10.1 %	292 km	106 %
Cultus Lake Sculpin *Cottus sp. 2*	G1	636 ha	100.0%	85.8	332.8 %	191 ha	333 %
Chum Salmon (SALMON ECOREGION) *Oncorhynchus keta*	G5	73 km	7.0%	3.6	14.0 %	523 km	137 %
Coho Salmon *Oncorhynchus kisutch*	G4	96 km	6.1%	3.1	12.1 %	792 km	132 %
Insects							
Autumn Meadowhawk *Sympetrum vicinum*	G5	1 occ	12.5%	3.2	12.5 %	8 occ	100 %
Emma's Dancer (nez Perce) *Argia emma*	G5	1 occ	20.0%	5.2	20.0 %	5 occ	100 %
Spring Stonefly trictura *Cascadoperla trictura*	G3G4	2 occ	100.0%	25.7	99.5 %	2 occ	100 %
Stonefly tibilalis *Setvena tibilalis*	G4	1 occ	100.0%	25.8	100.0 %	1 occ	100 %
Stonefly vedderensis *Isocapnia vedderensis*	G4	2 occ	66.7%	17.2	66.7 %	3 occ	100 %
Mammals							

Chilliwack River

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Pacific water Shrew *Sorex bendirii*	G4	1 occ	9.1%	2.6	10.0%	10 occ	100 %
Freshwater Ecological Systems							
small,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem shallow - tributary shallow		11,375 ha	40.6%	34.9	135.4%	8,399 ha	135 %
intermediate,geology_intrusive - metamorphic,elevation_low,gradient_mainstem shallow - tributary shallow		8,287 ha	34.3%	29.5	114.5%	7,238 ha	145 %
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow a		31,618 ha	5.5%	4.7	18.3%	172,507 ha	96 %
intermediate,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem steep - tributary steep		26,820 ha	10.7%	9.2	35.8%	74,970 ha	180 %

Clendinning

Site No 26

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	93 %	BC Provincial:	100 %	US State:	0 %
Area:	18,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	45,695	ac	Open Water	4 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		4,711 ha	0.5%	4.7	1.8 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		391 ha	0.3%	2.3	0.9 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		257 ha	1.3%	11.0	4.2 %	6,069 ha	158 %
North Pacific Montane Massive Bedrock, Cliff and Talus		977 ha	1.6%	13.5	5.2 %	18,742 ha	118 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		167 ha	0.1%	0.5	0.2 %	78,777 ha	159 %
North Pacific Lowland Riparian Forest and Shrubland		258 ha	0.5%	3.9	1.5 %	17,205 ha	171 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		173 ha	0.4%	3.6	1.4 %	12,529 ha	127 %
Montane composite		632 ha	0.6%	5.5	2.1 %	30,002 ha	123 %
Alpine composite		182 ha	0.7%	5.8	2.2 %	8,126 ha	110 %

Clendinning

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Aggregate lower elevation		6,201 ha	0.4%	3.8	1.5 %	421,069 ha	138 %
Aggregate higher elevation		5,578 ha	0.3%	2.9	1.1 %	496,454 ha	135 %
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	3,278 ha	1.2%	7.1	2.8 %	119,141 ha	200 %
Mammals							
Mountain goat *Oreamos americanus*	G5	2,173 ha	0.3%	3.0	1.1 %	189,856 ha	135 %
Plant Communities							
Picea sitchensis / Rubus spectabilis Dry Community *Picea sitchensis / Rubus spectabilis*		31,244 ha	50.0%	259.1	100.0 %	31,247 ha	200 %

Clowhom

Site No 27

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	17,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	41,990	ac	Open Water	4 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		4,017 ha	0.5%	4.4	1.5 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		546 ha	0.4%	3.4	1.2 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		148 ha	0.7%	6.9	2.4 %	6,069 ha	158 %
North Pacific Montane Massive Bedrock, Cliff and Talus		107 ha	0.2%	1.6	0.6 %	18,742 ha	118 %
North Pacific Mesic Western Hemlock - Silver fir Forest		631 ha	2.6%	24.7	8.8 %	7,191 ha	207 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		2,033 ha	0.8%	7.3	2.6 %	78,777 ha	159 %
North Pacific Maritime Mesic Subalpine Parkland		151 ha	0.1%	0.9	0.3 %	46,402 ha	112 %
North Pacific Lowland Riparian Forest and Shrubland		27 ha	0.0%	0.4	0.2 %	17,205 ha	171 %
Montane composite		12 ha	0.0%	0.1	0.0 %	30,002 ha	123 %

Clowhom

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Aggregate lower elevation		2,033 ha	0.1%	1.4	0.5 %	421,069 ha	138 %
Aggregate higher elevation		10,066 ha	0.6%	5.7	2.0 %	496,454 ha	135 %
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	3,632 ha	1.3%	8.6	3.0 %	119,141 ha	200 %
Mammals							
Mountain goat *Oreamos americanus*	G5	1,069 ha	0.2%	1.6	0.6 %	189,856 ha	135 %

Cooks Cove

Site No 28

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	1,235	ac	Open Water	10 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		438 ha	0.2%	53.3	0.6 %	78,777 ha	159 %
North Pacific Lowland Riparian Forest and Shrubland		4 ha	0.0%	2.2	0.0 %	17,205 ha	171 %
Aggregate lower elevation		438 ha	0.0%	10.0	0.1 %	421,069 ha	138 %
Species							
Vascular Plants							
Ussurian Water-milfoil *Myriophyllum ussuriense*	G3	1 occ	25.0%	4,793.5	50.0 %	2 occ	200 %

Copper Mound

Site No 29

Northeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	1,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	3,705	ac	Open Water	2 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland		272 ha	0.2%	18.2	0.6 %	47,698 ha	104 %
Old Growth Forest		80 ha	0.0%	1.0	0.0 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		9 ha	0.0%	0.6	0.0 %	44,848 ha	127 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		8 ha	0.0%	0.3	0.0 %	78,777 ha	159 %
North Pacific Maritime Mesic Subalpine Parkland		25 ha	0.0%	1.7	0.1 %	46,402 ha	112 %
Montane composite		0 ha	0.0%	0.0	0.0 %	30,002 ha	123 %
Alpine composite		5 ha	0.0%	2.0	0.1 %	8,126 ha	110 %
Aggregate lower elevation		213 ha	0.0%	1.6	0.1 %	421,069 ha	138 %
Aggregate higher elevation		294 ha	0.0%	1.9	0.1 %	496,454 ha	135 %

Copper Mound

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Species							
Birds							
Northern spotted owl *Strix occidentalis caurina*	G3T3	1 occ	1.5%	127.8	4.0 %	25 occ	204 %
Mammals							
Mountain goat *Oreamos americanus*	G5	135 ha	0.0%	2.3	0.1 %	189,856 ha	135 %
Vascular Plants							
Slender Gentian *Gentianella tenella ssp. tenella*	G4G5T4	1 occ	50.0%	3,195.7	100.0 %	1 occ	200 %

Coquihala Summit

Site No 30

Southeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	46 %	BC Provincial:	100 %	US State:	0 %
Area:	3,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	7,410	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland		202 ha	0.1%	6.8	0.4 %	47,698 ha	104 %
Old Growth Forest		535 ha	0.1%	3.3	0.2 %	259,308 ha	165 %
Northern Rocky Mountain Subalpine Dry Parkland		182 ha	0.7%	38.0	2.4 %	7,664 ha	109 %
North Pacific Mountain Hemlock Forest		241 ha	0.2%	8.6	0.5 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		7 ha	0.0%	2.0	0.1 %	6,069 ha	158 %
Montane composite		38 ha	0.0%	2.0	0.1 %	30,002 ha	123 %
Alpine composite		295 ha	1.1%	58.0	3.6 %	8,126 ha	110 %
Aggregate lower elevation		221 ha	0.0%	0.8	0.1 %	421,069 ha	138 %
Aggregate higher elevation		2,045 ha	0.1%	6.6	0.4 %	496,454 ha	135 %

Coquihala Summit

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Species							
Mammals							
Mtn beaver rainieri *Aplodontia rufa rainieri*	G5T4	2 occ	2.5%	184.4	11.5 %	13 occ	199 %
Mountain goat *Oreamos americanus*	G5	175 ha	0.0%	1.5	0.1 %	189,856 ha	135 %
Mollusks							
Northern Tightcoil *Pristiloma arcticum*	G3G4	1 occ	50.0%	1,597.8	100.0 %	1 occ	200 %

Cub Creek

Site No 31

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	65 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	0 %	US State:	10 %
Area:	2,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	6,175	ac	Open Water	1 %	GAP 3	49 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	24 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		415 ha	0.0%	3.1	0.2 %	259,308 ha	165 %
North Pacific Montane Massive Bedrock, Cliff and Talus		14 ha	0.0%	1.4	0.1 %	18,742 ha	118 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		163 ha	0.1%	4.0	0.2 %	78,777 ha	159 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		126 ha	0.1%	4.3	0.2 %	56,808 ha	131 %
North Pacific Lowland Riparian Forest and Shrubland		17 ha	0.0%	1.9	0.1 %	17,205 ha	171 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		11 ha	0.0%	1.7	0.1 %	12,529 ha	127 %
Montane composite		144 ha	0.1%	9.2	0.5 %	30,002 ha	123 %
Aggregate lower elevation		2,056 ha	0.1%	9.4	0.5 %	421,069 ha	138 %
Species							
Birds							

Cub Creek

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Marbled murrelet *Brachyramphus marmoratus*	G3G4	1 occ	0.7%	24.9	1.3 %	77 occ	194 %
Mammals							
Fisher *Martes pennanti*	G5	639 ha	0.1%		%	ha	%
Plant Communities							
Picea sitchensis / Polystichum munitum Forest Community *Picea sitchensis / Polystichum munitum*	G4?	67 ha	31.9%	1,227.5	64.0 %	104 ha	201 %

Cultus - Vedder

Site No 32

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	17 %	GAP 1	0 %	BC Provincial:	46 %	US State:	0 %
Area:	8,500	ha	Developed	13 %	GAP 2	0 %	Can Indigenous:	5 %	US Local:	0 %
	20,995	ac	Open Water	8 %	GAP 3	0 %	Can Private:	48 %	US Indigenous:	0 %
					GAP 4	52 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
North Pacific Mesic Western Hemlock - Silver fir Forest		86 ha	0.4%	6.8	1.2 %	7,191 ha	207 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		327 ha	0.1%	2.3	0.4 %	78,777 ha	159 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		777 ha	0.4%	7.7	1.4 %	56,808 ha	131 %
North Pacific Lowland Riparian Forest and Shrubland		206 ha	0.4%	6.7	1.2 %	17,205 ha	171 %
Aggregate lower elevation		4,036 ha	0.3%	5.4	1.0 %	421,069 ha	138 %
Aggregate higher elevation		399 ha	0.0%	0.5	0.1 %	496,454 ha	135 %
Old Growth Forest		4 ha	0.0%	0.0	0.0 %	259,308 ha	165 %
Species							
Birds							
Great blue heron *Ardia herodius fannini*	G5T4	1 occ	4.2%	47.0	8.3 %	12 occ	200 %

Cultus - Vedder

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Mammals							
Trowbridge's shrew *Sorex trowbridgii*	G5	2 occ	24.9%	279.1	49.5 %	4 occ	199 %
Fisher *Martes pennanti*	G5	2 ha	0.0%		%	ha	%
Mtn beaver rufa *Aplodontia rufa rufa*	G5T4?	1 occ	3.9%	43.4	7.7 %	13 occ	200 %
Mollusks							
Pacific Sideband *Monadenia fidelis*	G4G5	1 occ	25.0%	282.0	50.0 %	2 occ	200 %
Western Flat whorl *Planogyra clappi*	G3G4	1 occ	8.3%	94.0	16.7 %	6 occ	200 %
Conical Spot *Punctum randolphii*	G4	1 occ	3.5%	57.7	10.2 %	13 occ	231 %
Oregon Forestsnail *Allogona townsendiana*	G3G4	1 occ	5.6%	62.7	11.1 %	9 occ	200 %
Robust Lancetooth *Haplotrema vancouverens*	G5	1 occ	12.5%	141.0	25.0 %	4 occ	200 %
Pygmy Oregonian *Cryptomastix germana*	G3G4	1 occ	12.5%	141.0	25.0 %	4 occ	200 %
Vascular Plants							
Green-fruited Sedge *Carex interrupta*	G3G4	1 occ	50.0%	563.9	100.0 %	1 occ	200 %
Pacific Waterleaf *Hydrophyllum tenuipes*	G4G5	1 occ	50.0%	563.9	100.0 %	1 occ	200 %
Phantom Orchid *Cephalanthera austiniae*	G4	1 occ	10.0%	94.0	16.7 %	6 occ	167 %
Tall Bugbane *Cimicifuga elata*	G2	2 occ	5.6%	65.1	11.5 %	13 occ	169 %
Western Mannagrass *Glyceria occidentalis*	G5	1 occ	25.0%	282.0	50.0 %	2 occ	200 %
Giant Helleborine *Epipactis gigantea*	G3G4	1 occ	50.0%	563.9	100.0 %	1 occ	200 %
Other Ecological Features							
Karst SM		669 ha	0.7%	27.8	4.9 %	13,584 ha	233 %

Davis

Site No 33

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	91 %	US State:	0 %
Area:	1,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	3,705	ac	Open Water	5 %	GAP 3	0 %	Can Private:	9 %	US Indigenous:	0 %
					GAP 4	9 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		240 ha	0.0%	3.0	0.1 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		7 ha	0.0%	0.5	0.0 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		85 ha	0.4%	45.0	1.4 %	6,069 ha	158 %
North Pacific Mesic Western Hemlock - Silver fir Forest		90 ha	0.4%	40.2	1.3 %	7,191 ha	207 %
Aggregate higher elevation		1,055 ha	0.1%	6.8	0.2 %	496,454 ha	135 %
Species							
Birds							
Peregrine falcon *Falco peregrinus anatum*	G4T3	1 nst	2.4%	152.2	4.8 %	21 nst	198 %
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	175 ha	0.1%	4.7	0.1 %	119,141 ha	200 %

Deserted River

Site No 34

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	99 %	US State:	0 %
Area:	6,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	1 %	US Local:	0 %
	16,055	ac	Open Water	2 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	1 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		2,631 ha	0.3%	7.5	1.0 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		309 ha	0.2%	5.1	0.7 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		198 ha	1.0%	24.0	3.3 %	6,069 ha	158 %
North Pacific Mesic Western Hemlock - Silver fir Forest		282 ha	1.2%	28.9	3.9 %	7,191 ha	207 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		601 ha	0.2%	5.6	0.8 %	78,777 ha	159 %
North Pacific Lowland Riparian Forest and Shrubland		76 ha	0.1%	3.3	0.4 %	17,205 ha	171 %
Aggregate lower elevation		601 ha	0.0%	1.1	0.1 %	421,069 ha	138 %
Aggregate higher elevation		4,701 ha	0.3%	7.0	0.9 %	496,454 ha	135 %
Species							
Birds							

Deserted River

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	1,712 ha	0.6%	10.6	1.4 %	119,141 ha	200 %
<u>Mammals</u>							
Mountain goat *Oreamos americanus*	G5	893 ha	0.1%	3.5	0.5 %	189,856 ha	135 %

Desolation Sound

Site No 35

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	80 %	BC Provincial:	99 %	US State:	0 %
Area:	5,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	13,585	ac	Open Water	21 %	GAP 3	0 %	Can Private:	1 %	US Indigenous:	0 %
					GAP 4	1 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		161 ha	0.0%	0.5	0.1 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		19 ha	0.0%	0.4	0.0 %	44,848 ha	127 %
North Pacific Mesic Western Hemlock - Silver fir Forest		8 ha	0.0%	1.0	0.1 %	7,191 ha	207 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		2,147 ha	0.8%	23.8	2.7 %	78,777 ha	159 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		1,737 ha	0.9%	26.7	3.1 %	56,808 ha	131 %
North Pacific Lowland Riparian Forest and Shrubland		18 ha	0.0%	0.9	0.1 %	17,205 ha	171 %
Aggregate lower elevation		3,884 ha	0.3%	8.0	0.9 %	421,069 ha	138 %
Aggregate higher elevation		351 ha	0.0%	0.6	0.1 %	496,454 ha	135 %
Species							
Birds							

Desolation Sound

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	592 ha	0.2 %	4.3	0.5 %	119,141 ha	200 %

Duffey Gap

Site No 36

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	9 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	0 %	US State:	0 %
Area:	500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	1,235	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	91 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		32 ha	0.0%	1.2	0.0 %	259,308 ha	165 %
North Pacific Montane Massive Bedrock, Cliff and Talus		12 ha	0.0%	6.3	0.1 %	18,742 ha	118 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		18 ha	0.0%	2.2	0.0 %	78,777 ha	159 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		73 ha	0.0%	12.3	0.1 %	56,808 ha	131 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		0 ha	0.0%	0.3	0.0 %	12,529 ha	127 %
Montane composite		71 ha	0.1%	22.7	0.2 %	30,002 ha	123 %
Aggregate lower elevation		325 ha	0.0%	7.4	0.1 %	421,069 ha	138 %
Aggregate higher elevation		1 ha	0.0%	0.0	0.0 %	496,454 ha	135 %
Species							
Birds							

Duffey Gap

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Golden Eagle *Aquila chrysaetos*	G5	3 nst	7.9%	1,513.8	15.8 %	19 nst	189 %
Mammals							
Fisher *Martes pennanti*	G5	75 ha	0.0%		%	ha	%

Emery Creek

Site No 37

Northeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	73 %	US State:	0 %
Area:	3,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	3 %	US Local:	0 %
	8,645	ac	Open Water	2 %	GAP 3	0 %	Can Private:	24 %	US Indigenous:	0 %
					GAP 4	26 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		28 ha	0.0%	0.1	0.0 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		28 ha	0.0%	0.9	0.1 %	44,848 ha	127 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		273 ha	0.1%	4.8	0.3 %	78,777 ha	159 %
North Pacific Lowland Riparian Forest and Shrubland		35 ha	0.1%	2.8	0.2 %	17,205 ha	171 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		37 ha	0.1%	4.0	0.3 %	12,529 ha	127 %
Aggregate lower elevation		2,898 ha	0.2%	9.4	0.7 %	421,069 ha	138 %
Aggregate higher elevation		131 ha	0.0%	0.4	0.0 %	496,454 ha	135 %
Species							
Mollusks							
Pacific Sideband *Monadenia fidelis*	G4G5	1 occ	25.0%	684.8	50.0 %	2 occ	200 %

Emery Creek

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio

Finney O'Toole

Site No 38

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	80 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	0 %	US State:	3 %
Area:	9,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	23,465	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	17 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
North Pacific Lowland Riparian Forest and Shrubland		24 ha	0.0%	0.7	0.1 %	17,205 ha	171 %
Aggregate higher elevation		3,204 ha	0.2%	3.3	0.6 %	496,454 ha	135 %
Aggregate lower elevation		4,502 ha	0.3%	5.4	1.1 %	421,069 ha	138 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		96 ha	0.2%	3.9	0.8 %	12,529 ha	127 %
Old Growth Forest		2,145 ha	0.2%	4.2	0.8 %	259,308 ha	165 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		472 ha	0.2%	4.2	0.8 %	56,808 ha	131 %
North Pacific Maritime Mesic Subalpine Parkland		6 ha	0.0%	0.1	0.0 %	46,402 ha	112 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		109 ha	0.0%	0.7	0.1 %	78,777 ha	159 %
North Pacific Mesic Western Hemlock - Silver fir Forest		0 ha	0.0%	0.0	0.0 %	7,191 ha	207 %

Finney O'Toole

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Montane Massive Bedrock, Cliff and Talus		41 ha	0.1%	1.1	0.2 %	18,742 ha	118 %
North Pacific Montane Riparian Woodland and Shrubland		2 ha	0.0%	0.1	0.0 %	6,069 ha	158 %
North Pacific Mountain Hemlock Forest		517 ha	0.3%	5.8	1.2 %	44,848 ha	127 %
Montane composite		714 ha	0.7%	12.0	2.4 %	30,002 ha	123 %
Species							
Amphibians							
Cascades frog *Rana cascadae*	G3G4	1 occ	2.3%	38.8	7.7 %	13 occ	210 %
Birds							
Northern spotted owl Nests *Strix occidentalis caurina*	G3T3	1 nst	0.3%	3.0	0.6 %	169 nst	194 %
Marbled murrelet *Brachyramphus marmoratus*	G3G4	3 occ	1.8%	17.8	3.5 %	77 occ	194 %
Mammals							
Fisher *Martes pennanti*	G5	2,112 ha	0.4%		%	ha	%
Vascular Plants							
Poor Sedge *Carex magellanica ssp. irrigua*	G5T5	1 occ	8.3%	84.1	16.7 %	6 occ	200 %

Franks

Site No 39

Northeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	1,235	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		279 ha	0.0%	10.3	0.1 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		0 ha	0.0%	0.0	0.0 %	44,848 ha	127 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		71 ha	0.0%	8.7	0.1 %	78,777 ha	159 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		18 ha	0.0%	13.6	0.1 %	12,529 ha	127 %
Aggregate lower elevation		492 ha	0.0%	11.2	0.1 %	421,069 ha	138 %
Aggregate higher elevation		8 ha	0.0%	0.2	0.0 %	496,454 ha	135 %
Species							
Birds							
Northern spotted owl *Strix occidentalis caurina*	G3T3	1 occ	1.5%	383.5	4.0 %	25 occ	204 %

French Ridge

Site No 40

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	100 %
			Agriculture	0 %	GAP 1	100 %	BC Provincial:	0 %	US State:	0 %
Area:	1,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	3,705	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland		676 ha	0.4%	45.3	1.4 %	47,698 ha	104 %
Old Growth Forest		211 ha	0.0%	2.6	0.1 %	259,308 ha	165 %
Northern Rocky Mountain Subalpine Dry Parkland		50 ha	0.2%	20.9	0.7 %	7,664 ha	109 %
North Pacific Mountain Hemlock Forest		11 ha	0.0%	0.8	0.0 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		21 ha	0.1%	11.0	0.3 %	6,069 ha	158 %
North Pacific Montane Massive Bedrock, Cliff and Talus		33 ha	0.1%	5.6	0.2 %	18,742 ha	118 %
North Pacific Maritime Mesic Subalpine Parkland		101 ha	0.1%	6.9	0.2 %	46,402 ha	112 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		10 ha	0.0%	2.5	0.1 %	12,529 ha	127 %
Aggregate lower elevation		70 ha	0.0%	0.5	0.0 %	421,069 ha	138 %

French Ridge

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Aggregate higher elevation		633 ha	0.0%	4.1	0.1 %	496,454 ha	135 %
Species							
Mammals							
Fisher *Martes pennanti*	G5	12 ha	0.0%		%	ha	%

Frisco Creek

Site No 41

Southeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	100 %
			Agriculture	0 %	GAP 1	100 %	BC Provincial:	0 %	US State:	0 %
Area:	1,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	3,705	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
North Pacific Lowland Riparian Forest and Shrubland		9 ha	0.0%	1.7	0.1 %	17,205 ha	171 %
Aggregate higher elevation		288 ha	0.0%	1.9	0.1 %	496,454 ha	135 %
Aggregate lower elevation		374 ha	0.0%	2.8	0.1 %	421,069 ha	138 %
Alpine composite		70 ha	0.3%	27.7	0.9 %	8,126 ha	110 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		38 ha	0.1%	9.8	0.3 %	12,529 ha	127 %
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland		107 ha	0.1%	7.2	0.2 %	47,698 ha	104 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		52 ha	0.0%	2.9	0.1 %	56,808 ha	131 %
North Pacific Maritime Mesic Subalpine Parkland		166 ha	0.1%	11.4	0.4 %	46,402 ha	112 %
North Pacific Montane Massive Bedrock, Cliff and Talus		14 ha	0.0%	2.5	0.1 %	18,742 ha	118 %

Frisco Creek

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Montane Riparian Woodland and Shrubland		3 ha	0.0%	1.4	0.0 %	6,069 ha	158 %
North Pacific Mountain Hemlock Forest		21 ha	0.0%	1.5	0.0 %	44,848 ha	127 %
Northern Rocky Mountain Subalpine Dry Parkland		230 ha	0.9%	96.1	3.0 %	7,664 ha	109 %
Montane composite		259 ha	0.3%	27.6	0.9 %	30,002 ha	123 %
Species							
Mammals							
Fisher *Martes pennanti*	G5	11 ha	0.0%		%	ha	%
Wolverine *Gulo gulo*	G4	0 occ	0.5%	32.0	1.0 %	5 occ	198 %
Lynx *Lynx canadensis*	G5	1,384 ha	0.5%	54.5	1.7 %	81,154 ha	140 %
Gray wolf *Canis lupus*	G4	1 occ	2.1%	133.2	4.2 %	12 occ	196 %

Gambier

Site No 42

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	99 %	US State:	0 %
Area:	1,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	2,470	ac	Open Water	1 %	GAP 3	0 %	Can Private:	1 %	US Indigenous:	0 %
					GAP 4	1 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		98 ha	0.0%	1.8	0.0 %	259,308 ha	165 %
North Pacific Mesic Western Hemlock - Silver fir Forest		9 ha	0.0%	5.7	0.1 %	7,191 ha	207 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		852 ha	0.3%	51.9	1.1 %	78,777 ha	159 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		16 ha	0.0%	1.3	0.0 %	56,808 ha	131 %
North Pacific Lowland Riparian Forest and Shrubland		0 ha	0.0%	0.0	0.0 %	17,205 ha	171 %
Aggregate lower elevation		868 ha	0.1%	9.9	0.2 %	421,069 ha	138 %
Aggregate higher elevation		74 ha	0.0%	0.7	0.0 %	496,454 ha	135 %
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	99 ha	0.0%	4.0	0.1 %	119,141 ha	200 %

Gambier

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio

Garibaldi Complex

Site No 43

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	80 %	BC Provincial:	98 %	US State:	0 %
Area:	158,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	1 %	US Local:	0 %
	391,495	ac	Open Water	6 %	GAP 3	0 %	Can Private:	1 %	US Indigenous:	0 %
					GAP 4	2 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Alpine composite		1,825 ha	6.7%	6.8	22.5 %	8,126 ha	110 %
Aggregate lower elevation		37,637 ha	2.7%	2.7	8.9 %	421,069 ha	138 %
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland		2,687 ha	1.7%	1.7	5.6 %	47,698 ha	104 %
Montane composite		2,236 ha	2.2%	2.3	7.5 %	30,002 ha	123 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		1,054 ha	2.5%	2.5	8.4 %	12,529 ha	127 %
North Pacific Lowland Riparian Forest and Shrubland		1,540 ha	2.7%	2.7	8.9 %	17,205 ha	171 %
North Pacific Maritime Mesic Subalpine Parkland		2,805 ha	1.8%	1.8	6.0 %	46,402 ha	112 %
North Pacific Mesic Western Hemlock - Silver fir Forest		269 ha	1.1%	1.1	3.7 %	7,191 ha	207 %
North Pacific Montane Massive Bedrock, Cliff and Talus		781 ha	1.3%	1.3	4.2 %	18,742 ha	118 %

Garibaldi Complex

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Montane Riparian Woodland and Shrubland		1,315 ha	6.5%	6.6	21.7 %	6,069 ha	158 %
North Pacific Mountain Hemlock Forest		4,425 ha	3.0%	3.0	9.9 %	44,848 ha	127 %
Old Growth Forest		30,950 ha	3.6%	3.6	11.9 %	259,308 ha	165 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		6,989 ha	2.7%	2.7	8.9 %	78,777 ha	159 %
Aggregate higher elevation		63,807 ha	3.9%	3.9	12.9 %	496,454 ha	135 %
Species							
Birds							
Bald eagle roosts *Haliaeetus leucocephalus*	G5	0 rst	0.3%	0.6	2.1 %	9 rst	472 %
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	5,994 ha	2.1%	1.5	5.0 %	119,141 ha	200 %
Northern spotted owl *Strix occidentalis caurina*	G3T3	1 occ	1.6%	1.3	4.4 %	25 occ	204 %
Northern goshawk *Accipiter gentilis laingi*	G5	1 occ	1.6%	0.9	3.1 %	32 occ	194 %
Mammals							
Mountain goat *Oreamos americanus*	G5	4,255 ha	0.7%	0.7	2.2 %	189,856 ha	135 %
Mollusks							
Conical Spot *Punctum randolphii*	G4	1 occ	2.6%	2.3	7.7 %	13 occ	231 %
Vascular Plants							
Small-fruited Willowherb *Epilobium leptocarpum*	G5	1 occ	20.0%	10.1	33.3 %	3 occ	167 %
Nodding Semaphoregrass *Pleuropogon refractus*	G4	1 occ	10.0%	6.0	20.0 %	5 occ	200 %
Enander's Sedge *Carex lenticularis var. dolia*	G5T3Q	1 occ	50.0%	30.2	100.0 %	1 occ	200 %
Other Ecological Features							
Hot Spring		1 occ	3.8%	2.3	7.7 %	13 occ	200 %

Goat Island

Site No 44

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	1,235	ac	Open Water	100 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		40 ha	0.0%	1.5	0.0 %	259,308 ha	165 %
North Pacific Mesic Western Hemlock - Silver fir Forest		12 ha	0.0%	15.5	0.2 %	7,191 ha	207 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		286 ha	0.1%	34.8	0.4 %	78,777 ha	159 %
North Pacific Lowland Riparian Forest and Shrubland		0 ha	0.0%	0.2	0.0 %	17,205 ha	171 %
Aggregate lower elevation		286 ha	0.0%	6.5	0.1 %	421,069 ha	138 %
Aggregate higher elevation		211 ha	0.0%	4.1	0.0 %	496,454 ha	135 %
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	58 ha	0.0%	4.7	0.0 %	119,141 ha	200 %
Mammals							

Goat Island

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Mountain goat *Oreamos americanus*	G5	13 ha	0.0 %	0.6	0.0 %	189,856 ha	135 %

Golden Pitt

Site No 45

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	4 %	GAP 1	40 %	BC Provincial:	50 %	US State:	0 %
Area:	7,000	ha	Developed	0 %	GAP 2	4 %	Can Indigenous:	0 %	US Local:	0 %
	17,290	ac	Open Water	14 %	GAP 3	0 %	Can Private:	49 %	US Indigenous:	0 %
					GAP 4	8 %	Can NGO:	1 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		1,516 ha	0.2%	4.0	0.6 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		88 ha	0.1%	1.3	0.2 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		5 ha	0.0%	0.6	0.1 %	6,069 ha	158 %
North Pacific Mesic Western Hemlock - Silver fir Forest		63 ha	0.3%	6.0	0.9 %	7,191 ha	207 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		3,360 ha	1.3%	29.2	4.3 %	78,777 ha	159 %
North Pacific Lowland Riparian Forest and Shrubland		263 ha	0.5%	10.5	1.5 %	17,205 ha	171 %
Alpine composite		127 ha	0.5%	10.7	1.6 %	8,126 ha	110 %
Aggregate lower elevation		3,360 ha	0.2%	5.5	0.8 %	421,069 ha	138 %
Aggregate higher elevation		2,068 ha	0.1%	2.9	0.4 %	496,454 ha	135 %

Golden Pitt

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Species							
Birds							
Sandhill Crane *Grus canadensis*	G5	0 occ	8.1%	109.6	16.0%	1 occ	198 %
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	1,142 ha	0.4%	6.6	1.0%	119,141 ha	200 %
Mollusks							
Striated Tightcoil *Pristiloma stearnsii*	G3	1 occ	50.0%	684.8	100.0%	1 occ	200 %

Harrison Hot Springs

Site No 46

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	89 %	US State:	0 %
Area:	6,000	ha	Developed	3 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	14,820	ac	Open Water	36 %	GAP 3	0 %	Can Private:	11 %	US Indigenous:	0 %
					GAP 4	11 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		273 ha	0.0%	0.8	0.1 %	259,308 ha	165 %
North Pacific Mesic Western Hemlock - Silver fir Forest		24 ha	0.1%	2.7	0.3 %	7,191 ha	207 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		3,212 ha	1.2%	32.6	4.1 %	78,777 ha	159 %
North Pacific Lowland Riparian Forest and Shrubland		133 ha	0.2%	6.2	0.8 %	17,205 ha	171 %
Aggregate lower elevation		3,212 ha	0.2%	6.1	0.8 %	421,069 ha	138 %
Aggregate higher elevation		500 ha	0.0%	0.8	0.1 %	496,454 ha	135 %
Species							
Birds							
Peregrine falcon *Falco peregrinus anatum*	G4T3	1 nst	2.4%	37.7	4.7 %	21 nst	198 %
Vascular Plants							

<u>Harrison Hot Springs</u> Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Soft-leaved Willow *Salix sessilifolia*	G4	1 occ	10.1%	159.8	20.0%	5 occ	198 %
<u>Other Ecological Features</u>							
Karst SM		878 ha	1.0%	51.6	6.5%	13,584 ha	233 %
Hot Spring		1 occ	3.8%	61.5	7.7%	13 occ	200 %

Harrison Lake

Site No 47

Northeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	14,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	35,815	ac	Open Water	6 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
North Pacific Lowland Riparian Forest and Shrubland		55 ha	0.1%	1.0	0.3 %	17,205 ha	171 %
Old Growth Forest		4,428 ha	0.5%	5.6	1.7 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		825 ha	0.6%	6.1	1.8 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		11 ha	0.1%	0.6	0.2 %	6,069 ha	158 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		691 ha	0.3%	2.9	0.9 %	78,777 ha	159 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		452 ha	1.1%	11.9	3.6 %	12,529 ha	127 %
Alpine composite		114 ha	0.4%	4.6	1.4 %	8,126 ha	110 %
Aggregate lower elevation		9,038 ha	0.6%	7.1	2.1 %	421,069 ha	138 %
Aggregate higher elevation		3,680 ha	0.2%	2.5	0.7 %	496,454 ha	135 %

Harrison Lake

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Montane Massive Bedrock, Cliff and Talus		4 ha	0.0 %	0.1	0.0 %	18,742 ha	118 %
Species							
Birds							
Northern spotted owl *Strix occidentalis caurina*	G3T3	1 occ	1.5 %	13.2	4.0 %	25 occ	204 %
Mammals							
Mountain goat *Oreamos americanus*	G5	968 ha	0.2 %	1.7	0.5 %	189,856 ha	135 %
Other Ecological Features							
Hot Spring		1 occ	3.8 %	25.4	7.7 %	13 occ	200 %
Freshwater							
Species							
Amphibians							
Red-legged frog *Rana aurora*	G4	3 occ	14.3 %	3.7	15.8 %	19 occ	95 %
Coastal tailed frog *Ascaphus truei*	G4	1 occ	0.9 %	1.8	7.7 %	13 occ	400 %
Fishes							
Chinook Salmon (NO RUN INFO.) *Oncorhynchus tshawytscha*	G5	92 km	11.2 %	5.3	22.3 %	414 km	149 %
Pink Salmon, no run info (SALMON ECOREGION) *Oncorhynchus gorbuscha*	G5	95 km	11.9 %	5.6	23.7 %	399 km	149 %
Threespine stickleback *Gasterosteus aculeatus*	G5	96 km	13.3 %	10.5	44.7 %	215 km	246 %
Steelhead Salmon (winter) *Oncorhynchus mykiss*	G5	28 km	52.9 %	12.4	52.7 %	53 km	89 %
Steelhead Salmon (summer) *Oncorhynchus mykiss*	G5	1 km	2.4 %	0.6	2.4 %	41 km	92 %
Steelhead Salmon (no run info) *Oncorhynchus mykiss*	G5	110 km	16.6 %	7.8	33.3 %	330 km	121 %
Sockeye Salmon *Oncorhynchus nerka*	G5	110 km	14.3 %	6.8	28.7 %	383 km	148 %
Bull Trout *Salvelinus confluentus*	G3	1 km	0.2 %	0.1	0.3 %	292 km	106 %

Harrison Lake

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Pygmy Longfin Smelt/Harrison/Pitt Lake Smelt *Spirinchus sp. 1*	G1Q	21,930 ha	80.4%	63.1	268.1 %	8,181 ha	333 %
Chum Salmon (SALMON ECOREGION) *Oncorhynchus keta*	G5	99 km	9.5%	4.5	19.0 %	523 km	137 %
Mountain Sucker *Catostomus platyrhynchus*	G5	20 km	25.8%	20.1	85.3 %	23 km	325 %
Dolly Varden *Salvelinus malma*	G5	100 km	13.9%	10.9	46.2 %	217 km	185 %
Cutthroat Trout, Clarkil Subspecies *Oncorhynchus clarkiI clarkiI*	G4	139 km	9.4%	7.4	31.5 %	442 km	215 %
Coho Salmon *Oncorhynchus kisutch*	G4	121 km	7.6%	3.6	15.3 %	792 km	132 %
Coastal Cutthroat Trout, Clarki Subspecies (anadromous) *Oncorhynchus clarki clarki*	G4	89 km	32.3%	25.3	107.6 %	83 km	239 %
Salish Sucker *Catostomus sp. 4*	G1	7 km	9.5%	7.5	32.0 %	23 km	215 %
<u>Insects</u>							
Stonefly fraseri *Isocapnia fraseri*	G1	1 occ	100.0%	23.6	100.0 %	1 occ	100 %
Stonefly sasquatchi *Bolshecapnia sasquatchi*	G3	1 occ	100.0%	23.6	100.0 %	1 occ	100 %
<u>Mammals</u>							
Pacific water Shrew *Sorex bendirii*	G4	1 occ	9.1%	2.4	10.0 %	10 occ	100 %
<u>Freshwater Ecological Systems</u>							
intermediate,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem shallow - tributary shallow a		71,585 ha	72.5%	56.9	241.7 %	29,617 ha	256 %
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem moderate - tributary moderate b		13,906 ha	15.7%	12.3	52.2 %	26,645 ha	100 %

Harrison Mills

Site No 48

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	17 %	GAP 1	0 %	BC Provincial:	88 %	US State:	0 %
Area:	2,000	ha	Developed	0 %	GAP 2	9 %	Can Indigenous:	8 %	US Local:	0 %
	4,940	ac	Open Water	30 %	GAP 3	0 %	Can Private:	5 %	US Indigenous:	0 %
					GAP 4	12 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		114 ha	0.0%	1.1	0.0 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		2 ha	0.0%	0.1	0.0 %	44,848 ha	127 %
North Pacific Mesic Western Hemlock - Silver fir Forest		28 ha	0.1%	9.4	0.4 %	7,191 ha	207 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		708 ha	0.3%	21.6	0.9 %	78,777 ha	159 %
North Pacific Lowland Riparian Forest and Shrubland		187 ha	0.3%	26.1	1.1 %	17,205 ha	171 %
Aggregate lower elevation		708 ha	0.1%	4.0	0.2 %	421,069 ha	138 %
Aggregate higher elevation		220 ha	0.0%	1.1	0.0 %	496,454 ha	135 %
Species							
Birds							
Great blue heron *Ardia herodius fannini*	G5T4	1 occ	4.2%	199.7	8.3 %	12 occ	200 %

Harrison Mills

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Bald eagle roosts *Haliaeetus leucocephalus*	G5	1 rst	1.4%	266.3	11.1 %	9 rst	472 %
Mammals							
Trowbridge's shrew *Sorex trowbridgii*	G5	1 occ	12.6%	599.2	25.0 %	4 occ	199 %
Vascular Plants							
Phantom Orchid *Cephalanthera austiniae*	G4	1 occ	10.0%	399.5	16.7 %	6 occ	167 %

Hart Lake

Site No 49

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	100 %
			Agriculture	0 %	GAP 1	100 %	BC Provincial:	0 %	US State:	0 %
Area:	500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	1,235	ac	Open Water	2 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland		16 ha	0.0%	3.2	0.0 %	47,698 ha	104 %
Old Growth Forest		5 ha	0.0%	0.2	0.0 %	259,308 ha	165 %
Northern Rocky Mountain Subalpine Dry Parkland		36 ha	0.1%	44.7	0.5 %	7,664 ha	109 %
North Pacific Mountain Hemlock Forest		0 ha	0.0%	0.0	0.0 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		9 ha	0.0%	13.8	0.1 %	6,069 ha	158 %
North Pacific Montane Massive Bedrock, Cliff and Talus		19 ha	0.0%	9.6	0.1 %	18,742 ha	118 %
North Pacific Maritime Mesic Subalpine Parkland		11 ha	0.0%	2.3	0.0 %	46,402 ha	112 %
North Pacific Lowland Riparian Forest and Shrubland		29 ha	0.1%	16.1	0.2 %	17,205 ha	171 %
Montane composite		208 ha	0.2%	66.5	0.7 %	30,002 ha	123 %

Hart Lake Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Alpine composite		0 ha	0.0%	0.5	0.0 %	8,126 ha	110 %
Aggregate lower elevation		84 ha	0.0%	1.9	0.0 %	421,069 ha	138 %
Aggregate higher elevation		81 ha	0.0%	1.6	0.0 %	496,454 ha	135 %
Species							
Mammals							
Mountain goat *Oreamos americanus*	G5	110 ha	0.0%	5.6	0.1 %	189,856 ha	135 %
Fisher *Martes pennanti*	G5	22 ha	0.0%		%	ha	%

Hemionus

Site No 50

Northeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	1,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	3,705	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		342 ha	0.0%	4.2	0.1 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		68 ha	0.0%	4.8	0.2 %	44,848 ha	127 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		0 ha	0.0%	0.0	0.0 %	78,777 ha	159 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		12 ha	0.0%	3.1	0.1 %	12,529 ha	127 %
Aggregate lower elevation		687 ha	0.0%	5.2	0.2 %	421,069 ha	138 %
Aggregate higher elevation		464 ha	0.0%	3.0	0.1 %	496,454 ha	135 %
Species							
Mammals							
Mountain goat *Oreamos americanus*	G5	723 ha	0.1%	12.2	0.4 %	189,856 ha	135 %
Vascular Plants							

Hemionus

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Dwarf Groundsmoke *Gayophytum humile*	G5	1 occ	50.0 %	3,195.6	100.0 %	1 occ	200 %

Higgins Creek

Site No 51

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	97 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	0 %	US State:	1 %
Area:	6,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	16,055	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	3 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		76 ha	0.0%	1.0	0.1 %	56,808 ha	131 %
Aggregate higher elevation		3,791 ha	0.2%	5.6	0.8 %	496,454 ha	135 %
Aggregate lower elevation		1,174 ha	0.1%	2.1	0.3 %	421,069 ha	138 %
Montane composite		833 ha	0.8%	20.5	2.8 %	30,002 ha	123 %
North Pacific Lowland Riparian Forest and Shrubland		8 ha	0.0%	0.3	0.0 %	17,205 ha	171 %
Old Growth Forest		2,390 ha	0.3%	6.8	0.9 %	259,308 ha	165 %
North Pacific Maritime Mesic Subalpine Parkland		19 ha	0.0%	0.3	0.0 %	46,402 ha	112 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		75 ha	0.0%	0.7	0.1 %	78,777 ha	159 %
North Pacific Mesic Western Hemlock - Silver fir Forest		28 ha	0.1%	2.9	0.4 %	7,191 ha	207 %

Higgins Creek

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Montane Massive Bedrock, Cliff and Talus		34 ha	0.1%	1.3	0.2 %	18,742 ha	118 %
North Pacific Montane Riparian Woodland and Shrubland		30 ha	0.1%	3.6	0.5 %	6,069 ha	158 %
North Pacific Mountain Hemlock Forest		359 ha	0.2%	5.9	0.8 %	44,848 ha	127 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		115 ha	0.3%	6.8	0.9 %	12,529 ha	127 %
Species							
Birds							
Marbled murrelet *Brachyramphus marmoratus*	G3G4	3 occ	1.8%	26.2	3.6 %	77 occ	194 %
Northern spotted owl Nests *Strix occidentalis caurina*	G3T3	1 nst	0.3%	4.4	0.6 %	169 nst	194 %
Mammals							
Fisher *Martes pennanti*	G5	1,535 ha	0.3%		%	ha	%

I 90 Four

Site No 52

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	97 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	0 %	US State:	0 %
Area:	1,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	2,470	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	3 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		398 ha	0.0%	7.4	0.2 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		70 ha	0.0%	7.5	0.2 %	44,848 ha	127 %
North Pacific Montane Massive Bedrock, Cliff and Talus		0 ha	0.0%	0.1	0.0 %	18,742 ha	118 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		9 ha	0.0%	3.5	0.1 %	12,529 ha	127 %
Montane composite		5 ha	0.0%	0.8	0.0 %	30,002 ha	123 %
Aggregate lower elevation		339 ha	0.0%	3.9	0.1 %	421,069 ha	138 %
Aggregate higher elevation		565 ha	0.0%	5.5	0.1 %	496,454 ha	135 %
Species							
Amphibians							
Cascades frog *Rana cascadae*	G3G4	0 occ	0.3%	51.6	1.1 %	13 occ	210 %

I 90 Four

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Birds							
Red breasted sapsucker *Sphyrapicus ruber*	G5	1 occ	5.0%	479.4	10.0 %	10 occ	199 %
Northern spotted owl Nests *Strix occidentalis caurina*	G3T3	1 nst	0.3%	28.4	0.6 %	169 nst	194 %
Mammals							
Mountain goat *Oreamos americanus*	G5	3 ha	0.0%	0.1	0.0 %	189,856 ha	135 %
Fisher *Martes pennanti*	G5	280 ha	0.1%		%	ha	%

I 90 One

Site No 53

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	0 %	US State:	0 %
Area:	500	ha	Developed	13 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	1,235	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	100 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		27 ha	0.0%	1.0	0.0 %	259,308 ha	165 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		145 ha	0.1%	24.5	0.3 %	56,808 ha	131 %
North Pacific Lowland Riparian Forest and Shrubland		5 ha	0.0%	2.8	0.0 %	17,205 ha	171 %
Aggregate lower elevation		383 ha	0.0%	8.7	0.1 %	421,069 ha	138 %
Species							
Birds							
Red breasted sapsucker *Sphyrapicus ruber*	G5	1 occ	5.0%	958.7	10.0 %	10 occ	199 %
Mammals							
Fisher *Martes pennanti*	G5	68 ha	0.0%		%	ha	%

I 90 Three

Site No 54

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	75 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	0 %	US State:	0 %
Area:	1,000	ha	Developed	0 %	GAP 2	25 %	Can Indigenous:	0 %	US Local:	25 %
	2,470	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		167 ha	0.0%	3.1	0.1 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		30 ha	0.0%	3.2	0.1 %	44,848 ha	127 %
North Pacific Montane Massive Bedrock, Cliff and Talus		1 ha	0.0%	0.3	0.0 %	18,742 ha	118 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		5 ha	0.0%	1.7	0.0 %	12,529 ha	127 %
Montane composite		18 ha	0.0%	2.9	0.1 %	30,002 ha	123 %
Aggregate lower elevation		322 ha	0.0%	3.7	0.1 %	421,069 ha	138 %
Aggregate higher elevation		244 ha	0.0%	2.4	0.0 %	496,454 ha	135 %
Species							
Birds							
Red breasted sapsucker *Sphyrapicus ruber*	G5	1 occ	5.0%	479.3	10.0 %	10 occ	199 %

I 90 Three

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Mammals							
Fisher *Martes pennanti*	G5	115 ha	0.0%		%	ha	%
Nonvascular Plants							
Luminous Moss *Schistostega pennata*	G3G5	1 occ	16.7%	1,597.8	33.3%	3 occ	200 %

I 90 Two

Site No 55

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	94 %
			Agriculture	0 %	GAP 1	44 %	BC Provincial:	0 %	US State:	0 %
Area:	500	ha	Developed	0 %	GAP 2	3 %	Can Indigenous:	0 %	US Local:	4 %
	1,235	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	2 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		195 ha	0.0%	7.2	0.1 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		62 ha	0.0%	13.2	0.1 %	44,848 ha	127 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		2 ha	0.0%	1.3	0.0 %	12,529 ha	127 %
Montane composite		0 ha	0.0%	0.1	0.0 %	30,002 ha	123 %
Aggregate lower elevation		220 ha	0.0%	5.0	0.1 %	421,069 ha	138 %
Aggregate higher elevation		198 ha	0.0%	3.8	0.0 %	496,454 ha	135 %
Species							
Birds							
Red breasted sapsucker *Sphyrapicus ruber*	G5	1 occ	5.0%	958.7	10.0 %	10 occ	199 %
Northern spotted owl Nests *Strix occidentalis caurina*	G3T3	1 nst	0.3%	56.7	0.6 %	169 nst	194 %

I 90 Two

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Mammals							
Mountain goat *Oreamos americanus*	G5	22 ha	0.0%	1.1	0.0 %	189,856 ha	135 %
Fisher *Martes pennanti*	G5	126 ha	0.0%		%	ha	%

Icy Creek

Site No 56

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	100 %
			Agriculture	0 %	GAP 1	100 %	BC Provincial:	0 %	US State:	0 %
Area:	500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	1,235	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland		2 ha	0.0%	0.3	0.0 %	47,698 ha	104 %
Old Growth Forest		4 ha	0.0%	0.1	0.0 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		0 ha	0.0%	0.1	0.0 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		8 ha	0.0%	13.1	0.1 %	6,069 ha	158 %
North Pacific Montane Massive Bedrock, Cliff and Talus		29 ha	0.0%	14.9	0.2 %	18,742 ha	118 %
North Pacific Maritime Mesic Subalpine Parkland		51 ha	0.0%	10.5	0.1 %	46,402 ha	112 %
North Pacific Lowland Riparian Forest and Shrubland		16 ha	0.0%	8.7	0.1 %	17,205 ha	171 %
Montane composite		68 ha	0.1%	21.6	0.2 %	30,002 ha	123 %
Aggregate lower elevation		60 ha	0.0%	1.4	0.0 %	421,069 ha	138 %

Icy Creek Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Aggregate higher elevation		302 ha	0.0%	5.8	0.1 %	496,454 ha	135 %
Species							
Mammals							
Fisher *Martes pennanti*	G5	67 ha	0.0%		%	ha	%

Joffre

Site No 57

Northeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	46 %	BC Provincial:	100 %	US State:	0 %
Area:	500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	1,235	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
North Pacific Mountain Hemlock Forest		6 ha	0.0%	1.3	0.0 %	44,848 ha	127 %
Alpine composite		374 ha	1.4%	441.2	4.6 %	8,126 ha	110 %
Aggregate higher elevation		110 ha	0.0%	2.1	0.0 %	496,454 ha	135 %

Jordan Creek

Site No 58

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	2 %	GAP 1	0 %	BC Provincial:	0 %	US State:	17 %
Area:	1,000	ha	Developed	1 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	2,470	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	83 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		193 ha	0.0%	3.6	0.1 %	259,308 ha	165 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		90 ha	0.0%	5.5	0.1 %	78,777 ha	159 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		425 ha	0.2%	35.9	0.7 %	56,808 ha	131 %
North Pacific Lowland Riparian Forest and Shrubland		13 ha	0.0%	3.7	0.1 %	17,205 ha	171 %
Aggregate lower elevation		926 ha	0.1%	10.5	0.2 %	421,069 ha	138 %
Species							
Birds							
Vaux's swift *Chaetura vauxi*	G5	1 occ	7.1%	684.8	14.3 %	7 occ	171 %
Peregrine falcon *Falco peregrinus anatum*	G4T3	1 nst	2.4%	228.3	4.8 %	21 nst	198 %
Mammals							

Jordan Creek

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Fisher *Martes pennanti*	G5	266 ha	0.1%		%	ha	%

Klinger Ridge

Site No 59

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	93 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	0 %	US State:	0 %
Area:	2,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	4,940	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	7 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		804 ha	0.1%	7.4	0.3 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		113 ha	0.1%	6.1	0.3 %	44,848 ha	127 %
North Pacific Montane Massive Bedrock, Cliff and Talus		46 ha	0.1%	5.9	0.2 %	18,742 ha	118 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		87 ha	0.0%	2.6	0.1 %	78,777 ha	159 %
North Pacific Maritime Mesic Subalpine Parkland		25 ha	0.0%	1.3	0.1 %	46,402 ha	112 %
North Pacific Lowland Riparian Forest and Shrubland		20 ha	0.0%	2.8	0.1 %	17,205 ha	171 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		11 ha	0.0%	2.1	0.1 %	12,529 ha	127 %
Montane composite		357 ha	0.4%	28.5	1.2 %	30,002 ha	123 %
Aggregate lower elevation		997 ha	0.1%	5.7	0.2 %	421,069 ha	138 %

Klinger Ridge

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Aggregate higher elevation		533 ha	0.0 %	2.6	0.1 %	496,454 ha	135 %
Species							
Birds							
Northern spotted owl Nests *Strix occidentalis caurina*	G3T3	1 nst	0.3 %	14.2	0.6 %	169 nst	194 %
Mammals							
Fisher *Martes pennanti*	G5	693 ha	0.1 %		%	ha	%

Kunechin Point

Site No 60

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	1,235	ac	Open Water	6 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		25 ha	0.0%	0.9	0.0 %	259,308 ha	165 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		285 ha	0.1%	34.7	0.4 %	78,777 ha	159 %
Aggregate lower elevation		285 ha	0.0%	6.5	0.1 %	421,069 ha	138 %
Aggregate higher elevation		73 ha	0.0%	1.4	0.0 %	496,454 ha	135 %
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	74 ha	0.0%	6.0	0.1 %	119,141 ha	200 %

Lake Cavanaugh

Site No 61

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	0 %	US State:	64 %
Area:	4,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	9,880	ac	Open Water	8 %	GAP 3	1 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	36 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		454 ha	0.1%	2.1	0.2 %	259,308 ha	165 %
North Pacific Montane Massive Bedrock, Cliff and Talus		7 ha	0.0%	0.4	0.0 %	18,742 ha	118 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		162 ha	0.1%	2.5	0.2 %	78,777 ha	159 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		208 ha	0.1%	4.4	0.4 %	56,808 ha	131 %
North Pacific Lowland Riparian Forest and Shrubland		107 ha	0.2%	7.4	0.6 %	17,205 ha	171 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		28 ha	0.1%	2.7	0.2 %	12,529 ha	127 %
Montane composite		4 ha	0.0%	0.2	0.0 %	30,002 ha	123 %
Aggregate lower elevation		3,283 ha	0.2%	9.3	0.8 %	421,069 ha	138 %
Species							
Birds							

Lake Cavanaugh

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Northern goshawk *Accipiter gentilis laingi*	G5	4 occ	6.3%	149.8	12.5 %	32 occ	194 %
Marbled murrelet *Brachyramphus marmoratus*	G3G4	1 occ	0.9%	20.7	1.7 %	77 occ	194 %
Mammals							
Fisher *Martes pennanti*	G5	814 ha	0.2%		%	ha	%
Vascular Plants							
Water Lobelia *Lobelia dortmanna*	G4G5	1 occ	10.0%	239.7	20.0 %	5 occ	194 %

Lake Creek

Site No 62

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	100 %
			Agriculture	0 %	GAP 1	60 %	BC Provincial:	0 %	US State:	0 %
Area:	5,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	12,350	ac	Open Water	1 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland		322 ha	0.2%	6.5	0.7 %	47,698 ha	104 %
Old Growth Forest		1,884 ha	0.2%	7.0	0.7 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		121 ha	0.1%	2.6	0.3 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		60 ha	0.3%	9.5	1.0 %	6,069 ha	158 %
North Pacific Montane Massive Bedrock, Cliff and Talus		15 ha	0.0%	0.8	0.1 %	18,742 ha	118 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		1 ha	0.0%	0.0	0.0 %	78,777 ha	159 %
North Pacific Maritime Mesic Subalpine Parkland		153 ha	0.1%	3.2	0.3 %	46,402 ha	112 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		317 ha	0.2%	5.4	0.6 %	56,808 ha	131 %
North Pacific Lowland Riparian Forest and Shrubland		0 ha	0.0%	0.0	0.0 %	17,205 ha	171 %

Lake Creek

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		261 ha	0.6%	20.0	2.1 %	12,529 ha	127 %
Montane composite		69 ha	0.1%	2.2	0.2 %	30,002 ha	123 %
Aggregate lower elevation		2,080 ha	0.1%	4.7	0.5 %	421,069 ha	138 %
Aggregate higher elevation		2,179 ha	0.1%	4.2	0.4 %	496,454 ha	135 %
Species							
Birds							
Northern spotted owl Nests *Strix occidentalis caurina*	G3T3	1 nst	0.3%	5.7	0.6 %	169 nst	194 %
Mammals							
Fisher *Martes pennanti*	G5	1,033 ha	0.2%		%	ha	%

Lake Whatcom (WPG # 80)

Site No 63

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	1 %	GAP 1	0 %	BC Provincial:	0 %	US State:	49 %
Area:	11,500	ha	Developed	2 %	GAP 2	1 %	Can Indigenous:	0 %	US Local:	1 %
	28,405	ac	Open Water	16 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	50 %
									US NGO	1 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Aggregate lower elevation		8,212 ha	0.6%	8.1	2.0 %	421,069 ha	138 %
North Pacific Montane Massive Bedrock, Cliff and Talus		0 ha	0.0%	0.0	0.0 %	18,742 ha	118 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		128 ha	0.0%	0.7	0.2 %	78,777 ha	159 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		4,216 ha	2.2%	30.9	7.4 %	56,808 ha	131 %
North Pacific Lowland Riparian Forest and Shrubland		209 ha	0.4%	5.1	1.2 %	17,205 ha	171 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		27 ha	0.1%	0.9	0.2 %	12,529 ha	127 %
Montane composite		10 ha	0.0%	0.1	0.0 %	30,002 ha	123 %
Old Growth Forest		239 ha	0.0%	0.4	0.1 %	259,308 ha	165 %
Species							
Birds							

Lake Whatcom (WPG # 80)

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Common Loon *Gavia immer*	G5	1 nst	3.8%	32.1	7.7 %	13 nst	200 %
Bald eagle nests *Haliaeetus leucocephalus*	G5	4 nst	4.4%	151.6	36.4 %	11 nst	473 %
Marbled murrelet *Brachyramphus marmoratus*	G3G4	1 occ	0.7%	5.4	1.3 %	77 occ	194 %
Mammals							
Fisher *Martes pennanti*	G5	377 ha	0.1%		%	ha	%
Gray wolf *Canis lupus*	G4	0 occ	1.4%	11.5	2.8 %	12 occ	196 %
Roosevelt elk *Cervus canadensis*	G5T4	142 ha	0.1%	1.2	0.3 %	48,392 ha	147 %
Townsend's big-eared bat *Coryhorhinus townsendii*	G4	1 occ	8.3%	69.5	16.7 %	3 occ	200 %
Vascular Plants							
Water Lobelia *Lobelia dortmanna*	G4G5	2 occ	20.0%	166.7	40.0 %	5 occ	194 %

Lakes

Site No 64

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	29 %	BC Provincial:	99 %	US State:	0 %
Area:	9,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	23,465	ac	Open Water	13 %	GAP 3	0 %	Can Private:	1 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		233 ha	0.0%	0.5	0.1 %	259,308 ha	165 %
North Pacific Mesic Western Hemlock - Silver fir Forest		48 ha	0.2%	3.4	0.7 %	7,191 ha	207 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		6,562 ha	2.5%	42.0	8.3 %	78,777 ha	159 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		297 ha	0.2%	2.6	0.5 %	56,808 ha	131 %
North Pacific Lowland Riparian Forest and Shrubland		87 ha	0.2%	2.6	0.5 %	17,205 ha	171 %
Aggregate lower elevation		6,859 ha	0.5%	8.2	1.6 %	421,069 ha	138 %
Aggregate higher elevation		896 ha	0.1%	0.9	0.2 %	496,454 ha	135 %
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	605 ha	0.2%	2.6	0.5 %	119,141 ha	200 %

Lakes

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Mammals							
Mountain goat *Oreamos americanus*	G5	576 ha	0.1%	1.5	0.3%	189,856 ha	135 %

Lillooet Lake

Site No 65

Northeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	99 %	US State:	0 %
Area:	7,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	17,290	ac	Open Water	7 %	GAP 3	0 %	Can Private:	1 %	US Indigenous:	0 %
					GAP 4	1 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland		109 ha	0.1%	1.6	0.2 %	47,698 ha	104 %
Old Growth Forest		474 ha	0.1%	1.3	0.2 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		299 ha	0.2%	4.6	0.7 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		2 ha	0.0%	0.2	0.0 %	6,069 ha	158 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		258 ha	0.1%	2.2	0.3 %	78,777 ha	159 %
North Pacific Maritime Mesic Subalpine Parkland		10 ha	0.0%	0.2	0.0 %	46,402 ha	112 %
North Pacific Lowland Riparian Forest and Shrubland		41 ha	0.1%	1.6	0.2 %	17,205 ha	171 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		117 ha	0.3%	6.4	0.9 %	12,529 ha	127 %
East Cascades Mesic Montane Mixed Conifer Forest		737 ha	1.5%	35.1	5.1 %	14,376 ha	116 %

Lillooet Lake

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Aggregate lower elevation		3,970 ha	0.3%	6.5	0.9 %	421,069 ha	138 %
Aggregate higher elevation		1,603 ha	0.1%	2.2	0.3 %	496,454 ha	135 %
Species							
Birds							
Northern spotted owl Nests *Strix occidentalis caurina*	G3T3	3 nst	0.9%	12.2	1.8 %	169 nst	194 %
Northern spotted owl *Strix occidentalis caurina*	G3T3	1 occ	1.2%	22.7	3.3 %	25 occ	204 %
Mammals							
Mountain goat *Oreamos americanus*	G5	402 ha	0.1%	1.5	0.2 %	189,856 ha	135 %
Vascular Plants							
Washington Springbeauty *Claytonia washingtoniana*	G2G4	1 occ	50.0%	684.8	100.0 %	1 occ	200 %

Lois - Khartoume

Site No 66

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	99 %	US State:	0 %
Area:	7,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	17,290	ac	Open Water	6 %	GAP 3	0 %	Can Private:	1 %	US Indigenous:	0 %
					GAP 4	1 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		766 ha	0.1%	2.0	0.3 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		129 ha	0.1%	2.0	0.3 %	44,848 ha	127 %
North Pacific Montane Massive Bedrock, Cliff and Talus		17 ha	0.0%	0.6	0.1 %	18,742 ha	118 %
North Pacific Mesic Western Hemlock - Silver fir Forest		241 ha	1.0%	23.0	3.4 %	7,191 ha	207 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		2,651 ha	1.0%	23.0	3.4 %	78,777 ha	159 %
North Pacific Lowland Riparian Forest and Shrubland		48 ha	0.1%	1.9	0.3 %	17,205 ha	171 %
Aggregate lower elevation		2,651 ha	0.2%	4.3	0.6 %	421,069 ha	138 %
Aggregate higher elevation		2,131 ha	0.1%	2.9	0.4 %	496,454 ha	135 %
Species							
Birds							

Lois - Khartoume

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	1,456 ha	0.5%	8.4	1.2 %	119,141 ha	200 %
Mammals							
Mountain goat *Oreamos americanus*	G5	2,166 ha	0.3%	7.8	1.1 %	189,856 ha	135 %

Lower Stillaguamish

Site No 67

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	15 %	GAP 1	0 %	BC Provincial:	0 %	US State:	46 %
Area:	4,500	ha	Developed	1 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	2 %
	11,115	ac	Open Water	2 %	GAP 3	2 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	52 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		411 ha	0.0%	1.7	0.2 %	259,308 ha	165 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		97 ha	0.0%	1.3	0.1 %	78,777 ha	159 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		1,491 ha	0.8%	28.0	2.6 %	56,808 ha	131 %
North Pacific Lowland Riparian Forest and Shrubland		153 ha	0.3%	9.5	0.9 %	17,205 ha	171 %
Montane composite		13 ha	0.0%	0.5	0.0 %	30,002 ha	123 %
Aggregate lower elevation		3,422 ha	0.2%	8.7	0.8 %	421,069 ha	138 %
Species							
Birds							
Bald eagle roosts *Haliaeetus leucocephalus*	G5	1 rst	1.2%	103.0	9.7 %	9 rst	472 %
Mammals							

Lower Stillaguamish

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Fisher *Martes pennanti*	G5	661 ha	0.1%		%	ha	%

Lumchen Mountain

Site No 68

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	18 %
			Agriculture	0 %	GAP 1	55 %	BC Provincial:	82 %	US State:	0 %
Area:	3,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	7,410	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		1,117 ha	0.1%	6.9	0.4 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		321 ha	0.2%	11.4	0.7 %	44,848 ha	127 %
North Pacific Montane Massive Bedrock, Cliff and Talus		8 ha	0.0%	0.7	0.0 %	18,742 ha	118 %
North Pacific Mesic Western Hemlock - Silver fir Forest		22 ha	0.1%	5.0	0.3 %	7,191 ha	207 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		30 ha	0.0%	0.6	0.0 %	78,777 ha	159 %
North Pacific Maritime Mesic Subalpine Parkland		73 ha	0.0%	2.5	0.2 %	46,402 ha	112 %
North Pacific Lowland Riparian Forest and Shrubland		1 ha	0.0%	0.1	0.0 %	17,205 ha	171 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		6 ha	0.0%	0.8	0.0 %	12,529 ha	127 %
Montane composite		6 ha	0.0%	0.3	0.0 %	30,002 ha	123 %

Lumchen Mountain

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Aggregate lower elevation		442 ha	0.0%	1.7	0.1 %	421,069 ha	138 %
Aggregate higher elevation		2,265 ha	0.1%	7.3	0.5 %	496,454 ha	135 %
Species							
Mammals							
Fisher *Martes pennanti*	G5	6 ha	0.0%		%	ha	%
Vascular Plants							
Alpine Anemone *Anemone drummondii var. drummondii*	G4T4	1 occ	16.7%	532.6	33.3 %	3 occ	200 %
Other Ecological Features							
Karst SM		1,597 ha	1.8%	187.8	11.8 %	13,584 ha	233 %
Karst PH		145 ha	2.4%	96.5	6.0 %	2,404 ha	201 %

Mamquam

Site No 69

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	39 %	BC Provincial:	94 %	US State:	0 %
Area:	8,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	19,760	ac	Open Water	0 %	GAP 3	0 %	Can Private:	6 %	US Indigenous:	0 %
					GAP 4	4 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		680 ha	0.1%	1.6	0.3 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		220 ha	0.1%	2.9	0.5 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		33 ha	0.2%	3.2	0.5 %	6,069 ha	158 %
North Pacific Mesic Western Hemlock - Silver fir Forest		23 ha	0.1%	1.9	0.3 %	7,191 ha	207 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		2,879 ha	1.1%	21.9	3.7 %	78,777 ha	159 %
North Pacific Lowland Riparian Forest and Shrubland		48 ha	0.1%	1.7	0.3 %	17,205 ha	171 %
Aggregate lower elevation		2,879 ha	0.2%	4.1	0.7 %	421,069 ha	138 %
Aggregate higher elevation		4,211 ha	0.3%	5.1	0.8 %	496,454 ha	135 %
Species							
Birds							

Mamquam

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	346 ha	0.1%	1.7	0.3%	119,141 ha	200 %
Mammals							
Mountain goat *Oreamos americanus*	G5	0 ha	0.0%	0.0	0.0%	189,856 ha	135 %
Vascular Plants							
Nodding Semaphoregrass *Pleuropogon refractus*	G4	2 occ	20.0%	239.7	40.0%	5 occ	200 %

Marble Creek

Site No 70

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	10 %
			Agriculture	2 %	GAP 1	4 %	BC Provincial:	0 %	US State:	34 %
Area:	3,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	2 %
	8,645	ac	Open Water	1 %	GAP 3	3 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	55 %
									US NGO	1 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		686 ha	0.1%	3.6	0.3 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		106 ha	0.1%	3.2	0.2 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		3 ha	0.0%	0.8	0.1 %	6,069 ha	158 %
North Pacific Montane Massive Bedrock, Cliff and Talus		87 ha	0.1%	6.4	0.5 %	18,742 ha	118 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		60 ha	0.0%	1.0	0.1 %	78,777 ha	159 %
North Pacific Maritime Mesic Subalpine Parkland		6 ha	0.0%	0.2	0.0 %	46,402 ha	112 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		640 ha	0.3%	15.4	1.1 %	56,808 ha	131 %
North Pacific Lowland Riparian Forest and Shrubland		211 ha	0.4%	16.8	1.2 %	17,205 ha	171 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		10 ha	0.0%	1.1	0.1 %	12,529 ha	127 %

Marble Creek

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Montane composite		96 ha	0.1 %	4.4	0.3 %	30,002 ha	123 %
Aggregate lower elevation		2,329 ha	0.2 %	7.6	0.6 %	421,069 ha	138 %
Aggregate higher elevation		275 ha	0.0 %	0.8	0.1 %	496,454 ha	135 %
Species							
Mammals							
Fisher *Martes pennanti*	G5	948 ha	0.2 %		%	ha	%

McNab

Site No 71

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	6,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	14,820	ac	Open Water	9 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		587 ha	0.1%	1.8	0.2 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		256 ha	0.2%	4.6	0.6 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		4 ha	0.0%	0.5	0.1 %	6,069 ha	158 %
North Pacific Montane Massive Bedrock, Cliff and Talus		106 ha	0.2%	4.5	0.6 %	18,742 ha	118 %
North Pacific Mesic Western Hemlock - Silver fir Forest		84 ha	0.4%	9.4	1.2 %	7,191 ha	207 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		967 ha	0.4%	9.8	1.2 %	78,777 ha	159 %
North Pacific Lowland Riparian Forest and Shrubland		3 ha	0.0%	0.1	0.0 %	17,205 ha	171 %
Montane composite		175 ha	0.2%	4.7	0.6 %	30,002 ha	123 %
Aggregate lower elevation		967 ha	0.1%	1.8	0.2 %	421,069 ha	138 %

McNab

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Aggregate higher elevation		3,059 ha	0.2%	4.9	0.6 %	496,454 ha	135 %
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	961 ha	0.3%	6.4	0.8 %	119,141 ha	200 %
Mammals							
Mountain goat *Oreamos americanus*	G5	1,204 ha	0.2%	5.1	0.6 %	189,856 ha	135 %

Mill Creek

Site No 72

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	99 %	US State:	0 %
Area:	6,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	14,820	ac	Open Water	1 %	GAP 3	0 %	Can Private:	1 %	US Indigenous:	0 %
					GAP 4	1 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		3,680 ha	0.4%	11.3	1.4 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		498 ha	0.3%	8.9	1.1 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		30 ha	0.2%	4.0	0.5 %	6,069 ha	158 %
North Pacific Mesic Western Hemlock - Silver fir Forest		140 ha	0.6%	15.5	1.9 %	7,191 ha	207 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		256 ha	0.1%	2.6	0.3 %	78,777 ha	159 %
Aggregate lower elevation		256 ha	0.0%	0.5	0.1 %	421,069 ha	138 %
Aggregate higher elevation		5,282 ha	0.3%	8.5	1.1 %	496,454 ha	135 %
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	1,419 ha	0.5%	9.5	1.2 %	119,141 ha	200 %

Mill Creek

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Mammals							
Mountain goat *Oreamos americanus*	G5	219 ha	0.0%	0.9	0.1 %	189,856 ha	135 %

Miller River

Site No 73

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	93 %
			Agriculture	0 %	GAP 1	59 %	BC Provincial:	0 %	US State:	0 %
Area:	3,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	8,645	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	7 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
North Pacific Lowland Riparian Forest and Shrubland		96 ha	0.2%	7.6	0.6 %	17,205 ha	171 %
Aggregate higher elevation		2,234 ha	0.1%	6.2	0.4 %	496,454 ha	135 %
Montane composite		293 ha	0.3%	13.4	1.0 %	30,002 ha	123 %
Old Growth Forest		1,791 ha	0.2%	9.5	0.7 %	259,308 ha	165 %
North Pacific Maritime Mesic Subalpine Parkland		41 ha	0.0%	1.2	0.1 %	46,402 ha	112 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		121 ha	0.0%	2.1	0.2 %	78,777 ha	159 %
North Pacific Mesic Western Hemlock - Silver fir Forest		84 ha	0.3%	16.0	1.2 %	7,191 ha	207 %
North Pacific Montane Massive Bedrock, Cliff and Talus		60 ha	0.1%	4.4	0.3 %	18,742 ha	118 %
North Pacific Montane Riparian Woodland and Shrubland		16 ha	0.1%	3.5	0.3 %	6,069 ha	158 %

Miller River

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Mountain Hemlock Forest		165 ha	0.1%	5.0	0.4 %	44,848 ha	127 %
Aggregate lower elevation		775 ha	0.1%	2.5	0.2 %	421,069 ha	138 %
<u>Species</u>							
<u>Birds</u>							
Northern goshawk *Accipiter gentilis laingi*	G5	1 occ	1.6%	42.8	3.1 %	32 occ	194 %
Red breasted sapsucker *Sphyrapicus ruber*	G5	1 occ	2.5%	68.5	5.0 %	10 occ	199 %
Northern spotted owl Nests *Strix occidentalis caurina*	G3T3	1 nst	0.3%	8.1	0.6 %	169 nst	194 %
<u>Mammals</u>							
Mountain goat *Oreamos americanus*	G5	5 ha	0.0%	0.0	0.0 %	189,856 ha	135 %
Fisher *Martes pennanti*	G5	1,166 ha	0.2%		%	ha	%
<u>Vascular Plants</u>							
Treelike Clubmoss *Lycopodium dendroideum*	G5	1 occ	3.8%	195.7	14.3 %	7 occ	286 %

Misty

Site No 74

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	1,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	2,470	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		389 ha	0.0%	7.2	0.2 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		36 ha	0.0%	3.9	0.1 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		16 ha	0.1%	12.8	0.3 %	6,069 ha	158 %
North Pacific Mesic Western Hemlock - Silver fir Forest		25 ha	0.1%	16.8	0.4 %	7,191 ha	207 %
Aggregate higher elevation		919 ha	0.1%	8.9	0.2 %	496,454 ha	135 %
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	190 ha	0.1%	7.6	0.2 %	119,141 ha	200 %
Mammals							
Mountain goat *Oreamos americanus*	G5	7 ha	0.0%	0.2	0.0 %	189,856 ha	135 %

Misty

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio

Mount Baker

Site No 75

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	94 %
			Agriculture	0 %	GAP 1	81 %	BC Provincial:	0 %	US State:	3 %
Area:	38,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	93,860	ac	Open Water	3 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	3 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
North Pacific Lowland Riparian Forest and Shrubland		438 ha	0.8%	3.2	2.5 %	17,205 ha	171 %
Aggregate higher elevation		16,684 ha	1.0%	4.2	3.4 %	496,454 ha	135 %
Aggregate lower elevation		12,034 ha	0.9%	3.6	2.9 %	421,069 ha	138 %
Alpine composite		41 ha	0.1%	0.6	0.5 %	8,126 ha	110 %
Old Growth Forest		6,677 ha	0.8%	3.2	2.6 %	259,308 ha	165 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		915 ha	2.2%	9.2	7.3 %	12,529 ha	127 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		1,322 ha	0.7%	2.9	2.3 %	56,808 ha	131 %
North Pacific Maritime Mesic Subalpine Parkland		3,098 ha	2.0%	8.4	6.7 %	46,402 ha	112 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		517 ha	0.2%	0.8	0.7 %	78,777 ha	159 %

Mount Baker

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Mesic Western Hemlock - Silver fir Forest		65 ha	0.3%	1.1	0.9 %	7,191 ha	207 %
North Pacific Montane Massive Bedrock, Cliff and Talus		2,532 ha	4.1%	17.0	13.5 %	18,742 ha	118 %
North Pacific Montane Riparian Woodland and Shrubland		233 ha	1.2%	4.9	3.8 %	6,069 ha	158 %
North Pacific Mountain Hemlock Forest		1,208 ha	0.8%	3.4	2.7 %	44,848 ha	127 %
Montane composite		1,840 ha	1.8%	7.7	6.1 %	30,002 ha	123 %
<u>Species</u>							
<u>Amphibians</u>							
Western toad ts *Bufo boreas*	G4	1 occ	3.9%	18.0	14.3 %	7 occ	256 %
<u>Birds</u>							
Vaux's swift *Chaetura vauxi*	G5	1 occ	7.1%	18.0	14.3 %	7 occ	171 %
White-tailed ptarmigan *Lagopus leucurus*	G5	1 occ	12.4%	31.2	24.8 %	4 occ	200 %
Northern spotted owl *Strix occidentalis caurina*	G3T3	1 occ	1.5%	5.0	4.0 %	25 occ	204 %
Northern goshawk *Accipiter gentilis laingi*	G5	1 occ	1.6%	3.9	3.1 %	32 occ	194 %
Marbled murrelet *Brachyramphus marmoratus*	G3G4	3 occ	2.3%	5.7	4.5 %	77 occ	194 %
Northern spotted owl Nests *Strix occidentalis caurina*	G3T3	2 nst	0.6%	1.5	1.2 %	169 nst	194 %
Golden Eagle *Aquila chrysaetos*	G5	3 nst	7.9%	19.9	15.8 %	19 nst	189 %
Harlequin duck *Histrionicus histrionicus*	G4	2 occ	3.0%	16.9	13.4 %	13 occ	253 %
<u>Insects</u>							
common branded skipper *Hesperia comma*	G5	1 occ	16.7%	42.0	33.3 %	3 occ	200 %
Arctic blue *Plebejus glandon*	G5	1 occ	12.5%	31.5	25.0 %	4 occ	200 %
<u>Mammals</u>							
Wolverine *Gulo gulo*	G4	1 occ	10.0%	25.2	20.0 %	5 occ	198 %

Mount Baker

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Roosevelt elk *Cervus canadensis*	G5T4	2,879 ha	1.8%	7.5	5.9 %	48,392 ha	147 %
Mountain goat *Oreamos americanus*	G5	5,995 ha	0.9%	4.0	3.2 %	189,856 ha	135 %
Gray wolf *Canis lupus*	G4	0 occ	0.6%	1.5	1.2 %	12 occ	196 %
Fisher *Martes pennanti*	G5	7,148 ha	1.4%		%	ha	%
Vascular Plants							
Few-flowered Sedge *Carex pauciflora*	G5	1 occ	5.7%	18.0	14.3 %	7 occ	229 %
Black Lily *Fritillaria camschatcensis*	G5	1 occ	4.5%	18.0	14.3 %	7 occ	302 %
Several-flowered Sedge *Carex pluriflora*	G4	1 occ	14.8%	37.4	29.7 %	3 occ	193 %
Thompson's Chaenactis *Chaenactis thompsonii*	G2G3	1 occ	42.0%	106.0	84.0 %	1 occ	168 %
Treelike Clubmoss *Lycopodium dendroideum*	G5	1 occ	3.8%	18.0	14.3 %	7 occ	286 %
Triangular-lobed Moonwort *Botrychium ascendens*	G2G3	2 occ	23.0%	58.0	46.0 %	4 occ	200 %
Arctic Aster *Aster sibiricus var. meritus*	G5T5	1 occ	16.7%	42.0	33.3 %	3 occ	200 %
Plant Communities							
Carex pellita (=C. lanuginosa) Herbaceous Vegetation Community *Carex pellita (=C. lanuginosa) Herbaceous Vegetation*	G3	19 ha	50.0%	123.4	97.8 %	19 ha	196 %

Mount Bard

Site No 76

Northeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	1,235	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		33 ha	0.0%	1.2	0.0 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		109 ha	0.1%	23.3	0.2 %	44,848 ha	127 %
Aggregate lower elevation		2 ha	0.0%	0.0	0.0 %	421,069 ha	138 %
Aggregate higher elevation		498 ha	0.0%	9.6	0.1 %	496,454 ha	135 %

Mount Index

Site No 77

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	97 %
			Agriculture	0 %	GAP 1	50 %	BC Provincial:	0 %	US State:	0 %
Area:	2,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	4,940	ac	Open Water	1 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	3 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Montane composite		182 ha	0.2%	14.6	0.6 %	30,002 ha	123 %
Aggregate lower elevation		253 ha	0.0%	1.4	0.1 %	421,069 ha	138 %
Old Growth Forest		563 ha	0.1%	5.2	0.2 %	259,308 ha	165 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		17 ha	0.0%	0.7	0.0 %	56,808 ha	131 %
North Pacific Maritime Mesic Subalpine Parkland		235 ha	0.2%	12.2	0.5 %	46,402 ha	112 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		9 ha	0.0%	0.3	0.0 %	78,777 ha	159 %
North Pacific Mesic Western Hemlock - Silver fir Forest		13 ha	0.1%	4.4	0.2 %	7,191 ha	207 %
North Pacific Montane Massive Bedrock, Cliff and Talus		142 ha	0.2%	18.1	0.8 %	18,742 ha	118 %
North Pacific Mountain Hemlock Forest		199 ha	0.1%	10.6	0.4 %	44,848 ha	127 %

Mount Index

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Aggregate higher elevation		1,358 ha	0.1%	6.6	0.3 %	496,454 ha	135 %
Species							
Mammals							
Fisher *Martes pennanti*	G5	315 ha	0.1%		%	ha	%
Mountain goat *Oreamos americanus*	G5	488 ha	0.1%	6.2	0.3 %	189,856 ha	135 %
Vascular Plants							
Treelike Clubmoss *Lycopodium dendroideum*	G5	1 occ	3.8%	342.4	14.3 %	7 occ	286 %
Cooley's Buttercup *Ranunculus cooleyae*	G4	1 occ	16.7%	798.9	33.3 %	3 occ	200 %
Choris' Bog-orchid *Platanthera chorisiana*	G3G4	1 occ	7.1%	342.4	14.3 %	7 occ	171 %
Alaska Harebell *Campanula lasiocarpa*	G5	1 occ	7.1%	342.4	14.3 %	7 occ	194 %

Mount McGuire

Site No 78

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	1 %	GAP 1	0 %	BC Provincial:	96 %	US State:	0 %
Area:	11,000	ha	Developed	1 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	27,170	ac	Open Water	0 %	GAP 3	0 %	Can Private:	4 %	US Indigenous:	0 %
					GAP 4	3 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Aggregate lower elevation		5,490 ha	0.4%	5.7	1.3 %	421,069 ha	138 %
Old Growth Forest		1,046 ha	0.1%	1.8	0.4 %	259,308 ha	165 %
Aggregate higher elevation		2,929 ha	0.2%	2.6	0.6 %	496,454 ha	135 %
Montane composite		224 ha	0.2%	3.3	0.7 %	30,002 ha	123 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		37 ha	0.1%	1.3	0.3 %	12,529 ha	127 %
North Pacific Lowland Riparian Forest and Shrubland		98 ha	0.2%	2.5	0.6 %	17,205 ha	171 %
North Pacific Maritime Mesic Subalpine Parkland		1 ha	0.0%	0.0	0.0 %	46,402 ha	112 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		654 ha	0.2%	3.6	0.8 %	78,777 ha	159 %
North Pacific Mesic Western Hemlock - Silver fir Forest		99 ha	0.4%	6.0	1.4 %	7,191 ha	207 %

Mount McGuire

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Montane Riparian Woodland and Shrubland		12 ha	0.1%	0.8	0.2 %	6,069 ha	158 %
North Pacific Mountain Hemlock Forest		444 ha	0.3%	4.3	1.0 %	44,848 ha	127 %
Species							
Mammals							
Mtn beaver rufa *Aplodontia rufa rufa*	G5T4?	2 occ	7.7%	66.7	15.3 %	13 occ	200 %
Trowbridge's shrew *Sorex trowbridgii*	G5	1 occ	12.5%	107.9	24.8 %	4 occ	199 %
Mountain goat *Oreamos americanus*	G5	1,151 ha	0.2%	2.6	0.6 %	189,856 ha	135 %
Mollusks							
Oregon Forestsnail *Allogona townsendiana*	G3G4	1 occ	5.6%	48.4	11.1 %	9 occ	200 %
Conical Spot *Punctum randolphii*	G4	1 occ	2.6%	33.5	7.7 %	13 occ	231 %
Western thorn *Carychium occidentale*	G3G4	1 occ	50.0%	435.8	100.0 %	1 occ	200 %
Western Flat whorl *Planogyra clappi*	G3G4	1 occ	8.3%	72.6	16.7 %	6 occ	200 %
Pygmy Oregonian *Cryptomastix germana*	G3G4	1 occ	12.5%	108.9	25.0 %	4 occ	200 %
Vascular Plants							
Short-fruited Smelowskia *Smelowskia ovalis*	G5	1 occ	10.0%	87.2	20.0 %	5 occ	200 %
Alpine Anemone *Anemone drummondii var. drummondii*	G4T4	1 occ	16.7%	145.3	33.3 %	3 occ	200 %
Leafy Mitrewort *Mitella caulescens*	G5	1 occ	50.0%	435.8	100.0 %	1 occ	200 %
Tall Bugbane *Cimicifuga elata*	G2	1 occ	3.7%	33.5	7.7 %	13 occ	169 %
Cascade Parsley Fern *Cryptogramma cascadensis*	G5	1 occ	11.1%	77.6	17.8 %	5 occ	156 %
Other Ecological Features							
Karst PH		863 ha	14.4%	156.4	35.9 %	2,404 ha	201 %
Karst SM		6,540 ha	7.2%	209.8	48.1 %	13,584 ha	233 %

Mount McGuire

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio

Mount Outram

Site No 79

Southeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	1,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	2,470	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland		226 ha	0.1%	22.7	0.5 %	47,698 ha	104 %
Old Growth Forest		57 ha	0.0%	1.1	0.0 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		2 ha	0.0%	0.3	0.0 %	44,848 ha	127 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		12 ha	0.0%	4.7	0.1 %	12,529 ha	127 %
Montane composite		187 ha	0.2%	29.9	0.6 %	30,002 ha	123 %
Alpine composite		83 ha	0.3%	49.1	1.0 %	8,126 ha	110 %
Aggregate lower elevation		219 ha	0.0%	2.5	0.1 %	421,069 ha	138 %
Aggregate higher elevation		284 ha	0.0%	2.7	0.1 %	496,454 ha	135 %
Species							
Mammals							

Mount Outram

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Mtn beaver rainieri *Aplodontia rufa rainieri*	G5T4	5 occ	8.0%	1,777.3	37.1 %	13 occ	199 %
Mountain goat *Oreamos americanus*	G5	291 ha	0.0%	7.3	0.2 %	189,856 ha	135 %

Mount Woodside

Site No 80

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	37 %	GAP 1	0 %	BC Provincial:	86 %	US State:	0 %
Area:	1,500	ha	Developed	1 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	3,705	ac	Open Water	23 %	GAP 3	0 %	Can Private:	14 %	US Indigenous:	0 %
					GAP 4	14 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		329 ha	0.1%	13.4	0.4 %	78,777 ha	159 %
North Pacific Lowland Riparian Forest and Shrubland		193 ha	0.3%	35.9	1.1 %	17,205 ha	171 %
Aggregate lower elevation		329 ha	0.0%	2.5	0.1 %	421,069 ha	138 %
Species							
Birds							
Bald eagle roosts *Haliaeetus leucocephalus*	G5	1 rst	1.4%	355.1	11.1 %	9 rst	472 %
Mollusks							
Oregon Forestsnail *Allogona townsendiana*	G3G4	1 occ	5.6%	355.1	11.1 %	9 occ	200 %
Other Ecological Features							
Karst SM		91 ha	0.1%	21.3	0.7 %	13,584 ha	233 %

Mount Woodside							
Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio

Mountain View

Site No 81

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	18 %	GAP 1	0 %	BC Provincial:	0 %	US State:	0 %
Area:	500	ha	Developed	1 %	GAP 2	11 %	Can Indigenous:	0 %	US Local:	0 %
	1,235	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	89 %
									US NGO	11 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		0 ha	0.0%	0.0	0.0 %	259,308 ha	165 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		0 ha	0.0%	0.0	0.0 %	78,777 ha	159 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		224 ha	0.1%	37.9	0.4 %	56,808 ha	131 %
North Pacific Lowland Riparian Forest and Shrubland		29 ha	0.1%	16.3	0.2 %	17,205 ha	171 %
Montane composite		0 ha	0.0%	0.0	0.0 %	30,002 ha	123 %
Aggregate lower elevation		339 ha	0.0%	7.7	0.1 %	421,069 ha	138 %
Species							
Mammals							
Gray wolf *Canis lupus*	G4	0 occ	1.4%	263.6	2.8 %	12 occ	196 %

Nahatlatch

Site No 82

Northeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	1,235	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		65 ha	0.0%	2.4	0.0 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		20 ha	0.0%	4.3	0.0 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		1 ha	0.0%	1.4	0.0 %	6,069 ha	158 %
North Pacific Maritime Mesic Subalpine Parkland		29 ha	0.0%	6.0	0.1 %	46,402 ha	112 %
Montane composite		4 ha	0.0%	1.4	0.0 %	30,002 ha	123 %
Alpine composite		102 ha	0.4%	120.3	1.3 %	8,126 ha	110 %
Aggregate higher elevation		373 ha	0.0%	7.2	0.1 %	496,454 ha	135 %
Freshwater							
Species							
Fishes							

Nahatlatch

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Coho Salmon *Oncorhynchus kisutch*	G4	1 km	0.1%	0.1	0.2 %	792 km	132 %
Bull Trout *Salvelinus confluentus*	G3	1 km	0.2%	0.3	0.5 %	292 km	106 %
<u>Freshwater Ecological Systems</u>							
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow b		28,976 ha	17.6%	40.8	58.7 %	49,361 ha	72 %

Narrows Inlet

Site No 83

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	99 %	US State:	0 %
Area:	2,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	6,175	ac	Open Water	13 %	GAP 3	0 %	Can Private:	1 %	US Indigenous:	0 %
					GAP 4	1 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		346 ha	0.0%	2.6	0.1 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		40 ha	0.0%	1.7	0.1 %	44,848 ha	127 %
North Pacific Mesic Western Hemlock - Silver fir Forest		145 ha	0.6%	38.7	2.0 %	7,191 ha	207 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		1,062 ha	0.4%	25.8	1.3 %	78,777 ha	159 %
North Pacific Lowland Riparian Forest and Shrubland		15 ha	0.0%	1.7	0.1 %	17,205 ha	171 %
Aggregate lower elevation		1,062 ha	0.1%	4.8	0.3 %	421,069 ha	138 %
Aggregate higher elevation		954 ha	0.1%	3.7	0.2 %	496,454 ha	135 %
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	377 ha	0.1%	6.1	0.3 %	119,141 ha	200 %

Narrows Inlet

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Mammals							
Mountain goat *Oreamos americanus*	G5	85 ha	0.0%	0.9	0.0 %	189,856 ha	135 %

Nelson Island

Site No 84

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	94 %	US State:	0 %
Area:	2,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	4,940	ac	Open Water	23 %	GAP 3	0 %	Can Private:	6 %	US Indigenous:	0 %
					GAP 4	3 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		21 ha	0.0%	0.2	0.0 %	259,308 ha	165 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		1,464 ha	0.6%	44.5	1.9 %	78,777 ha	159 %
North Pacific Lowland Riparian Forest and Shrubland		3 ha	0.0%	0.4	0.0 %	17,205 ha	171 %
Aggregate lower elevation		1,464 ha	0.1%	8.3	0.3 %	421,069 ha	138 %
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	314 ha	0.1%	6.3	0.3 %	119,141 ha	200 %

Nicomen Slough

Site No 85

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	53 %	GAP 1	0 %	BC Provincial:	21 %	US State:	0 %
Area:	5,000	ha	Developed	8 %	GAP 2	3 %	Can Indigenous:	13 %	US Local:	0 %
	12,350	ac	Open Water	18 %	GAP 3	0 %	Can Private:	66 %	US Indigenous:	0 %
					GAP 4	79 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		0 ha	0.0%	0.0	0.0 %	259,308 ha	165 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		580 ha	0.2%	7.1	0.7 %	78,777 ha	159 %
North Pacific Lowland Riparian Forest and Shrubland		625 ha	1.1%	34.8	3.6 %	17,205 ha	171 %
Aggregate lower elevation		580 ha	0.0%	1.3	0.1 %	421,069 ha	138 %
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	3 ha	0.0%	0.0	0.0 %	119,141 ha	200 %
Great blue heron *Ardia herodius fannini*	G5T4	1 occ	4.2%	79.9	8.3 %	12 occ	200 %
Mollusks							
Oregon Forestsnail *Allogona townsendiana*	G3G4	1 occ	5.6%	106.5	11.1 %	9 occ	200 %

Nicomen Slough

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Conical Spot *Punctum randolphii*	G4	1 occ	2.6%	73.7	7.7%	13 occ	231 %

Noisy - Diobsud

Site No 86

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	88 %
			Agriculture	0 %	GAP 1	43 %	BC Provincial:	0 %	US State:	5 %
Area:	17,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	41,990	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	7 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		250 ha	0.6%	5.6	2.0 %	12,529 ha	127 %
Aggregate higher elevation		4,802 ha	0.3%	2.7	1.0 %	496,454 ha	135 %
Montane composite		944 ha	0.9%	8.9	3.1 %	30,002 ha	123 %
Old Growth Forest		6,626 ha	0.8%	7.2	2.6 %	259,308 ha	165 %
North Pacific Lowland Riparian Forest and Shrubland		300 ha	0.5%	4.9	1.7 %	17,205 ha	171 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		1,875 ha	1.0%	9.3	3.3 %	56,808 ha	131 %
North Pacific Maritime Mesic Subalpine Parkland		479 ha	0.3%	2.9	1.0 %	46,402 ha	112 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		249 ha	0.1%	0.9	0.3 %	78,777 ha	159 %
North Pacific Montane Massive Bedrock, Cliff and Talus		42 ha	0.1%	0.6	0.2 %	18,742 ha	118 %

Noisy - Diobsud

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Montane Riparian Woodland and Shrubland		48 ha	0.2%	2.2	0.8 %	6,069 ha	158 %
North Pacific Mountain Hemlock Forest		570 ha	0.4%	3.6	1.3 %	44,848 ha	127 %
Aggregate lower elevation		10,270 ha	0.7%	6.9	2.4 %	421,069 ha	138 %
Species							
Birds							
Bald eagle roosts *Haliaeetus leucocephalus*	G5	1 rst	1.5%	33.5	11.9 %	9 rst	472 %
Peregrine falcon *Falco peregrinus anatum*	G4T3	1 nst	2.4%	13.4	4.8 %	21 nst	198 %
Northern spotted owl Nests *Strix occidentalis caurina*	G3T3	1 nst	0.3%	1.7	0.6 %	169 nst	194 %
Marbled murrelet *Brachyramphus marmoratus*	G3G4	1 occ	0.7%	3.7	1.3 %	77 occ	194 %
Harlequin duck *Histrionicus histrionicus*	G4	1 occ	1.7%	21.7	7.7 %	13 occ	253 %
Mammals							
Gray wolf *Canis lupus*	G4	0 occ	0.8%	4.7	1.7 %	12 occ	196 %
Fisher *Martes pennanti*	G5	6,156 ha	1.2%		%	ha	%

North Shore Complex

Site No 87

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	44 %	BC Provincial:	95 %	US State:	0 %
Area:	204,000	ha	Developed	0 %	GAP 2	2 %	Can Indigenous:	0 %	US Local:	0 %
	503,879	ac	Open Water	4 %	GAP 3	0 %	Can Private:	3 %	US Indigenous:	0 %
					GAP 4	2 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Aggregate lower elevation		11,016 ha	0.8%	0.6	2.6 %	421,069 ha	138 %
Aggregate higher elevation		130,635 ha	7.9%	6.2	26.3 %	496,454 ha	135 %
Old Growth Forest		98,242 ha	11.4%	8.9	37.9 %	259,308 ha	165 %
Alpine composite		321 ha	1.2%	0.9	3.9 %	8,126 ha	110 %
Montane composite		411 ha	0.4%	0.3	1.4 %	30,002 ha	123 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		17 ha	0.0%	0.0	0.1 %	12,529 ha	127 %
North Pacific Lowland Riparian Forest and Shrubland		1,076 ha	1.9%	1.5	6.3 %	17,205 ha	171 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		10,557 ha	4.0%	3.1	13.4 %	78,777 ha	159 %
North Pacific Mesic Western Hemlock - Silver fir Forest		5,923 ha	24.7%	19.4	82.4 %	7,191 ha	207 %

North Shore Complex

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Montane Massive Bedrock, Cliff and Talus		2,442 ha	3.9%	3.1	13.0 %	18,742 ha	118 %
North Pacific Montane Riparian Woodland and Shrubland		1,826 ha	9.0%	7.1	30.1 %	6,069 ha	158 %
North Pacific Mountain Hemlock Forest		11,175 ha	7.5%	5.9	24.9 %	44,848 ha	127 %
North Pacific Maritime Mesic Subalpine Parkland		185 ha	0.1%	0.1	0.4 %	46,402 ha	112 %
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	51,502 ha	18.4%	10.2	43.2 %	119,141 ha	200 %
Northern goshawk *Accipiter gentilis laingi*	G5	1 occ	1.6%	0.7	3.1 %	32 occ	194 %
Northern spotted owl *Strix occidentalis caurina*	G3T3	3 occ	4.3%	2.7	11.7 %	25 occ	204 %
Northern spotted owl Nests *Strix occidentalis caurina*	G3T3	1 nst	0.3%	0.1	0.6 %	169 nst	194 %
Peregrine falcon *Falco peregrinus anatum*	G4T3	1 nst	2.4%	1.1	4.8 %	21 nst	198 %
Mammals							
Mountain goat *Oreamos americanus*	G5	5,083 ha	0.8%	0.6	2.7 %	189,856 ha	135 %
Vascular Plants							
Snow Bramble *Rubus nivalis*	G4?	1 occ	50.0%	23.5	100.0 %	1 occ	200 %
Lace Fern *Cheilanthes gracillima*	G4G5	1 occ	20.0%	7.8	33.3 %	3 occ	167 %
Woodland Penstemon *Nothochelone nemorosa*	G5	2 occ	56.0%	26.3	112.0 %	2 occ	200 %
Small-fruited Willowherb *Epilobium leptocarpum*	G5	1 occ	20.0%	7.8	33.3 %	3 occ	167 %
Nodding Semaphoregrass *Pleuropogon refractus*	G4	1 occ	10.0%	4.7	20.0 %	5 occ	200 %

Otter Creek

Site No 88

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	100 %
			Agriculture	0 %	GAP 1	38 %	BC Provincial:	0 %	US State:	0 %
Area:	5,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	13,585	ac	Open Water	1 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
North Pacific Lowland Riparian Forest and Shrubland		49 ha	0.1%	2.5	0.3 %	17,205 ha	171 %
Aggregate higher elevation		2,424 ha	0.1%	4.3	0.5 %	496,454 ha	135 %
Aggregate lower elevation		2,415 ha	0.2%	5.0	0.6 %	421,069 ha	138 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		31 ha	0.1%	2.2	0.2 %	12,529 ha	127 %
Old Growth Forest		2,925 ha	0.3%	9.8	1.1 %	259,308 ha	165 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		75 ha	0.0%	1.1	0.1 %	56,808 ha	131 %
North Pacific Maritime Mesic Subalpine Parkland		256 ha	0.2%	4.8	0.6 %	46,402 ha	112 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		141 ha	0.1%	1.6	0.2 %	78,777 ha	159 %
North Pacific Montane Massive Bedrock, Cliff and Talus		174 ha	0.3%	8.1	0.9 %	18,742 ha	118 %

Otter Creek

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Montane Riparian Woodland and Shrubland		44 ha	0.2%	6.3	0.7 %	6,069 ha	158 %
North Pacific Mountain Hemlock Forest		320 ha	0.2%	6.2	0.7 %	44,848 ha	127 %
Montane composite		141 ha	0.1%	4.1	0.5 %	30,002 ha	123 %
Species							
Amphibians							
Cascades frog *Rana cascadae*	G3G4	1 occ	2.3%	67.0	7.7 %	13 occ	210 %
Birds							
Northern spotted owl Nests *Strix occidentalis caurina*	G3T3	1 nst	0.3%	5.2	0.6 %	169 nst	194 %
Marbled murrelet *Brachyramphus marmoratus*	G3G4	1 occ	0.7%	11.3	1.3 %	77 occ	194 %
Mammals							
Fisher *Martes pennanti*	G5	2,042 ha	0.4%		%	ha	%

Park Creek

Site No 89

Southeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	100 %
			Agriculture	0 %	GAP 1	100 %	BC Provincial:	0 %	US State:	0 %
Area:	500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	1,235	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		0 ha	0.0%	0.0	0.0 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		163 ha	0.1%	34.9	0.4 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		4 ha	0.0%	5.5	0.1 %	6,069 ha	158 %
North Pacific Montane Massive Bedrock, Cliff and Talus		26 ha	0.0%	13.0	0.1 %	18,742 ha	118 %
North Pacific Maritime Mesic Subalpine Parkland		39 ha	0.0%	8.0	0.1 %	46,402 ha	112 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		2 ha	0.0%	1.2	0.0 %	12,529 ha	127 %
Montane composite		28 ha	0.0%	9.1	0.1 %	30,002 ha	123 %
Alpine composite		2 ha	0.0%	2.4	0.0 %	8,126 ha	110 %
Aggregate lower elevation		6 ha	0.0%	0.1	0.0 %	421,069 ha	138 %

Park Creek

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Aggregate higher elevation		433 ha	0.0%	8.4	0.1 %	496,454 ha	135 %
Species							
Amphibians							
Cascades frog *Rana cascadae*	G3G4	1 occ	2.3%	737.5	7.7 %	13 occ	210 %
Mammals							
Lynx *Lynx canadensis*	G5	355 ha	0.1%	41.9	0.4 %	81,154 ha	140 %
Fisher *Martes pennanti*	G5	7 ha	0.0%		%	ha	%

Pemberton - Mount Currie

Site No 90

Northeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	11 %	GAP 1	0 %	BC Provincial:	75 %	US State:	0 %
Area:	5,000	ha	Developed	3 %	GAP 2	7 %	Can Indigenous:	12 %	US Local:	0 %
	12,350	ac	Open Water	3 %	GAP 3	0 %	Can Private:	13 %	US Indigenous:	0 %
					GAP 4	25 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland		11 ha	0.0%	0.2	0.0 %	47,698 ha	104 %
Old Growth Forest		258 ha	0.0%	1.0	0.1 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		14 ha	0.0%	0.3	0.0 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		0 ha	0.0%	0.0	0.0 %	6,069 ha	158 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		136 ha	0.1%	1.7	0.2 %	78,777 ha	159 %
North Pacific Lowland Riparian Forest and Shrubland		258 ha	0.5%	14.4	1.5 %	17,205 ha	171 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		118 ha	0.3%	9.0	0.9 %	12,529 ha	127 %
East Cascades Mesic Montane Mixed Conifer Forest		1,375 ha	2.9%	91.7	9.6 %	14,376 ha	116 %
Aggregate lower elevation		3,165 ha	0.2%	7.2	0.8 %	421,069 ha	138 %

Pemberton - Mount Currie

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Aggregate higher elevation		94 ha	0.0%	0.2	0.0%	496,454 ha	135 %
Species							
Mammals							
Mountain goat *Oreamos americanus*	G5	68 ha	0.0%	0.3	0.0%	189,856 ha	135 %
Vascular Plants							
Ussurian Water-milfoil *Myriophyllum ussuriense*	G3	1 occ	25.0%	479.4	50.0%	2 occ	200 %
Lace Fern *Cheilanthes gracillima*	G4G5	1 occ	20.0%	319.6	33.3%	3 occ	167 %
Geyer's Onion *Allium geyeri var. tenerum*	G4G5TN	1 occ	50.0%	958.7	100.0%	1 occ	200 %

Pemberton Meadows

Site No 91

Northeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	500	ha	Developed	0 %	GAP 2	1 %	Can Indigenous:	0 %	US Local:	0 %
	1,235	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland		148 ha	0.1%	29.8	0.3 %	47,698 ha	104 %
Old Growth Forest		15 ha	0.0%	0.6	0.0 %	259,308 ha	165 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		2 ha	0.0%	0.2	0.0 %	78,777 ha	159 %
North Pacific Lowland Riparian Forest and Shrubland		1 ha	0.0%	0.4	0.0 %	17,205 ha	171 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		2 ha	0.0%	1.8	0.0 %	12,529 ha	127 %
East Cascades Mesic Montane Mixed Conifer Forest		106 ha	0.2%	70.8	0.7 %	14,376 ha	116 %
Aggregate lower elevation		350 ha	0.0%	8.0	0.1 %	421,069 ha	138 %
Species							
Mammals							
Mountain goat *Oreamos americanus*	G5	77 ha	0.0%	3.9	0.0 %	189,856 ha	135 %

Pemberton Meadows

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio

Perry Creek

Site No 92

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	78 %
			Agriculture	0 %	GAP 1	78 %	BC Provincial:	0 %	US State:	20 %
Area:	9,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	22,230	ac	Open Water	1 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	2 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		59 ha	0.1%	2.5	0.5 %	12,529 ha	127 %
Old Growth Forest		3,645 ha	0.4%	7.5	1.4 %	259,308 ha	165 %
Montane composite		417 ha	0.4%	7.4	1.4 %	30,002 ha	123 %
Aggregate higher elevation		5,505 ha	0.3%	5.9	1.1 %	496,454 ha	135 %
North Pacific Lowland Riparian Forest and Shrubland		131 ha	0.2%	4.1	0.8 %	17,205 ha	171 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		89 ha	0.0%	0.8	0.2 %	56,808 ha	131 %
North Pacific Maritime Mesic Subalpine Parkland		1,468 ha	0.9%	16.8	3.2 %	46,402 ha	112 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		43 ha	0.0%	0.3	0.1 %	78,777 ha	159 %
North Pacific Mesic Western Hemlock - Silver fir Forest		23 ha	0.1%	1.7	0.3 %	7,191 ha	207 %

Perry Creek

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Montane Massive Bedrock, Cliff and Talus		513 ha	0.8%	14.6	2.7 %	18,742 ha	118 %
North Pacific Montane Riparian Woodland and Shrubland		2 ha	0.0%	0.2	0.0 %	6,069 ha	158 %
North Pacific Mountain Hemlock Forest		527 ha	0.4%	6.3	1.2 %	44,848 ha	127 %
Aggregate lower elevation		1,877 ha	0.1%	2.4	0.4 %	421,069 ha	138 %
Species							
Amphibians							
Cascades frog *Rana cascadae*	G3G4	1 occ	2.3%	41.0	7.7 %	13 occ	210 %
Birds							
Harlequin duck *Histrionicus histrionicus*	G4	1 occ	1.7%	41.0	7.7 %	13 occ	253 %
Marbled murrelet *Brachyramphus marmoratus*	G3G4	2 occ	1.3%	13.8	2.6 %	77 occ	194 %
Northern spotted owl Nests *Strix occidentalis caurina*	G3T3	1 nst	0.3%	3.2	0.6 %	169 nst	194 %
Vaux's swift *Chaetura vauxi*	G5	1 occ	7.1%	76.1	14.3 %	7 occ	171 %
Mammals							
Fisher *Martes pennanti*	G5	2,415 ha	0.5%		%	ha	%
Mountain goat *Oreamos americanus*	G5	1,819 ha	0.3%	5.1	1.0 %	189,856 ha	135 %
Nonvascular Plants							
Lescur's Bartramiopsis Moss *Bartramiopsis lescurii*	G3G5	1 occ	50.0%	532.6	100.0 %	1 occ	200 %
Vascular Plants							
Alaska Harebell *Campanula lasiocarpa*	G5	1 occ	7.1%	76.1	14.3 %	7 occ	194 %
Black Lily *Fritillaria camschatcensis*	G5	5 occ	21.7%	363.7	68.3 %	7 occ	302 %
Cooley's Buttercup *Ranunculus cooleyae*	G4	1 occ	16.7%	177.5	33.3 %	3 occ	200 %
Stalked Moonwort *Botrychium pedunculosum*	G2G3	1 occ	16.7%	177.5	33.3 %	3 occ	200 %
Few-flowered Sedge *Carex pauciflora*	G5	0 occ	1.2%	16.0	3.0 %	7 occ	229 %

Perry Creek

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio

Pitt Macro Site

Site No 93

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	15 %	GAP 1	37 %	BC Provincial:	53 %	US State:	0 %
Area:	5,000	ha	Developed	8 %	GAP 2	16 %	Can Indigenous:	0 %	US Local:	0 %
	12,350	ac	Open Water	32 %	GAP 3	0 %	Can Private:	34 %	US Indigenous:	0 %
					GAP 4	34 %	Can NGO:	5 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		615 ha	0.1%	2.3	0.2 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		16 ha	0.0%	0.3	0.0 %	44,848 ha	127 %
North Pacific Mesic Western Hemlock - Silver fir Forest		2 ha	0.0%	0.3	0.0 %	7,191 ha	207 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		1,922 ha	0.7%	23.4	2.4 %	78,777 ha	159 %
North Pacific Lowland Riparian Forest and Shrubland		523 ha	0.9%	29.1	3.0 %	17,205 ha	171 %
Aggregate lower elevation		1,922 ha	0.1%	4.4	0.5 %	421,069 ha	138 %
Aggregate higher elevation		657 ha	0.0%	1.3	0.1 %	496,454 ha	135 %
Species							
Birds							
Sandhill Crane *Grus canadensis*	G5	1 occ	41.9%	795.7	83.0 %	1 occ	198 %

Pitt Macro Site

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	270 ha	0.1%	2.2	0.2%	119,141 ha	200 %
Great blue heron *Ardia herodius fannini*	G5T4	1 occ	4.2%	79.9	8.3%	12 occ	200 %

Powell - Daniels

Site No 94

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	26,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	64,220	ac	Open Water	2 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		5,975 ha	0.7%	4.2	2.3 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		1,310 ha	0.9%	5.4	2.9 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		332 ha	1.6%	10.1	5.5 %	6,069 ha	158 %
North Pacific Montane Massive Bedrock, Cliff and Talus		446 ha	0.7%	4.4	2.4 %	18,742 ha	118 %
North Pacific Mesic Western Hemlock - Silver fir Forest		839 ha	3.5%	21.5	11.7 %	7,191 ha	207 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		1,696 ha	0.6%	4.0	2.2 %	78,777 ha	159 %
North Pacific Maritime Mesic Subalpine Parkland		1,135 ha	0.7%	4.5	2.4 %	46,402 ha	112 %
North Pacific Lowland Riparian Forest and Shrubland		42 ha	0.1%	0.4	0.2 %	17,205 ha	171 %
Montane composite		286 ha	0.3%	1.8	1.0 %	30,002 ha	123 %

Powell - Daniels

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Alpine composite		70 ha	0.3%	1.6	0.9 %	8,126 ha	110 %
Aggregate lower elevation		1,696 ha	0.1%	0.7	0.4 %	421,069 ha	138 %
Aggregate higher elevation		16,571 ha	1.0%	6.2	3.3 %	496,454 ha	135 %
<u>Species</u>							
<u>Birds</u>							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	4,897 ha	1.7%	7.6	4.1 %	119,141 ha	200 %
<u>Mammals</u>							
Mountain goat *Oreamos americanus*	G5	3,082 ha	0.5%	3.0	1.6 %	189,856 ha	135 %

Princess Louisa Inlet

Site No 95

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	21 %	BC Provincial:	67 %	US State:	0 %
Area:	2,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	6,175	ac	Open Water	6 %	GAP 3	0 %	Can Private:	14 %	US Indigenous:	0 %
					GAP 4	14 %	Can NGO:	19 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		463 ha	0.1%	3.4	0.2 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		55 ha	0.0%	2.3	0.1 %	44,848 ha	127 %
North Pacific Mesic Western Hemlock - Silver fir Forest		112 ha	0.5%	29.9	1.6 %	7,191 ha	207 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		624 ha	0.2%	15.2	0.8 %	78,777 ha	159 %
North Pacific Lowland Riparian Forest and Shrubland		30 ha	0.1%	3.3	0.2 %	17,205 ha	171 %
Aggregate lower elevation		624 ha	0.0%	2.8	0.1 %	421,069 ha	138 %
Aggregate higher elevation		1,574 ha	0.1%	6.1	0.3 %	496,454 ha	135 %
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	506 ha	0.2%	8.2	0.4 %	119,141 ha	200 %

Princess Louisa Inlet

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Mammals							
Mountain goat *Oreamos americanus*	G5	292 ha	0.0%	3.0	0.2 %	189,856 ha	135 %

Ragged Ridge

Site No 96

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	59 %
			Agriculture	0 %	GAP 1	49 %	BC Provincial:	0 %	US State:	37 %
Area:	7,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	18,525	ac	Open Water	1 %	GAP 3	1 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	4 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Montane composite		423 ha	0.4%	9.0	1.4 %	30,002 ha	123 %
Aggregate lower elevation		1,641 ha	0.1%	2.5	0.4 %	421,069 ha	138 %
Old Growth Forest		2,424 ha	0.3%	6.0	0.9 %	259,308 ha	165 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		93 ha	0.2%	4.7	0.7 %	12,529 ha	127 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		314 ha	0.2%	3.5	0.6 %	56,808 ha	131 %
North Pacific Maritime Mesic Subalpine Parkland		604 ha	0.4%	8.3	1.3 %	46,402 ha	112 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		150 ha	0.1%	1.2	0.2 %	78,777 ha	159 %
North Pacific Mesic Western Hemlock - Silver fir Forest		14 ha	0.1%	1.2	0.2 %	7,191 ha	207 %
North Pacific Montane Massive Bedrock, Cliff and Talus		286 ha	0.5%	9.8	1.5 %	18,742 ha	118 %

Ragged Ridge

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Montane Riparian Woodland and Shrubland		35 ha	0.2%	3.7	0.6 %	6,069 ha	158 %
North Pacific Mountain Hemlock Forest		618 ha	0.4%	8.8	1.4 %	44,848 ha	127 %
Aggregate higher elevation		4,904 ha	0.3%	6.3	1.0 %	496,454 ha	135 %
Species							
Birds							
Peregrine falcon *Falco peregrinus anatum*	G4T3	3 nst	7.2%	91.3	14.3 %	21 nst	198 %
Marbled murrelet *Brachyramphus marmoratus*	G3G4	1 occ	0.6%	8.2	1.3 %	77 occ	194 %
Mammals							
Mountain goat *Oreamos americanus*	G5	2,318 ha	0.4%	7.8	1.2 %	189,856 ha	135 %
Fisher *Martes pennanti*	G5	1,383 ha	0.3%		%	ha	%
Vascular Plants							
Spleenwort-leaved Goldthread *Coptis aspleniifolia*	G5	2 occ	25.0%	319.6	50.0 %	4 occ	200 %
Long-styled Sedge *Carex stylosa*	G5	1 occ	7.1%	91.3	14.3 %	7 occ	197 %
Choris' Bog-orchid *Platanthera chorisiana*	G3G4	1 occ	7.1%	91.3	14.3 %	7 occ	171 %
Plant Communities							
Tsuga mertensiana - Abies amabilis / Elliottia pyroliflorus Woodland Community *Tsuga mertensiana - Abies amabilis / Elliottia pyroliflorus*	G3G4	296 ha	15.4%	197.3	30.9 %	959 ha	200 %

Ramillies

Site No 97

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	98 %	US State:	0 %
Area:	1,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	2,470	ac	Open Water	100 %	GAP 3	0 %	Can Private:	2 %	US Indigenous:	0 %
					GAP 4	2 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		22 ha	0.0%	0.4	0.0 %	259,308 ha	165 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		528 ha	0.2%	32.1	0.7 %	78,777 ha	159 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		131 ha	0.1%	11.1	0.2 %	56,808 ha	131 %
North Pacific Lowland Riparian Forest and Shrubland		3 ha	0.0%	0.9	0.0 %	17,205 ha	171 %
Aggregate lower elevation		659 ha	0.0%	7.5	0.2 %	421,069 ha	138 %
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	157 ha	0.1%	6.3	0.1 %	119,141 ha	200 %

Redonda

Site No 98

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	80 %	BC Provincial:	96 %	US State:	0 %
Area:	2,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	4,940	ac	Open Water	17 %	GAP 3	0 %	Can Private:	4 %	US Indigenous:	0 %
					GAP 4	4 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		361 ha	0.0%	3.3	0.1 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		61 ha	0.0%	3.3	0.1 %	44,848 ha	127 %
North Pacific Mesic Western Hemlock - Silver fir Forest		55 ha	0.2%	18.3	0.8 %	7,191 ha	207 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		659 ha	0.3%	20.0	0.8 %	78,777 ha	159 %
North Pacific Lowland Riparian Forest and Shrubland		2 ha	0.0%	0.3	0.0 %	17,205 ha	171 %
Aggregate lower elevation		659 ha	0.0%	3.8	0.2 %	421,069 ha	138 %
Aggregate higher elevation		958 ha	0.1%	4.6	0.2 %	496,454 ha	135 %
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	186 ha	0.1%	3.7	0.2 %	119,141 ha	200 %

Redonda

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio

Ross Lake Transition

Site No 99

Southeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	65 %
			Agriculture	0 %	GAP 1	97 %	BC Provincial:	31 %	US State:	0 %
Area:	94,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	232,180	ac	Open Water	5 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	4 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Alpine composite		890 ha	3.3%	5.6	10.9 %	8,126 ha	110 %
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland		4,153 ha	2.6%	4.4	8.7 %	47,698 ha	104 %
Aggregate lower elevation		39,901 ha	2.8%	4.8	9.5 %	421,069 ha	138 %
East Cascades Mesic Montane Mixed Conifer Forest		10,553 ha	22.0%	37.4	73.4 %	14,376 ha	116 %
Montane composite		2,086 ha	2.1%	3.5	7.0 %	30,002 ha	123 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		2,644 ha	6.3%	10.8	21.1 %	12,529 ha	127 %
North Pacific Lowland Riparian Forest and Shrubland		1,679 ha	2.9%	5.0	9.8 %	17,205 ha	171 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		31 ha	0.0%	0.0	0.1 %	56,808 ha	131 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		241 ha	0.1%	0.2	0.3 %	78,777 ha	159 %

Ross Lake Transition

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Montane Massive Bedrock, Cliff and Talus		2,133 ha	3.4%	5.8	11.4 %	18,742 ha	118 %
North Pacific Montane Riparian Woodland and Shrubland		533 ha	2.6%	4.5	8.8 %	6,069 ha	158 %
North Pacific Mountain Hemlock Forest		2,128 ha	1.4%	2.4	4.7 %	44,848 ha	127 %
Northern Rocky Mountain Subalpine Dry Parkland		507 ha	2.0%	3.4	6.6 %	7,664 ha	109 %
Old Growth Forest		18,773 ha	2.2%	3.7	7.2 %	259,308 ha	165 %
North Pacific Maritime Mesic Subalpine Parkland		6,189 ha	4.0%	6.8	13.3 %	46,402 ha	112 %
Aggregate higher elevation		31,153 ha	1.9%	3.2	6.3 %	496,454 ha	135 %
<u>Species</u>							
<u>Amphibians</u>							
Western toad ts *Bufo boreas*	G4	2 occ	7.7%	14.5	28.4 %	7 occ	256 %
<u>Birds</u>							
Common Loon *Gavia immer*	G5	3 nst	11.5%	11.8	23.1 %	13 nst	200 %
Northern spotted owl Nests *Strix occidentalis caurina*	G3T3	6 nst	1.8%	1.8	3.6 %	169 nst	194 %
Northern goshawk *Accipiter gentilis laingi*	G5	3 occ	4.7%	4.8	9.4 %	32 occ	194 %
Northern spotted owl *Strix occidentalis caurina*	G3T3	1 occ	2.2%	3.0	5.8 %	25 occ	204 %
<u>Mammals</u>							
Fisher *Martes pennanti*	G5	14,514 ha	2.8%		%	ha	%
Gray wolf *Canis lupus*	G4	1 occ	3.1%	3.1	6.2 %	12 occ	196 %
Lynx *Lynx canadensis*	G5	3,971 ha	1.5%	2.5	4.9 %	81,154 ha	140 %
Mountain goat *Oreamos americanus*	G5	957 ha	0.2%	0.3	0.5 %	189,856 ha	135 %
Mtn beaver rainieri *Aplodontia rufa rainieri*	G5T4	1 occ	1.7%	3.9	7.7 %	13 occ	199 %
<u>Vascular Plants</u>							

Ross Lake Transition

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Bog Clubmoss *Lycopodiella inundata*	G5	1 occ	25.0%	25.5	50.0 %	2 occ	200 %
Regel's Rush *Juncus regelii*	G4?	1 occ	50.0%	51.0	100.0 %	1 occ	200 %
Alpine Anemone *Anemone drummondii var. drummondii*	G4T4	1 occ	16.7%	17.0	33.3 %	3 occ	200 %
Cliff Paintbrush *Castilleja rupicola*	G2G3	2 occ	18.2%	17.0	33.3 %	6 occ	183 %
Elegant Jacob's-ladder *Polemonium elegans*	G4	1 occ	50.0%	51.0	100.0 %	1 occ	200 %
Elmera *Elmera racemosa var. racemosa*	G4G5T4	4 occ	50.9%	51.9	101.8 %	4 occ	200 %
Gray's Bluegrass *Poa arctica ssp. arctica*	G5T3T5	1 occ	50.0%	51.0	100.0 %	1 occ	200 %
Kruckeberg's Holly Fern *Polystichum kruckebergii*	G4	1 occ	25.0%	25.5	50.0 %	2 occ	200 %
Lance-leaved Figwort *Scrophularia lanceolata*	G5	1 occ	50.0%	51.0	100.0 %	1 occ	200 %
Oniongrass *Melica bulbosa var. bulbosa*	G5TNR	1 occ	50.0%	51.0	100.0 %	1 occ	200 %
Purple-marked Yellow Violet *Viola purpurea var. venosa*	G5T4T5	1 occ	33.3%	25.5	50.0 %	2 occ	150 %
Short-fruited Smelowskia *Smelowskia ovalis*	G5	1 occ	10.0%	10.2	20.0 %	5 occ	200 %
Slender Spike-rush *Eleocharis nitida*	G3G4	1 occ	50.0%	51.0	100.0 %	1 occ	200 %
Stalked Moonwort *Botrychium pedunculosum*	G2G3	1 occ	16.7%	17.0	33.3 %	3 occ	200 %
Treelike Clubmoss *Lycopodium dendroideum*	G5	1 occ	3.8%	7.3	14.3 %	7 occ	286 %
Poor Sedge *Carex magellanica ssp. irrigua*	G5T5	2 occ	16.7%	17.0	33.3 %	6 occ	200 %
Other Ecological Features							
Karst PH		922 ha	15.3%	19.6	38.3 %	2,404 ha	201 %

Royal Reaches

Site No 100

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	27,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	67,925	ac	Open Water	22 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		3,768 ha	0.4%	2.5	1.5 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		317 ha	0.2%	1.2	0.7 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		37 ha	0.2%	1.1	0.6 %	6,069 ha	158 %
North Pacific Montane Massive Bedrock, Cliff and Talus		279 ha	0.4%	2.6	1.5 %	18,742 ha	118 %
North Pacific Mesic Western Hemlock - Silver fir Forest		954 ha	4.0%	23.1	13.3 %	7,191 ha	207 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		10,633 ha	4.0%	23.5	13.5 %	78,777 ha	159 %
North Pacific Lowland Riparian Forest and Shrubland		68 ha	0.1%	0.7	0.4 %	17,205 ha	171 %
Montane composite		51 ha	0.1%	0.3	0.2 %	30,002 ha	123 %
Aggregate lower elevation		10,633 ha	0.8%	4.4	2.5 %	421,069 ha	138 %

Royal Reaches

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Aggregate higher elevation		8,538 ha	0.5%	3.0	1.7%	496,454 ha	135 %
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	4,108 ha	1.5%	6.0	3.4%	119,141 ha	200 %
Mammals							
Mountain goat *Oreamos americanus*	G5	3,578 ha	0.6%	3.3	1.9%	189,856 ha	135 %

Ryan

Site No 101

Northeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	1,235	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		106 ha	0.0%	3.9	0.0 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		5 ha	0.0%	1.0	0.0 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		0 ha	0.0%	0.3	0.0 %	6,069 ha	158 %
North Pacific Maritime Mesic Subalpine Parkland		140 ha	0.1%	29.0	0.3 %	46,402 ha	112 %
Montane composite		187 ha	0.2%	59.7	0.6 %	30,002 ha	123 %
Alpine composite		3 ha	0.0%	3.5	0.0 %	8,126 ha	110 %
Aggregate lower elevation		9 ha	0.0%	0.2	0.0 %	421,069 ha	138 %
Aggregate higher elevation		285 ha	0.0%	5.5	0.1 %	496,454 ha	135 %

Salmon Inlet

Site No 102

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	12 %	BC Provincial:	100 %	US State:	0 %
Area:	7,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	18,525	ac	Open Water	12 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		891 ha	0.1%	2.2	0.3 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		81 ha	0.1%	1.2	0.2 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		5 ha	0.0%	0.5	0.1 %	6,069 ha	158 %
North Pacific Mesic Western Hemlock - Silver fir Forest		130 ha	0.5%	11.5	1.8 %	7,191 ha	207 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		3,753 ha	1.4%	30.4	4.8 %	78,777 ha	159 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		192 ha	0.1%	2.2	0.3 %	56,808 ha	131 %
North Pacific Lowland Riparian Forest and Shrubland		14 ha	0.0%	0.5	0.1 %	17,205 ha	171 %
Aggregate lower elevation		3,945 ha	0.3%	6.0	0.9 %	421,069 ha	138 %
Aggregate higher elevation		1,927 ha	0.1%	2.5	0.4 %	496,454 ha	135 %

Salmon Inlet

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	1,063 ha	0.4 %	5.7	0.9 %	119,141 ha	200 %

Saltery

Site No 103

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	1 %	BC Provincial:	95 %	US State:	0 %
Area:	3,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	8,645	ac	Open Water	12 %	GAP 3	0 %	Can Private:	5 %	US Indigenous:	0 %
					GAP 4	5 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		45 ha	0.0%	0.2	0.0 %	259,308 ha	165 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		2,144 ha	0.8%	37.3	2.7 %	78,777 ha	159 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		798 ha	0.4%	19.2	1.4 %	56,808 ha	131 %
North Pacific Lowland Riparian Forest and Shrubland		1 ha	0.0%	0.1	0.0 %	17,205 ha	171 %
Aggregate lower elevation		2,942 ha	0.2%	9.6	0.7 %	421,069 ha	138 %
Aggregate higher elevation		93 ha	0.0%	0.3	0.0 %	496,454 ha	135 %
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	155 ha	0.1%	1.8	0.1 %	119,141 ha	200 %
Mammals							

Saltery Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Mountain goat *Oreamos americanus*	G5	150 ha	0.0%	1.1	0.1 %	189,856 ha	135 %
Mollusks							
Pygmy Oregonian *Cryptomastix germana*	G3G4	1 occ	12.5%	342.4	25.0 %	4 occ	200 %
Conical Spot *Punctum randolphii*	G4	1 occ	2.6%	105.4	7.7 %	13 occ	231 %

Sauk

Site No 104

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	100 %
			Agriculture	0 %	GAP 1	61 %	BC Provincial:	0 %	US State:	0 %
Area:	75,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	185,250	ac	Open Water	1 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Aggregate lower elevation		24,502 ha	1.7%	3.7	5.8 %	421,069 ha	138 %
Aggregate higher elevation		37,697 ha	2.3%	4.9	7.6 %	496,454 ha	135 %
Alpine composite		265 ha	1.0%	2.1	3.3 %	8,126 ha	110 %
Montane composite		3,178 ha	3.2%	6.8	10.6 %	30,002 ha	123 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		1,138 ha	2.7%	5.8	9.1 %	12,529 ha	127 %
North Pacific Lowland Riparian Forest and Shrubland		1,058 ha	1.8%	3.9	6.2 %	17,205 ha	171 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		2,039 ha	1.1%	2.3	3.6 %	56,808 ha	131 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		773 ha	0.3%	0.6	1.0 %	78,777 ha	159 %
North Pacific Mesic Western Hemlock - Silver fir Forest		33 ha	0.1%	0.3	0.5 %	7,191 ha	207 %

Sauk Targets known in this Conservation Area:	GRank	Abundance		% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal		% of Goal Captured by Portfolio
North Pacific Montane Massive Bedrock, Cliff and Talus		2,060	ha	3.3%	7.0	11.0 %	18,742	ha	118 %
North Pacific Montane Riparian Woodland and Shrubland		289	ha	1.4%	3.0	4.8 %	6,069	ha	158 %
North Pacific Mountain Hemlock Forest		4,133	ha	2.8%	5.9	9.2 %	44,848	ha	127 %
Northern Rocky Mountain Subalpine Dry Parkland		58	ha	0.2%	0.5	0.8 %	7,664	ha	109 %
North Pacific Maritime Mesic Subalpine Parkland		8,111	ha	5.2%	11.2	17.5 %	46,402	ha	112 %
Old Growth Forest		29,478	ha	3.4%	7.3	11.4 %	259,308	ha	165 %
Species									
Amphibians									
Cascades frog *Rana cascadae*	G3G4	1	occ	2.3%	4.9	7.7 %	13	occ	210 %
Western toad ts *Bufo boreas*	G4	1	occ	3.8%	9.0	14.1 %	7	occ	256 %
Birds									
Marbled murrelet *Brachyramphus marmoratus*	G3G4	2	occ	1.6%	2.1	3.2 %	77	occ	194 %
Northern goshawk *Accipiter gentilis laingi*	G5	1	occ	1.6%	2.0	3.1 %	32	occ	194 %
Northern spotted owl Nests *Strix occidentalis caurina*	G3T3	1	nst	0.3%	0.4	0.6 %	169	nst	194 %
White-tailed ptarmigan *Lagopus leucurus*	G5	1	occ	12.5%	16.0	25.0 %	4	occ	200 %
Golden Eagle *Aquila chrysaetos*	G5	1	nst	2.6%	3.4	5.3 %	19	nst	189 %
Harlequin duck *Histrionicus histrionicus*	G4	2	occ	3.8%	10.9	17.1 %	13	occ	253 %
Mammals									
Mountain goat *Oreamos americanus*	G5	10,340	ha	1.6%	3.5	5.4 %	189,856	ha	135 %
Gray wolf *Canis lupus*	G4	0	occ	1.0%	1.3	2.1 %	12	occ	196 %
Fisher *Martes pennanti*	G5	18,416	ha	3.6%		%		ha	%
Wolverine *Gulo gulo*	G4	1	occ	5.0%	6.4	10.0 %	5	occ	198 %

Sauk

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Nonvascular Plants							
Oldgrowth Specklebelly *Pseudocyphellaria rainierensis*	G3	1 occ	42.5%	54.3	85.0 %	1 occ	200 %
Vascular Plants							
Spleenwort-leaved Goldthread *Coptis aspleniifolia*	G5	1 occ	12.5%	16.0	25.0 %	4 occ	200 %
Alaska Harebell *Campanula lasiocarpa*	G5	1 occ	7.1%	9.1	14.3 %	7 occ	194 %
Cooley's Buttercup *Ranunculus cooleyae*	G4	1 occ	16.7%	21.3	33.3 %	3 occ	200 %
Choris' Bog-orchid *Platanthera chorisiana*	G3G4	1 occ	7.1%	9.1	14.3 %	7 occ	171 %

Scuzzy Creek

Site No 105

Northeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	2,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	4,940	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland		96 ha	0.1%	4.8	0.2 %	47,698 ha	104 %
Old Growth Forest		4 ha	0.0%	0.0	0.0 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		133 ha	0.1%	7.1	0.3 %	44,848 ha	127 %
North Pacific Lowland Riparian Forest and Shrubland		18 ha	0.0%	2.5	0.1 %	17,205 ha	171 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		119 ha	0.3%	22.8	1.0 %	12,529 ha	127 %
East Cascades Mesic Montane Mixed Conifer Forest		504 ha	1.1%	84.0	3.5 %	14,376 ha	116 %
Aggregate lower elevation		1,226 ha	0.1%	7.0	0.3 %	421,069 ha	138 %
Aggregate higher elevation		560 ha	0.0%	2.7	0.1 %	496,454 ha	135 %

Sea - To - Sky Vista

Site No 106

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	14 %	BC Provincial:	71 %	US State:	0 %
Area:	15,000	ha	Developed	8 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	37,051	ac	Open Water	19 %	GAP 3	0 %	Can Private:	28 %	US Indigenous:	0 %
					GAP 4	27 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		1,773 ha	0.2%	2.2	0.7 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		230 ha	0.2%	1.6	0.5 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		1 ha	0.0%	0.0	0.0 %	6,069 ha	158 %
North Pacific Montane Massive Bedrock, Cliff and Talus		11 ha	0.0%	0.2	0.1 %	18,742 ha	118 %
North Pacific Mesic Western Hemlock - Silver fir Forest		177 ha	0.7%	7.9	2.5 %	7,191 ha	207 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		6,522 ha	2.5%	26.5	8.3 %	78,777 ha	159 %
North Pacific Lowland Riparian Forest and Shrubland		74 ha	0.1%	1.4	0.4 %	17,205 ha	171 %
Aggregate lower elevation		6,522 ha	0.5%	4.9	1.5 %	421,069 ha	138 %
Aggregate higher elevation		3,251 ha	0.2%	2.1	0.7 %	496,454 ha	135 %

Sea - To - Sky Vista

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Species							
Birds							
Peregrine falcon *Falco peregrinus anatum*	G4T3	1 nst	2.1%	13.2	4.1 %	21 nst	198 %
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	1,556 ha	0.6%	4.2	1.3 %	119,141 ha	200 %
Great blue heron *Ardia herodius fannini*	G5T4	1 occ	4.2%	26.6	8.3 %	12 occ	200 %
Mammals							
Mountain goat *Oreamos americanus*	G5	294 ha	0.0%	0.5	0.2 %	189,856 ha	135 %
Mollusks							
Conical Spot *Punctum randolphii*	G4	1 occ	2.6%	24.6	7.7 %	13 occ	231 %
Vascular Plants							
Woodland Penstemon *Nothochelone nemorosa*	G5	1 occ	13.5%	86.3	27.0 %	2 occ	200 %

Sechelt Peninsula

Site No 107

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	13 %	BC Provincial:	96 %	US State:	0 %
Area:	19,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	48,165	ac	Open Water	5 %	GAP 3	0 %	Can Private:	3 %	US Indigenous:	0 %
					GAP 4	4 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Aggregate higher elevation		2,772 ha	0.2%	1.4	0.6 %	496,454 ha	135 %
Aggregate lower elevation		13,335 ha	1.0%	7.8	3.2 %	421,069 ha	138 %
North Pacific Lowland Riparian Forest and Shrubland		98 ha	0.2%	1.4	0.6 %	17,205 ha	171 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		4,254 ha	2.2%	18.4	7.5 %	56,808 ha	131 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		9,081 ha	3.5%	28.3	11.5 %	78,777 ha	159 %
North Pacific Mesic Western Hemlock - Silver fir Forest		45 ha	0.2%	1.5	0.6 %	7,191 ha	207 %
North Pacific Mountain Hemlock Forest		3 ha	0.0%	0.0	0.0 %	44,848 ha	127 %
Old Growth Forest		960 ha	0.1%	0.9	0.4 %	259,308 ha	165 %
Species							
Birds							

Sechelt Peninsula

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	1,915 ha	0.7%	4.0	1.6 %	119,141 ha	200 %
Mollusks							
Conical Spot *Punctum randolphii*	G4	1 occ	2.6%	18.9	7.7 %	13 occ	231 %
Other Ecological Features							
Karst SM		149 ha	0.2%	2.7	1.1 %	13,584 ha	233 %
Freshwater							
Species							
Fishes							
Chum Salmon (SALMON ECOREGION) *Oncorhynchus keta*	G5	14 km	2.3%	2.9	4.7 %	297 km	101 %
Coastal Cutthroat Trout, Clarki Subspecies (anadromous) *Oncorhynchus clarki clarki*	G4	8 km	6.0%	12.2	20.0 %	38 km	178 %
Coho Salmon *Oncorhynchus kisutch*	G4	42 km	3.6%	4.4	7.3 %	578 km	100 %
Cutthroat Trout, Clarkil Subspecies *Oncorhynchus clarkil clarkil*	G4	71 km	5.8%	11.8	19.3 %	368 km	146 %
Dolly Varden *Salvelinus malma*	G5	2 km	0.3%	0.5	0.9 %	274 km	162 %
Kokanee *Oncorhynchus nerka*	G5	15 km	5.8%	7.0	11.5 %	129 km	120 %
Sockeye Salmon (Sakinaw Lake) *Oncorhynchus nerka*	G5	14 km	100.0%	60.4	98.9 %	14 km	99 %
Steelhead Salmon (no run info) *Oncorhynchus mykiss*	G5	14 km	2.4%	2.9	4.8 %	291 km	100 %
Threespine stickleback *Gasterosteus aculeatus*	G5	19 km	9.7%	19.6	32.1 %	58 km	189 %
Insects							
Blue Dasher *Pachydiplax longipennis*	G5	1 occ	16.7%	10.2	16.7 %	6 occ	83 %
Western Pondhawk *Erythemis collocata*	G5	1 occ	50.0%	30.6	50.0 %	2 occ	100 %
Freshwater Ecological Systems							

Sechelt Peninsula

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
intermediate,geology_intrusive - metamorphic,elevation_low,gradient_mainstem shallow - tributary shallow		35,835 ha	20.7%	42.1	68.8 %	52,060 ha	120 %
intermediate,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem steep - tributary steep		7,280 ha	1.5%	3.0	4.9 %	147,682 ha	97 %
intermediate,geology_hard_sediments,elevation_low,gradient_mainstem shallow - tributary shallow		7,439 ha	2.0%	4.0	6.5 %	114,239 ha	104 %

Seymour Narrows

Site No 108

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	6 %	BC Provincial:	13 %	US State:	0 %
Area:	9,500	ha	Developed	24 %	GAP 2	6 %	Can Indigenous:	0 %	US Local:	0 %
	23,465	ac	Open Water	5 %	GAP 3	0 %	Can Private:	70 %	US Indigenous:	0 %
					GAP 4	69 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		786 ha	0.1%	1.5	0.3 %	259,308 ha	165 %
North Pacific Montane Riparian Woodland and Shrubland		3 ha	0.0%	0.3	0.1 %	6,069 ha	158 %
North Pacific Mesic Western Hemlock - Silver fir Forest		30 ha	0.1%	2.1	0.4 %	7,191 ha	207 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		4,888 ha	1.9%	31.3	6.2 %	78,777 ha	159 %
North Pacific Lowland Riparian Forest and Shrubland		91 ha	0.2%	2.7	0.5 %	17,205 ha	171 %
Aggregate lower elevation		4,888 ha	0.3%	5.9	1.2 %	421,069 ha	138 %
Aggregate higher elevation		1,139 ha	0.1%	1.2	0.2 %	496,454 ha	135 %
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	956 ha	0.3%	4.0	0.8 %	119,141 ha	200 %

Seymour Narrows

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Mollusks							
Western Flat whorl *Planogyra clappi*	G3G4	1 occ	8.3%	84.1	16.7 %	6 occ	200 %
Pygmy Oregonian *Cryptomastix germana*	G3G4	1 occ	12.5%	126.1	25.0 %	4 occ	200 %
Conical Spot *Punctum randolphii*	G4	1 occ	2.6%	38.8	7.7 %	13 occ	231 %

Silver - Hope

Site No 109

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	1 %	GAP 1	6 %	BC Provincial:	78 %	US State:	0 %
Area:	22,500	ha	Developed	6 %	GAP 2	0 %	Can Indigenous:	4 %	US Local:	0 %
	55,575	ac	Open Water	4 %	GAP 3	0 %	Can Private:	18 %	US Indigenous:	0 %
					GAP 4	21 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Montane composite		25 ha	0.0%	0.2	0.1 %	30,002 ha	123 %
Aggregate lower elevation		14,552 ha	1.0%	7.4	3.5 %	421,069 ha	138 %
Aggregate higher elevation		3,880 ha	0.2%	1.7	0.8 %	496,454 ha	135 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		510 ha	1.2%	8.7	4.1 %	12,529 ha	127 %
North Pacific Lowland Riparian Forest and Shrubland		275 ha	0.5%	3.4	1.6 %	17,205 ha	171 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		5,909 ha	2.3%	16.0	7.5 %	78,777 ha	159 %
North Pacific Mesic Western Hemlock - Silver fir Forest		60 ha	0.3%	1.8	0.8 %	7,191 ha	207 %
North Pacific Montane Riparian Woodland and Shrubland		5 ha	0.0%	0.2	0.1 %	6,069 ha	158 %
North Pacific Mountain Hemlock Forest		145 ha	0.1%	0.7	0.3 %	44,848 ha	127 %

Silver - Hope

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Old Growth Forest		1,962 ha	0.2%	1.6	0.8 %	259,308 ha	165 %
Species							
Birds							
Peregrine falcon *Falco peregrinus anatum*	G4T3	2 nst	4.7%	20.1	9.4 %	21 nst	198 %
Northern spotted owl *Strix occidentalis caurina*	G3T3	1 occ	1.0%	5.9	2.8 %	25 occ	204 %
Mammals							
Mtn beaver rufa *Aplodontia rufa rufa*	G5T4?	1 occ	3.9%	16.4	7.7 %	13 occ	200 %
Mountain goat *Oreamos americanus*	G5	648 ha	0.1%	0.7	0.3 %	189,856 ha	135 %
Mtn beaver rainieri *Aplodontia rufa rainieri*	G5T4	1 occ	1.7%	16.4	7.7 %	13 occ	199 %
Mollusks							
Western Flat whorl *Planogyra clappi*	G3G4	1 occ	8.3%	35.5	16.7 %	6 occ	200 %
Conical Spot *Punctum randolphii*	G4	1 occ	2.6%	16.4	7.7 %	13 occ	231 %
Vascular Plants							
Bearded Sedge *Carex comosa*	G5	1 occ	25.0%	106.5	50.0 %	2 occ	200 %
Soft-leaved Willow *Salix sessilifolia*	G4	6 occ	63.5%	267.2	125.4 %	5 occ	198 %
Water-pepper *Polygonum hydropiperoides*	G5	1 occ	50.0%	213.0	100.0 %	1 occ	200 %
Stiff-leaved Pondweed *Potamogeton strictifolius*	G5	1 occ	50.0%	213.0	100.0 %	1 occ	200 %

Silver River

Site No 110

Northeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	11,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	27,170	ac	Open Water	5 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		3,186 ha	0.4%	5.4	1.2 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		668 ha	0.4%	6.5	1.5 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		1 ha	0.0%	0.1	0.0 %	6,069 ha	158 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		310 ha	0.1%	1.7	0.4 %	78,777 ha	159 %
North Pacific Maritime Mesic Subalpine Parkland		232 ha	0.1%	2.2	0.5 %	46,402 ha	112 %
North Pacific Lowland Riparian Forest and Shrubland		43 ha	0.1%	1.1	0.3 %	17,205 ha	171 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		320 ha	0.8%	11.1	2.6 %	12,529 ha	127 %
Alpine composite		134 ha	0.5%	7.2	1.7 %	8,126 ha	110 %
Aggregate lower elevation		6,724 ha	0.5%	7.0	1.6 %	421,069 ha	138 %

Silver River

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Aggregate higher elevation		2,920 ha	0.2%	2.6	0.6 %	496,454 ha	135 %
<u>Species</u>							
<u>Birds</u>							
Northern spotted owl *Strix occidentalis caurina*	G3T3	1 occ	1.5%	17.4	4.0 %	25 occ	204 %
<u>Mammals</u>							
Mountain goat *Oreamos americanus*	G5	1,043 ha	0.2%	2.4	0.5 %	189,856 ha	135 %
<u>Other Ecological Features</u>							
Hot Spring		1 occ	3.8%	33.5	7.7 %	13 occ	200 %

Skagit - Sauk Riparian (Added to WPG Site)

Site No 111

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	9 %
			Agriculture	9 %	GAP 1	4 %	BC Provincial:	0 %	US State:	16 %
Area:	38,000	ha	Developed	2 %	GAP 2	2 %	Can Indigenous:	0 %	US Local:	0 %
	93,860	ac	Open Water	2 %	GAP 3	1 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	73 %
									US NGO	2 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Montane composite		1,518 ha	1.5%	6.4	5.1 %	30,002 ha	123 %
Aggregate lower elevation		18,798 ha	1.3%	5.6	4.5 %	421,069 ha	138 %
Aggregate higher elevation		681 ha	0.0%	0.2	0.1 %	496,454 ha	135 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		55 ha	0.1%	0.5	0.4 %	12,529 ha	127 %
North Pacific Lowland Riparian Forest and Shrubland		5,941 ha	10.4%	43.6	34.5 %	17,205 ha	171 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		11,330 ha	6.0%	25.2	19.9 %	56,808 ha	131 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		462 ha	0.2%	0.7	0.6 %	78,777 ha	159 %
North Pacific Montane Massive Bedrock, Cliff and Talus		211 ha	0.3%	1.4	1.1 %	18,742 ha	118 %
North Pacific Montane Riparian Woodland and Shrubland		5 ha	0.0%	0.1	0.1 %	6,069 ha	158 %

Skagit - Sauk Riparian (Added to WPG Site)

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Mountain Hemlock Forest		118 ha	0.1%	0.3	0.3 %	44,848 ha	127 %
Old Growth Forest		4,455 ha	0.5%	2.2	1.7 %	259,308 ha	165 %
<u>Species</u>							
<u>Amphibians</u>							
Western toad ts *Bufo boreas*	G4	1 occ	3.9%	18.0	14.3 %	7 occ	256 %
<u>Birds</u>							
Northern goshawk *Accipiter gentilis laingi*	G5	1 occ	1.6%	3.9	3.1 %	32 occ	194 %
Bald eagle nests *Haliaeetus leucocephalus*	G5	3 nst	3.3%	34.4	27.3 %	11 nst	473 %
Bald eagle roosts *Haliaeetus leucocephalus*	G5	4 rst	5.8%	57.5	45.6 %	9 rst	472 %
Marbled murrelet *Brachyramphus marmoratus*	G3G4	1 occ	0.8%	2.1	1.6 %	77 occ	194 %
Peregrine falcon *Falco peregrinus anatum*	G4T3	2 nst	4.8%	12.0	9.5 %	21 nst	198 %
Northern spotted owl Nests *Strix occidentalis caurina*	G3T3	1 nst	0.3%	0.7	0.6 %	169 nst	194 %
<u>Mammals</u>							
Fisher *Martes pennanti*	G5	5,984 ha	1.2%		%	ha	%
Gray wolf *Canis lupus*	G4	1 occ	2.2%	5.6	4.4 %	12 occ	196 %
Wolverine *Gulo gulo*	G4	1 occ	10.0%	25.2	20.0 %	5 occ	198 %
Roosevelt elk *Cervus canadensis*	G5T4	4,393 ha	2.7%	11.5	9.1 %	48,392 ha	147 %
<u>Plant Communities</u>							
Thuja plicata - Tsuga heterophylla / Lysichiton americanus Forest Community *Thuja plicata - Tsuga heterophylla / Lysichiton americanus*	G2	34 ha	17.8%	44.8	35.5 %	95 ha	200 %

Skwawka - Brittain

Site No 112

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	26,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	65,455	ac	Open Water	3 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		7,756 ha	0.9%	5.4	3.0 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		1,309 ha	0.9%	5.3	2.9 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		580 ha	2.9%	17.3	9.6 %	6,069 ha	158 %
North Pacific Montane Massive Bedrock, Cliff and Talus		193 ha	0.3%	1.9	1.0 %	18,742 ha	118 %
North Pacific Mesic Western Hemlock - Silver fir Forest		770 ha	3.2%	19.4	10.7 %	7,191 ha	207 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		1,391 ha	0.5%	3.2	1.8 %	78,777 ha	159 %
North Pacific Maritime Mesic Subalpine Parkland		1,491 ha	1.0%	5.8	3.2 %	46,402 ha	112 %
North Pacific Lowland Riparian Forest and Shrubland		82 ha	0.1%	0.9	0.5 %	17,205 ha	171 %
Montane composite		595 ha	0.6%	3.6	2.0 %	30,002 ha	123 %

Skwawka - Brittain

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Alpine composite		12 ha	0.0%	0.3	0.1 %	8,126 ha	110 %
Aggregate lower elevation		1,391 ha	0.1%	0.6	0.3 %	421,069 ha	138 %
Aggregate higher elevation		18,364 ha	1.1%	6.7	3.7 %	496,454 ha	135 %
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	5,451 ha	1.9%	8.3	4.6 %	119,141 ha	200 %
Mammals							
Mountain goat *Oreamos americanus*	G5	4,252 ha	0.7%	4.1	2.2 %	189,856 ha	135 %

Skykomish Riparian (WPG Site # 183)

Site No 113

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	0 %	US State:	0 %
Area:	3,000	ha	Developed	1 %	GAP 2	59 %	Can Indigenous:	0 %	US Local:	0 %
	7,410	ac	Open Water	3 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	41 %
									US NGO	59 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		377 ha	0.0%	2.3	0.1 %	259,308 ha	165 %
North Pacific Montane Massive Bedrock, Cliff and Talus		32 ha	0.1%	2.7	0.2 %	18,742 ha	118 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		2 ha	0.0%	0.0	0.0 %	78,777 ha	159 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		1,424 ha	0.8%	40.1	2.5 %	56,808 ha	131 %
North Pacific Lowland Riparian Forest and Shrubland		335 ha	0.6%	31.1	1.9 %	17,205 ha	171 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		3 ha	0.0%	0.4	0.0 %	12,529 ha	127 %
Montane composite		9 ha	0.0%	0.5	0.0 %	30,002 ha	123 %
Aggregate lower elevation		2,211 ha	0.2%	8.4	0.5 %	421,069 ha	138 %
Species							
Birds							

Skykomish Riparian (WPG Site # 183)

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Bald eagle roosts *Haliaeetus leucocephalus*	G5	1 rst	1.4%	175.8	11.0 %	9 rst	472 %
<u>Mammals</u>							
Fisher *Martes pennanti*	G5	513 ha	0.1%		%	ha	%

Smith Range

Site No 114

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	84 %	BC Provincial:	100 %	US State:	0 %
Area:	1,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	2,470	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		906 ha	0.1%	16.7	0.3 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		63 ha	0.0%	6.7	0.1 %	44,848 ha	127 %
North Pacific Mesic Western Hemlock - Silver fir Forest		1 ha	0.0%	0.8	0.0 %	7,191 ha	207 %
Aggregate higher elevation		979 ha	0.1%	9.4	0.2 %	496,454 ha	135 %
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	31 ha	0.0%	1.2	0.0 %	119,141 ha	200 %

Snoqualmie - Tolt

Site No 115

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	64 %
			Agriculture	0 %	GAP 1	34 %	BC Provincial:	0 %	US State:	1 %
Area:	7,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	4 %
	18,525	ac	Open Water	3 %	GAP 3	4 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	31 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Montane composite		132 ha	0.1%	2.8	0.4 %	30,002 ha	123 %
Old Growth Forest		2,931 ha	0.3%	7.2	1.1 %	259,308 ha	165 %
Aggregate lower elevation		2,748 ha	0.2%	4.2	0.7 %	421,069 ha	138 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		39 ha	0.1%	2.0	0.3 %	12,529 ha	127 %
North Pacific Lowland Riparian Forest and Shrubland		447 ha	0.8%	16.6	2.6 %	17,205 ha	171 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		203 ha	0.1%	2.3	0.4 %	56,808 ha	131 %
North Pacific Mountain Hemlock Forest		396 ha	0.3%	5.6	0.9 %	44,848 ha	127 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		372 ha	0.1%	3.0	0.5 %	78,777 ha	159 %
North Pacific Mesic Western Hemlock - Silver fir Forest		30 ha	0.1%	2.6	0.4 %	7,191 ha	207 %

Snoqualmie - Tolt

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Montane Massive Bedrock, Cliff and Talus		39 ha	0.1%	1.3	0.2 %	18,742 ha	118 %
North Pacific Montane Riparian Woodland and Shrubland		100 ha	0.5%	10.5	1.6 %	6,069 ha	158 %
North Pacific Maritime Mesic Subalpine Parkland		1 ha	0.0%	0.0	0.0 %	46,402 ha	112 %
Aggregate higher elevation		3,561 ha	0.2%	4.6	0.7 %	496,454 ha	135 %
Species							
Birds							
Northern spotted owl Nests *Strix occidentalis caurina*	G3T3	1 nst	0.3%	3.8	0.6 %	169 nst	194 %
Red breasted sapsucker *Sphyrapicus ruber*	G5	1 occ	2.5%	32.0	5.0 %	10 occ	199 %
Harlequin duck *Histrionicus histrionicus*	G4	1 occ	1.7%	49.2	7.7 %	13 occ	253 %
Common Loon *Gavia immer*	G5	1 nst	3.8%	49.2	7.7 %	13 nst	200 %
Marbled murrelet *Brachyramphus marmoratus*	G3G4	2 occ	1.0%	12.5	1.9 %	77 occ	194 %
Golden Eagle *Aquila chrysaetos*	G5	1 nst	2.6%	33.6	5.3 %	19 nst	189 %
Mammals							
Mountain goat *Oreamos americanus*	G5	793 ha	0.1%	2.7	0.4 %	189,856 ha	135 %
Fisher *Martes pennanti*	G5	1,972 ha	0.4%		%	ha	%
Vascular Plants							
Flat-leaved Bladderwort *Utricularia intermedia*	G5	1 occ	50.0%	639.1	100.0 %	1 occ	200 %
Black Lily *Fritillaria camschatcensis*	G5	1 occ	2.6%	52.0	8.1 %	7 occ	302 %
Few-flowered Sedge *Carex pauciflora*	G5	1 occ	5.7%	91.3	14.3 %	7 occ	229 %
Choris' Bog-orchid *Platanthera chorisiana*	G3G4	1 occ	7.1%	91.3	14.3 %	7 occ	171 %
Plant Communities							

Snoqualmie - Tolt

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Carex (livida, utriculata) / Sphagnum spp. Herbaceous Vegetation Community *Carex (livida, utriculata) / Sphagnum spp. Herbaceous Vegetation*	G1G2	20 ha	50.0%	639.7	100.1%	20 ha	200 %
Tsuga heterophylla - (Thuja plicata) / Ledum groenlandicum / Sphagnum spp. Woodland Community *Tsuga heterophylla - (Thuja plicata) / Ledum groenlandicum / Sphagnum spp.*		27 ha	20.5%	260.9	40.8%	66 ha	199 %
Thuja plicata - Tsuga heterophylla / Lysichiton americanus Forest Community *Thuja plicata - Tsuga heterophylla / Lysichiton americanus*	G2	13 ha	6.9%	88.6	13.9%	95 ha	200 %
Rhynchospora alba - (Vaccinium oxycoccus) / Sphagnum tenellum Herbaceous Vegetation Community *Rhynchospora alba - (Vaccinium oxycoccus) / Sphagnum tenellum*	G3	20 ha	25.1%	319.9	50.0%	40 ha	200 %

Snoqualmie Foothill Forest (WPG Site # 177)

Site No 116

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	0 %	US State:	90 %
Area:	4,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	11,115	ac	Open Water	1 %	GAP 3	15 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	10 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		577 ha	0.1%	2.4	0.2 %	259,308 ha	165 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		66 ha	0.0%	0.9	0.1 %	78,777 ha	159 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		2,831 ha	1.5%	53.1	5.0 %	56,808 ha	131 %
North Pacific Lowland Riparian Forest and Shrubland		42 ha	0.1%	2.6	0.2 %	17,205 ha	171 %
Montane composite		4 ha	0.0%	0.1	0.0 %	30,002 ha	123 %
Aggregate lower elevation		3,899 ha	0.3%	9.9	0.9 %	421,069 ha	138 %
Species							
Amphibians							
Cascades frog *Rana cascadae*	G3G4	1 occ	2.3%	81.9	7.7 %	13 occ	210 %
Mammals							

Snoqualmie Foothill Forest (WPG Site # 177)

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Fisher *Martes pennanti*	G5	494 ha	0.1%		%	ha	%

Snoqualmie Pass

Site No 117

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	73 %
			Agriculture	0 %	GAP 1	69 %	BC Provincial:	0 %	US State:	0 %
Area:	1,000	ha	Developed	1 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	2,470	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	27 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		177 ha	0.4%	67.7	1.4 %	12,529 ha	127 %
Aggregate higher elevation		76 ha	0.0%	0.7	0.0 %	496,454 ha	135 %
Montane composite		137 ha	0.1%	21.8	0.5 %	30,002 ha	123 %
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland		6 ha	0.0%	0.6	0.0 %	47,698 ha	104 %
North Pacific Lowland Riparian Forest and Shrubland		10 ha	0.0%	2.8	0.1 %	17,205 ha	171 %
North Pacific Maritime Mesic Subalpine Parkland		19 ha	0.0%	1.9	0.0 %	46,402 ha	112 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		2 ha	0.0%	0.1	0.0 %	78,777 ha	159 %
North Pacific Montane Massive Bedrock, Cliff and Talus		2 ha	0.0%	0.4	0.0 %	18,742 ha	118 %
North Pacific Montane Riparian Woodland and Shrubland		13 ha	0.1%	10.0	0.2 %	6,069 ha	158 %

Snoqualmie Pass

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Mountain Hemlock Forest		5 ha	0.0%	0.6	0.0 %	44,848 ha	127 %
Old Growth Forest		377 ha	0.0%	7.0	0.1 %	259,308 ha	165 %
Aggregate lower elevation		616 ha	0.0%	7.0	0.1 %	421,069 ha	138 %
Species							
Birds							
Harlequin duck *Histrionicus histrionicus*	G4	1 occ	0.9%	184.4	3.8 %	13 occ	253 %
Red breasted sapsucker *Sphyrapicus ruber*	G5	0 occ	1.7%	158.2	3.3 %	10 occ	199 %
Mammals							
Mountain goat *Oreamos americanus*	G5	99 ha	0.0%	2.5	0.1 %	189,856 ha	135 %
Gray wolf *Canis lupus*	G4	1 occ	4.2%	399.5	8.3 %	12 occ	196 %
Fisher *Martes pennanti*	G5	354 ha	0.1%		%	ha	%
Vascular Plants							
Few-flowered Sedge *Carex pauciflora*	G5	1 occ	5.7%	684.8	14.3 %	7 occ	229 %

South Sunshine

Site No 118

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	1 %	BC Provincial:	78 %	US State:	0 %
Area:	2,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	4,940	ac	Open Water	0 %	GAP 3	0 %	Can Private:	22 %	US Indigenous:	0 %
					GAP 4	20 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		127 ha	0.0%	1.2	0.0 %	259,308 ha	165 %
North Pacific Mesic Western Hemlock - Silver fir Forest		0 ha	0.0%	0.0	0.0 %	7,191 ha	207 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		1,576 ha	0.6%	48.0	2.0 %	78,777 ha	159 %
North Pacific Lowland Riparian Forest and Shrubland		9 ha	0.0%	1.3	0.1 %	17,205 ha	171 %
Aggregate lower elevation		1,576 ha	0.1%	9.0	0.4 %	421,069 ha	138 %
Aggregate higher elevation		185 ha	0.0%	0.9	0.0 %	496,454 ha	135 %
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	157 ha	0.1%	3.2	0.1 %	119,141 ha	200 %

Sowaqua

Site No 119

Southeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	2,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	6,175	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland		257 ha	0.2%	10.3	0.5 %	47,698 ha	104 %
Old Growth Forest		386 ha	0.0%	2.9	0.1 %	259,308 ha	165 %
Northern Rocky Mountain Subalpine Dry Parkland		238 ha	0.9%	59.5	3.1 %	7,664 ha	109 %
North Pacific Mountain Hemlock Forest		55 ha	0.0%	2.3	0.1 %	44,848 ha	127 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		1 ha	0.0%	0.0	0.0 %	78,777 ha	159 %
North Pacific Lowland Riparian Forest and Shrubland		4 ha	0.0%	0.4	0.0 %	17,205 ha	171 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		36 ha	0.1%	5.6	0.3 %	12,529 ha	127 %
Aggregate lower elevation		762 ha	0.1%	3.5	0.2 %	421,069 ha	138 %
Aggregate higher elevation		1,211 ha	0.1%	4.7	0.2 %	496,454 ha	135 %

Sowaqua

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Species							
Birds							
Northern spotted owl Nests *Strix occidentalis caurina*	G3T3	1 nst	0.3%	11.3	0.6 %	169 nst	194 %
Northern spotted owl *Strix occidentalis caurina*	G3T3	1 occ	1.0%	52.9	2.8 %	25 occ	204 %
Mammals							
Mtn beaver rainieri *Aplodontia rufa rainieri*	G5T4	1 occ	1.7%	147.5	7.7 %	13 occ	199 %
Mountain goat *Oreamos americanus*	G5	40 ha	0.0%	0.4	0.0 %	189,856 ha	135 %

Spuzzum

Site No 120

Northeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	83 %	US State:	0 %
Area:	6,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	6 %	US Local:	0 %
	14,820	ac	Open Water	1 %	GAP 3	0 %	Can Private:	12 %	US Indigenous:	0 %
					GAP 4	17 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		294 ha	0.0%	0.9	0.1 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		149 ha	0.1%	2.7	0.3 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		24 ha	0.1%	3.1	0.4 %	6,069 ha	158 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		313 ha	0.1%	3.2	0.4 %	78,777 ha	159 %
North Pacific Lowland Riparian Forest and Shrubland		24 ha	0.0%	1.1	0.1 %	17,205 ha	171 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		160 ha	0.4%	10.2	1.3 %	12,529 ha	127 %
Aggregate lower elevation		4,432 ha	0.3%	8.4	1.1 %	421,069 ha	138 %
Aggregate higher elevation		1,073 ha	0.1%	1.7	0.2 %	496,454 ha	135 %
Species							
Birds							

Spuzzum

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Northern spotted owl *Strix occidentalis caurina*	G3T3	1 occ	1.3%	28.4	3.6 %	25 occ	204 %
Mammals							
Mtn beaver rainieri *Aplodontia rufa rainieri*	G5T4	1 occ	1.7%	61.5	7.7 %	13 occ	199 %
Other Ecological Features							
Karst PH		27 ha	0.4%	9.0	1.1 %	2,404 ha	201 %

Squeah Mountain

Site No 121

Southeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	1,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	2,470	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		145 ha	0.0%	2.7	0.1 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		8 ha	0.0%	0.8	0.0 %	44,848 ha	127 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		84 ha	0.0%	5.1	0.1 %	78,777 ha	159 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		77 ha	0.2%	29.6	0.6 %	12,529 ha	127 %
Aggregate lower elevation		798 ha	0.1%	9.1	0.2 %	421,069 ha	138 %
Aggregate higher elevation		196 ha	0.0%	1.9	0.0 %	496,454 ha	135 %
Species							
Mammals							
Mtn beaver rainieri *Aplodontia rufa rainieri*	G5T4	1 occ	1.7%	368.7	7.7 %	13 occ	199 %

Stakawus

Site No 122

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	1,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	3,705	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		206 ha	0.0%	2.5	0.1 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		116 ha	0.1%	8.3	0.3 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		81 ha	0.4%	42.9	1.3 %	6,069 ha	158 %
North Pacific Mesic Western Hemlock - Silver fir Forest		40 ha	0.2%	17.9	0.6 %	7,191 ha	207 %
Aggregate higher elevation		1,321 ha	0.1%	8.5	0.3 %	496,454 ha	135 %
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	231 ha	0.1%	6.2	0.2 %	119,141 ha	200 %
Mammals							
Mountain goat *Oreamos americanus*	G5	318 ha	0.1%	5.4	0.2 %	189,856 ha	135 %

Stakawus

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio

Stawamus

Site No 123

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	2,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	6,175	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		1,365 ha	0.2%	10.1	0.5 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		195 ha	0.1%	8.3	0.4 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		10 ha	0.0%	3.2	0.2 %	6,069 ha	158 %
North Pacific Montane Massive Bedrock, Cliff and Talus		102 ha	0.2%	10.5	0.5 %	18,742 ha	118 %
North Pacific Mesic Western Hemlock - Silver fir Forest		24 ha	0.1%	6.3	0.3 %	7,191 ha	207 %
Aggregate higher elevation		1,976 ha	0.1%	7.6	0.4 %	496,454 ha	135 %
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	406 ha	0.1%	6.5	0.3 %	119,141 ha	200 %
Mammals							

Stawamus

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Mountain goat *Oreamos americanus*	G5	145 ha	0.0%	1.5	0.1%	189,856 ha	135 %

Stein - Mehatl - Nahatlatch

Site No 124

Northeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	85 %	BC Provincial:	100 %	US State:	0 %
Area:	41,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	101,270	ac	Open Water	1 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Terrestrial

Terrestrial Ecological Systems

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Maritime Mesic Subalpine Parkland		918 ha	0.6%	2.3	2.0 %	46,402 ha	112 %
Aggregate higher elevation		13,477 ha	0.8%	3.2	2.7 %	496,454 ha	135 %
Aggregate lower elevation		8,847 ha	0.6%	2.5	2.1 %	421,069 ha	138 %
Alpine composite		191 ha	0.7%	2.7	2.3 %	8,126 ha	110 %
East Cascades Mesic Montane Mixed Conifer Forest		1,051 ha	2.2%	8.5	7.3 %	14,376 ha	116 %
Montane composite		32 ha	0.0%	0.1	0.1 %	30,002 ha	123 %
North Pacific Lowland Riparian Forest and Shrubland		304 ha	0.5%	2.1	1.8 %	17,205 ha	171 %
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland		9,922 ha	6.2%	24.3	20.8 %	47,698 ha	104 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		100 ha	0.0%	0.1	0.1 %	78,777 ha	159 %

Stein - Mehatl - Nahatlatch

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Montane Massive Bedrock, Cliff and Talus		22 ha	0.0%	0.1	0.1 %	18,742 ha	118 %
North Pacific Montane Riparian Woodland and Shrubland		420 ha	2.1%	8.1	6.9 %	6,069 ha	158 %
North Pacific Mountain Hemlock Forest		1,260 ha	0.8%	3.3	2.8 %	44,848 ha	127 %
Northern Interior Spruce-Fir woodland and forest		5 ha	0.7%	2.8	2.4 %	220 ha	135 %
Old Growth Forest		7,955 ha	0.9%	3.6	3.1 %	259,308 ha	165 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		198 ha	0.5%	1.8	1.6 %	12,529 ha	127 %
Species							
Birds							
Northern spotted owl *Strix occidentalis caurina*	G3T3	1 occ	1.5%	4.7	4.0 %	25 occ	204 %
Mammals							
Mountain goat *Oreamos americanus*	G5	195 ha	0.0%	0.1	0.1 %	189,856 ha	135 %

Steven's Pass

Site No 125

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	97 %
			Agriculture	0 %	GAP 1	57 %	BC Provincial:	0 %	US State:	0 %
Area:	4,500	ha	Developed	1 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	11,115	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	3 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Montane composite		718 ha	0.7%	25.5	2.4 %	30,002 ha	123 %
Aggregate lower elevation		157 ha	0.0%	0.4	0.0 %	421,069 ha	138 %
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland		728 ha	0.5%	16.3	1.5 %	47,698 ha	104 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		13 ha	0.0%	1.1	0.1 %	12,529 ha	127 %
North Pacific Maritime Mesic Subalpine Parkland		432 ha	0.3%	9.9	0.9 %	46,402 ha	112 %
North Pacific Montane Massive Bedrock, Cliff and Talus		41 ha	0.1%	2.3	0.2 %	18,742 ha	118 %
North Pacific Montane Riparian Woodland and Shrubland		3 ha	0.0%	0.4	0.0 %	6,069 ha	158 %
North Pacific Mountain Hemlock Forest		253 ha	0.2%	6.0	0.6 %	44,848 ha	127 %
Northern Rocky Mountain Subalpine Dry Parkland		11 ha	0.0%	1.5	0.1 %	7,664 ha	109 %

Steven's Pass

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Old Growth Forest		755 ha	0.1%	3.1	0.3 %	259,308 ha	165 %
Aggregate higher elevation		2,787 ha	0.2%	6.0	0.6 %	496,454 ha	135 %
Species							
Amphibians							
Cascades frog *Rana cascadae*	G3G4	1 occ	2.3%	81.9	7.7 %	13 occ	210 %
Birds							
Northern spotted owl Nests *Strix occidentalis caurina*	G3T3	1 nst	0.3%	6.3	0.6 %	169 nst	194 %
Northern goshawk *Accipiter gentilis laingi*	G5	1 occ	1.6%	33.3	3.1 %	32 occ	194 %
Mammals							
Gray wolf *Canis lupus*	G4	1 occ	4.2%	88.8	8.3 %	12 occ	196 %
Fisher *Martes pennanti*	G5	178 ha	0.0%		%	ha	%
Vascular Plants							
Stalked Moonwort *Botrychium pedunculosum*	G2G3	1 occ	16.7%	355.1	33.3 %	3 occ	200 %
Long-styled Sedge *Carex stylosa*	G5	1 occ	7.1%	152.2	14.3 %	7 occ	197 %

Stillaguamish - Port Susan (WPG #129)

Site No 126

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	0 %	US State:	71 %
Area:	8,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	19,760	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	29 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		324 ha	0.0%	0.7	0.1 %	259,308 ha	165 %
North Pacific Montane Riparian Woodland and Shrubland		0 ha	0.0%	0.0	0.0 %	6,069 ha	158 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		125 ha	0.0%	0.9	0.2 %	78,777 ha	159 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		2,393 ha	1.3%	25.2	4.2 %	56,808 ha	131 %
North Pacific Lowland Riparian Forest and Shrubland		97 ha	0.2%	3.4	0.6 %	17,205 ha	171 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		809 ha	1.9%	38.7	6.5 %	12,529 ha	127 %
Montane composite		8 ha	0.0%	0.2	0.0 %	30,002 ha	123 %
Aggregate lower elevation		7,080 ha	0.5%	10.1	1.7 %	421,069 ha	138 %
Species							
Birds							

Stillaguamish - Port Susan (WPG #129)

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Northern goshawk *Accipiter gentilis laingi*	G5	1 occ	1.6%	18.7	3.1 %	32 occ	194 %
Marbled murrelet *Brachyramphus marmoratus*	G3G4	1 occ	0.7%	7.8	1.3 %	77 occ	194 %
<u>Mammals</u>							
Fisher *Martes pennanti*	G5	665 ha	0.1%		%	ha	%
<u>Vascular Plants</u>							
Poor Sedge *Carex magellanica ssp. irrigua*	G5T5	3 occ	28.6%	342.5	57.2 %	6 occ	200 %
Long-styled Sedge *Carex stylosa*	G5	5 occ	34.3%	410.9	68.6 %	7 occ	197 %

Stoyoma

Site No 127

Southeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	11 %	BC Provincial:	100 %	US State:	0 %
Area:	500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	1,235	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland		149 ha	0.1%	29.9	0.3 %	47,698 ha	104 %
Old Growth Forest		0 ha	0.0%	0.0	0.0 %	259,308 ha	165 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		11 ha	0.0%	8.4	0.1 %	12,529 ha	127 %
East Cascades Mesic Montane Mixed Conifer Forest		11 ha	0.0%	7.5	0.1 %	14,376 ha	116 %
Aggregate lower elevation		296 ha	0.0%	6.7	0.1 %	421,069 ha	138 %
Species							
Mammals							
Mtn beaver rainieri *Aplodontia rufa rainieri*	G5T4	1 occ	1.7%	737.5	7.7 %	13 occ	199 %

Suiattle

Site No 128

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	86 %
			Agriculture	0 %	GAP 1	44 %	BC Provincial:	0 %	US State:	9 %
Area:	27,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	67,925	ac	Open Water	1 %	GAP 3	1 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	5 %
									US NGO	1 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Montane composite		1,352 ha	1.4%	7.9	4.5 %	30,002 ha	123 %
Aggregate higher elevation		8,842 ha	0.5%	3.1	1.8 %	496,454 ha	135 %
Alpine composite		125 ha	0.5%	2.7	1.5 %	8,126 ha	110 %
Old Growth Forest		12,138 ha	1.4%	8.2	4.7 %	259,308 ha	165 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		256 ha	0.6%	3.6	2.0 %	12,529 ha	127 %
North Pacific Lowland Riparian Forest and Shrubland		1,271 ha	2.2%	12.9	7.4 %	17,205 ha	171 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		4,409 ha	2.3%	13.5	7.8 %	56,808 ha	131 %
North Pacific Maritime Mesic Subalpine Parkland		1,697 ha	1.1%	6.4	3.7 %	46,402 ha	112 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		419 ha	0.2%	0.9	0.5 %	78,777 ha	159 %

Suiattle

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Montane Massive Bedrock, Cliff and Talus		364 ha	0.6%	3.4	1.9 %	18,742 ha	118 %
North Pacific Montane Riparian Woodland and Shrubland		22 ha	0.1%	0.6	0.4 %	6,069 ha	158 %
North Pacific Mountain Hemlock Forest		1,811 ha	1.2%	7.0	4.0 %	44,848 ha	127 %
Aggregate lower elevation		13,977 ha	1.0%	5.8	3.3 %	421,069 ha	138 %
Species							
Birds							
Bald eagle roosts *Haliaeetus leucocephalus*	G5	1 rst	1.4%	19.4	11.1 %	9 rst	472 %
White-tailed ptarmigan *Lagopus leucurus*	G5	1 occ	12.5%	43.6	25.0 %	4 occ	200 %
Northern spotted owl Nests *Strix occidentalis caurina*	G3T3	1 nst	0.3%	1.0	0.6 %	169 nst	194 %
Northern goshawk *Accipiter gentilis laingi*	G5	1 occ	1.6%	5.4	3.1 %	32 occ	194 %
Harlequin duck *Histrionicus histrionicus*	G4	1 occ	0.9%	6.7	3.8 %	13 occ	253 %
Mammals							
Mountain goat *Oreamos americanus*	G5	638 ha	0.1%	0.6	0.3 %	189,856 ha	135 %
Gray wolf *Canis lupus*	G4	1 occ	4.2%	14.5	8.3 %	12 occ	196 %
Fisher *Martes pennanti*	G5	10,743 ha	2.1%		%	ha	%

Sultan Basin

Site No 129

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	36 %
			Agriculture	0 %	GAP 1	17 %	BC Provincial:	0 %	US State:	47 %
Area:	34,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	5 %
	83,980	ac	Open Water	1 %	GAP 3	6 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	12 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Montane composite		759 ha	0.8%	3.6	2.5 %	30,002 ha	123 %
Old Growth Forest		10,791 ha	1.2%	5.9	4.2 %	259,308 ha	165 %
Aggregate lower elevation		17,379 ha	1.2%	5.8	4.1 %	421,069 ha	138 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		29 ha	0.1%	0.3	0.2 %	12,529 ha	127 %
North Pacific Lowland Riparian Forest and Shrubland		526 ha	0.9%	4.3	3.1 %	17,205 ha	171 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		7,065 ha	3.7%	17.5	12.4 %	56,808 ha	131 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		853 ha	0.3%	1.5	1.1 %	78,777 ha	159 %
North Pacific Mesic Western Hemlock - Silver fir Forest		262 ha	1.1%	5.1	3.6 %	7,191 ha	207 %
North Pacific Montane Massive Bedrock, Cliff and Talus		215 ha	0.3%	1.6	1.1 %	18,742 ha	118 %

Sultan Basin

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Mountain Hemlock Forest		894 ha	0.6%	2.8	2.0 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		26 ha	0.1%	0.6	0.4 %	6,069 ha	158 %
Aggregate higher elevation		11,774 ha	0.7%	3.3	2.4 %	496,454 ha	135 %
North Pacific Maritime Mesic Subalpine Parkland		268 ha	0.2%	0.8	0.6 %	46,402 ha	112 %
Species							
Amphibians							
Cascades frog *Rana cascadae*	G3G4	1 occ	1.9%	9.2	6.5 %	13 occ	210 %
Western toad ts *Bufo boreas*	G4	1 occ	3.8%	19.9	14.1 %	7 occ	256 %
Birds							
Vaux's swift *Chaetura vauxi*	G5	1 occ	3.6%	10.1	7.1 %	7 occ	171 %
Great blue heron *Ardia herodius fannini*	G5T4	1 occ	4.2%	11.7	8.3 %	12 occ	200 %
Marbled murrelet *Brachyramphus marmoratus*	G3G4	5 occ	3.2%	9.1	6.5 %	77 occ	194 %
Northern spotted owl Nests *Strix occidentalis caurina*	G3T3	1 nst	0.3%	0.8	0.6 %	169 nst	194 %
Bald eagle nests *Haliaeetus leucocephalus*	G5	1 nst	1.1%	12.8	9.1 %	11 nst	473 %
Mammals							
Mountain goat *Oreamos americanus*	G5	2,287 ha	0.4%	1.7	1.2 %	189,856 ha	135 %
Fisher *Martes pennanti*	G5	10,663 ha	2.1%		%	ha	%
Vascular Plants							
Few-flowered Sedge *Carex pauciflora*	G5	4 occ	21.9%	77.5	55.0 %	7 occ	229 %
Black Lily *Fritillaria camschatcensis*	G5	1 occ	4.5%	20.1	14.3 %	7 occ	302 %
Creeping Snowberry *Gaultheria hispidula*	G5	1 occ	50.0%	141.0	100.0 %	1 occ	200 %
Long-styled Sedge *Carex stylosa*	G5	1 occ	7.1%	20.1	14.3 %	7 occ	197 %

Sultan Basin

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Several-flowered Sedge *Carex pluriflora*	G4	1 occ	16.7%	47.0	33.3 %	3 occ	193 %
Spleenwort-leaved Goldthread *Coptis aspleniifolia*	G5	1 occ	12.5%	35.2	25.0 %	4 occ	200 %
Choris' Bog-orchid *Platanthera chorisiana*	G3G4	1 occ	7.1%	20.1	14.3 %	7 occ	171 %
Plant Communities							
Carex aquatilis var. dives - Carex utriculata Herbaceous Vegetation Community *Carex aquatilis var. dives - Carex utriculata Herbaceous Vegetation*		13 ha	50.0%	145.2	103.0 %	13 ha	206 %
Tsuga mertensiana - Abies amabilis / Elliottia pyroliflorus Woodland Community *Tsuga mertensiana - Abies amabilis / Elliottia pyroliflorus*	G3G4	663 ha	34.6%	97.5	69.1 %	959 ha	200 %
Tsuga heterophylla - (Thuja plicata) / Ledum groenlandicum / Sphagnum spp. Woodland Community *Tsuga heterophylla - (Thuja plicata) / Ledum groenlandicum / Sphagnum spp.*		39 ha	29.5%	82.9	58.8 %	66 ha	199 %
Thuja plicata - Tsuga heterophylla / Lysichiton americanus Forest Community *Thuja plicata - Tsuga heterophylla / Lysichiton americanus*	G2	44 ha	23.5%	66.0	46.8 %	95 ha	200 %
Deschampsia caespitosa Herbaceous Vegetation Community *Deschampsia caespitosa Herbaceous Vegetation*	G4	23 ha	50.0%	138.4	98.1 %	23 ha	196 %

Sumas

Site No 130

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	1 %	GAP 1	0 %	BC Provincial:	0 %	US State:	63 %
Area:	12,000	ha	Developed	0 %	GAP 2	3 %	Can Indigenous:	0 %	US Local:	1 %
	29,640	ac	Open Water	0 %	GAP 3	1 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	33 %
									US NGO	3 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Montane composite		77 ha	0.1%	1.0	0.3 %	30,002 ha	123 %
Aggregate lower elevation		10,208 ha	0.7%	9.7	2.4 %	421,069 ha	138 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		267 ha	0.6%	8.5	2.1 %	12,529 ha	127 %
North Pacific Lowland Riparian Forest and Shrubland		398 ha	0.7%	9.2	2.3 %	17,205 ha	171 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		4,075 ha	2.2%	28.7	7.2 %	56,808 ha	131 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		303 ha	0.1%	1.5	0.4 %	78,777 ha	159 %
North Pacific Montane Riparian Woodland and Shrubland		1 ha	0.0%	0.1	0.0 %	6,069 ha	158 %
North Pacific Mountain Hemlock Forest		6 ha	0.0%	0.1	0.0 %	44,848 ha	127 %
Old Growth Forest		252 ha	0.0%	0.4	0.1 %	259,308 ha	165 %

Sumas Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Montane Massive Bedrock, Cliff and Talus		3 ha	0.0%	0.1	0.0 %	18,742 ha	118 %
Aggregate higher elevation		226 ha	0.0%	0.2	0.0 %	496,454 ha	135 %
Species							
Birds							
Bald eagle roosts *Haliaeetus leucocephalus*	G5	1 rst	1.1%	33.3	8.3 %	9 rst	472 %
Band-tailed pigeon *Columba fasciata*	G4	1 occ	9.9%	78.3	19.6 %	5 occ	199 %
Great blue heron *Ardia herodius fannini*	G5T4	1 occ	4.2%	33.3	8.3 %	12 occ	200 %
Marbled murrelet *Brachyramphus marmoratus*	G3G4	1 occ	0.7%	5.2	1.3 %	77 occ	194 %
Mammals							
Roosevelt elk *Cervus canadensis*	G5T4	3,117 ha	1.9%	25.7	6.4 %	48,392 ha	147 %
Fisher *Martes pennanti*	G5	560 ha	0.1%		%	ha	%
Gray wolf *Canis lupus*	G4	0 occ	0.6%	4.7	1.2 %	12 occ	196 %
Vascular Plants							
Lesser Bladderwort *Utricularia minor*	G5	1 occ	50.0%	399.5	100.0 %	1 occ	200 %
Plant Communities							
Carex interior - Hypericum anagalloides Herbaceous Vegetation Community *Carex interior - Hypericum anagalloides Herbaceous Vegetation*	G2?Q	43 ha	50.0%	401.8	100.6 %	43 ha	201 %
Thuja plicata - Tsuga heterophylla / Lysichiton americanus Forest Community *Thuja plicata - Tsuga heterophylla / Lysichiton americanus*	G2	3 ha	1.8%	14.4	3.6 %	95 ha	200 %
Eriophorum chamissonis / Sphagnum spp. Herbaceous Vegetation Community *Eriophorum chamissonis / Sphagnum spp.*		43 ha	34.2%	274.2	68.7 %	63 ha	201 %

Freshwater

Species

Fishes

Sumas

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Chum Salmon (SALMON ECOREGION) *Oncorhynchus keta*	G5	25 km	2.4%	6.8	4.7%	523 km	137 %
Coho Salmon *Oncorhynchus kisutch*	G4	81 km	5.1%	14.9	10.3%	792 km	132 %
Freshwater Ecological Systems							
intermediate,geology_hard_sediments,elevation_low,gradient_mainstem shallow - tributary shallow		13,869 ha	13.6%	65.8	45.3%	30,620 ha	100 %

Sumas River

Site No 131

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	66 %	GAP 1	0 %	BC Provincial:	0 %	US State:	5 %
Area:	4,000	ha	Developed	1 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	9,880	ac	Open Water	0 %	GAP 3	0 %	Can Private:	8 %	US Indigenous:	0 %
					GAP 4	8 %	Can NGO:	0 %	US Private	86 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		29 ha	0.0%	0.1	0.0 %	259,308 ha	165 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		8 ha	0.0%	0.1	0.0 %	78,777 ha	159 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		766 ha	0.4%	16.2	1.3 %	56,808 ha	131 %
North Pacific Lowland Riparian Forest and Shrubland		99 ha	0.2%	6.9	0.6 %	17,205 ha	171 %
Montane composite		5 ha	0.0%	0.2	0.0 %	30,002 ha	123 %
Aggregate lower elevation		967 ha	0.1%	2.8	0.2 %	421,069 ha	138 %
Species							
Birds							
Peregrine falcon *Falco peregrinus anatum*	G4T3	1 nst	2.4%	57.1	4.8 %	21 nst	198 %
Band-tailed pigeon *Columba fasciata*	G4	5 occ	50.1%	1,193.6	99.6 %	5 occ	199 %

Sumas River

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Bald eagle roosts *Haliaeetus leucocephalus*	G5	0 rst	0.6%	55.9	4.7%	9 rst	472 %
Bald eagle nests *Haliaeetus leucocephalus*	G5	1 nst	1.1%	108.9	9.1%	11 nst	473 %
Mammals							
Fisher *Martes pennanti*	G5	78 ha	0.0%		%	ha	%
Other Ecological Features							
Karst SM		435 ha	0.5%	38.4	3.2%	13,584 ha	233 %

Sunday Creek

Site No 132

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	40 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	0 %	US State:	0 %
Area:	2,000	ha	Developed	0 %	GAP 2	13 %	Can Indigenous:	0 %	US Local:	29 %
	4,940	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	30 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		195 ha	0.0%	1.8	0.1 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		24 ha	0.0%	1.3	0.1 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		0 ha	0.0%	0.0	0.0 %	6,069 ha	158 %
North Pacific Montane Massive Bedrock, Cliff and Talus		2 ha	0.0%	0.3	0.0 %	18,742 ha	118 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		131 ha	0.0%	4.0	0.2 %	78,777 ha	159 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		153 ha	0.1%	6.5	0.3 %	56,808 ha	131 %
North Pacific Lowland Riparian Forest and Shrubland		8 ha	0.0%	1.1	0.0 %	17,205 ha	171 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		85 ha	0.2%	16.3	0.7 %	12,529 ha	127 %
Montane composite		15 ha	0.0%	1.2	0.1 %	30,002 ha	123 %

Sunday Creek

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Aggregate lower elevation		1,513 ha	0.1%	8.6	0.4 %	421,069 ha	138 %
Aggregate higher elevation		58 ha	0.0%	0.3	0.0 %	496,454 ha	135 %
Species							
Birds							
Red breasted sapsucker *Sphyrapicus ruber*	G5	1 occ	3.3%	155.8	6.5 %	10 occ	199 %
Northern spotted owl Nests *Strix occidentalis caurina*	G3T3	1 nst	0.3%	14.2	0.6 %	169 nst	194 %
Mammals							
Mountain goat *Oreamos americanus*	G5	137 ha	0.0%	1.7	0.1 %	189,856 ha	135 %
Fisher *Martes pennanti*	G5	208 ha	0.0%		%	ha	%

Sunshine Valley

Site No 133

Southeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	4 %	GAP 1	0 %	BC Provincial:	84 %	US State:	0 %
Area:	2,500	ha	Developed	2 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	6,175	ac	Open Water	1 %	GAP 3	0 %	Can Private:	16 %	US Indigenous:	0 %
					GAP 4	16 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		270 ha	0.0%	2.0	0.1 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		1 ha	0.0%	0.1	0.0 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		45 ha	0.2%	14.3	0.7 %	6,069 ha	158 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		1 ha	0.0%	0.0	0.0 %	78,777 ha	159 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		82 ha	0.2%	12.6	0.7 %	12,529 ha	127 %
Montane composite		341 ha	0.3%	21.8	1.1 %	30,002 ha	123 %
Aggregate lower elevation		1,054 ha	0.1%	4.8	0.3 %	421,069 ha	138 %
Aggregate higher elevation		917 ha	0.1%	3.5	0.2 %	496,454 ha	135 %
Species							
Birds							

Sunshine Valley

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Northern spotted owl *Strix occidentalis caurina*	G3T3	0 occ	0.4%	18.4	1.0%	25 occ	204 %
Mammals							
Mountain goat *Oreamos americanus*	G5	363 ha	0.1%	3.7	0.2%	189,856 ha	135 %
Vascular Plants							
Western Mannagrass *Glyceria occidentalis*	G5	1 occ	25.0%	958.7	50.0%	2 occ	200 %
Other Ecological Features							
Karst PH		360 ha	6.0%	287.1	15.0%	2,404 ha	201 %

Tantalus

Site No 134

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	88 %	BC Provincial:	98 %	US State:	0 %
Area:	5,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	12,350	ac	Open Water	9 %	GAP 3	0 %	Can Private:	2 %	US Indigenous:	0 %
					GAP 4	2 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		1,680 ha	0.2%	6.2	0.6 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		370 ha	0.2%	7.9	0.8 %	44,848 ha	127 %
North Pacific Mesic Western Hemlock - Silver fir Forest		58 ha	0.2%	7.7	0.8 %	7,191 ha	207 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		120 ha	0.0%	1.5	0.2 %	78,777 ha	159 %
North Pacific Lowland Riparian Forest and Shrubland		200 ha	0.3%	11.2	1.2 %	17,205 ha	171 %
Montane composite		43 ha	0.0%	1.4	0.1 %	30,002 ha	123 %
Aggregate lower elevation		120 ha	0.0%	0.3	0.0 %	421,069 ha	138 %
Aggregate higher elevation		3,396 ha	0.2%	6.6	0.7 %	496,454 ha	135 %
Species							
Birds							

Tantalus

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	213 ha	0.1%	1.7	0.2 %	119,141 ha	200 %
Mammals							
Mountain goat *Oreamos americanus*	G5	243 ha	0.0%	1.2	0.1 %	189,856 ha	135 %

Tetrahedon Extension

Site No 135

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	18 %	BC Provincial:	98 %	US State:	0 %
Area:	8,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	19,760	ac	Open Water	0 %	GAP 3	0 %	Can Private:	2 %	US Indigenous:	0 %
					GAP 4	2 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		2,839 ha	0.3%	6.6	1.1 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		461 ha	0.3%	6.2	1.0 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		37 ha	0.2%	3.7	0.6 %	6,069 ha	158 %
North Pacific Mesic Western Hemlock - Silver fir Forest		338 ha	1.4%	28.2	4.7 %	7,191 ha	207 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		389 ha	0.1%	3.0	0.5 %	78,777 ha	159 %
Aggregate lower elevation		389 ha	0.0%	0.6	0.1 %	421,069 ha	138 %
Aggregate higher elevation		6,534 ha	0.4%	7.9	1.3 %	496,454 ha	135 %
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	1,475 ha	0.5%	7.4	1.2 %	119,141 ha	200 %

Tetrahedon Extension

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Mammals							
Mountain goat *Oreamos americanus*	G5	915 ha	0.1%	2.9	0.5%	189,856 ha	135 %

TFL 10

Site No 136

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	7,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	17,290	ac	Open Water	7 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		1,832 ha	0.2%	4.8	0.7 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		178 ha	0.1%	2.7	0.4 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		41 ha	0.2%	4.6	0.7 %	6,069 ha	158 %
North Pacific Montane Massive Bedrock, Cliff and Talus		166 ha	0.3%	6.1	0.9 %	18,742 ha	118 %
North Pacific Mesic Western Hemlock - Silver fir Forest		101 ha	0.4%	9.6	1.4 %	7,191 ha	207 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		334 ha	0.1%	2.9	0.4 %	78,777 ha	159 %
North Pacific Lowland Riparian Forest and Shrubland		112 ha	0.2%	4.5	0.7 %	17,205 ha	171 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		48 ha	0.1%	2.6	0.4 %	12,529 ha	127 %
Montane composite		169 ha	0.2%	3.9	0.6 %	30,002 ha	123 %

TFL 10

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Aggregate lower elevation		734 ha	0.1%	1.2	0.2 %	421,069 ha	138 %
Aggregate higher elevation		3,180 ha	0.2%	4.4	0.6 %	496,454 ha	135 %
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	814 ha	0.3%	4.7	0.7 %	119,141 ha	200 %
Mammals							
Mountain goat *Oreamos americanus*	G5	273 ha	0.0%	1.0	0.1 %	189,856 ha	135 %

TFL 38

Site No 137

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	2 %	BC Provincial:	99 %	US State:	0 %
Area:	53,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	132,145	ac	Open Water	2 %	GAP 3	0 %	Can Private:	1 %	US Indigenous:	0 %
					GAP 4	1 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		1,277 ha	3.1%	9.1	10.2 %	12,529 ha	127 %
Aggregate higher elevation		10,408 ha	0.6%	1.9	2.1 %	496,454 ha	135 %
Aggregate lower elevation		30,880 ha	2.2%	6.6	7.3 %	421,069 ha	138 %
Montane composite		1,120 ha	1.1%	3.3	3.7 %	30,002 ha	123 %
Old Growth Forest		21,995 ha	2.5%	7.6	8.5 %	259,308 ha	165 %
North Pacific Lowland Riparian Forest and Shrubland		1,483 ha	2.6%	7.7	8.6 %	17,205 ha	171 %
North Pacific Maritime Mesic Subalpine Parkland		359 ha	0.2%	0.7	0.8 %	46,402 ha	112 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		2,049 ha	0.8%	2.3	2.6 %	78,777 ha	159 %
North Pacific Mesic Western Hemlock - Silver fir Forest		133 ha	0.6%	1.7	1.9 %	7,191 ha	207 %

TFL 38

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Montane Massive Bedrock, Cliff and Talus		150 ha	0.2%	0.7	0.8 %	18,742 ha	118 %
North Pacific Montane Riparian Woodland and Shrubland		149 ha	0.7%	2.2	2.5 %	6,069 ha	158 %
North Pacific Mountain Hemlock Forest		1,232 ha	0.8%	2.5	2.7 %	44,848 ha	127 %
Alpine composite		2 ha	0.0%	0.0	0.0 %	8,126 ha	110 %
Species							
Birds							
Northern goshawk *Accipiter gentilis laingi*	G5	1 occ	1.6%	2.8	3.1 %	32 occ	194 %
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	13,419 ha	4.8%	10.1	11.3 %	119,141 ha	200 %
Mammals							
Mountain goat *Oreamos americanus*	G5	6,660 ha	1.1%	3.1	3.5 %	189,856 ha	135 %
Plant Communities							
Picea sitchensis / Rubus spectabilis Dry Community *Picea sitchensis / Rubus spectabilis*		3 ha	0.0%	0.0	0.0 %	31,247 ha	200 %
Other Ecological Features							
Hot Spring		1 occ	3.8%	6.9	7.7 %	13 occ	200 %

The Knuckles

Site No 138

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	8,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	20,995	ac	Open Water	4 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		920 ha	0.1%	2.0	0.4 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		296 ha	0.2%	3.7	0.7 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		89 ha	0.4%	8.2	1.5 %	6,069 ha	158 %
North Pacific Mesic Western Hemlock - Silver fir Forest		40 ha	0.2%	3.1	0.6 %	7,191 ha	207 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		3,910 ha	1.5%	28.0	5.0 %	78,777 ha	159 %
North Pacific Lowland Riparian Forest and Shrubland		148 ha	0.3%	4.9	0.9 %	17,205 ha	171 %
Aggregate lower elevation		3,910 ha	0.3%	5.2	0.9 %	421,069 ha	138 %
Aggregate higher elevation		3,490 ha	0.2%	4.0	0.7 %	496,454 ha	135 %
Species							
Birds							

The Knuckles

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	534 ha	0.2%	2.5	0.4 %	119,141 ha	200 %
Mammals							
Mountain goat *Oreamos americanus*	G5	654 ha	0.1%	1.9	0.3 %	189,856 ha	135 %
Vascular Plants							
Pointed Broom Sedge *Carex scoparia*	G5	1 occ	50.0%	563.9	100.0 %	1 occ	200 %
Menzies' Burnet *Sanguisorba menziesii*	G3G4	1 occ	50.0%	563.9	100.0 %	1 occ	200 %

Tokul Basin

Site No 139

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	1 %	GAP 1	0 %	BC Provincial:	0 %	US State:	1 %
Area:	4,000	ha	Developed	1 %	GAP 2	13 %	Can Indigenous:	0 %	US Local:	0 %
	9,880	ac	Open Water	3 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	86 %
									US NGO	13 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		181 ha	0.0%	0.8	0.1 %	259,308 ha	165 %
North Pacific Montane Massive Bedrock, Cliff and Talus		2 ha	0.0%	0.1	0.0 %	18,742 ha	118 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		17 ha	0.0%	0.3	0.0 %	78,777 ha	159 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		2,030 ha	1.1%	42.8	3.6 %	56,808 ha	131 %
North Pacific Lowland Riparian Forest and Shrubland		65 ha	0.1%	4.5	0.4 %	17,205 ha	171 %
Montane composite		26 ha	0.0%	1.1	0.1 %	30,002 ha	123 %
Aggregate lower elevation		2,855 ha	0.2%	8.1	0.7 %	421,069 ha	138 %
Species							
Birds							
Peregrine falcon *Falco peregrinus anatum*	G4T3	1 nst	2.4%	57.1	4.8 %	21 nst	198 %

Tokul Basin

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Northern goshawk *Accipiter gentilis laingi*	G5	1 occ	1.6%	37.4	3.1 %	32 occ	194 %
Mammals							
Fisher *Martes pennanti*	G5	270 ha	0.1%		%	ha	%
Plant Communities							
Spiraea douglasii / Carex aquatilis var. dives Shrubland Community *Spiraea douglasii / Carex aquatilis var. dives*	G4	16 ha	50.0%	1,186.5	99.0 %	16 ha	198 %
Rhynchospora alba - (Vaccinium oxycoccus) / Sphagnum tenellum Herbaceous Vegetation Community *Rhynchospora alba - (Vaccinium oxycoccus) / Sphagnum tenellum*	G3	20 ha	24.9%	596.8	49.8 %	40 ha	200 %
Ledum groenlandicum - Myrica gale / Sphagnum spp. Shrubland Community *Ledum groenlandicum - Myrica gale / Sphagnum spp.*	G2	7 ha	50.0%	1,135.3	94.7 %	7 ha	189 %
Eriophorum chamissonis / Sphagnum spp. Herbaceous Vegetation Community *Eriophorum chamissonis / Sphagnum spp.*		20 ha	15.8%	378.9	31.6 %	63 ha	201 %
Carex cusickii - (Carex aquatilis var. dives) / Sphagnum spp. Herbaceous Vegetation Community *Carex cusickii - (Carex aquatilis var. dives) / Sphagnum spp. Herbaceous Vegetation*		20 ha	50.0%	1,193.5	99.6 %	20 ha	199 %

Tomyhoi Lake

Site No 140

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	100 %
			Agriculture	0 %	GAP 1	100 %	BC Provincial:	0 %	US State:	0 %
Area:	2,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	4,940	ac	Open Water	4 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		158 ha	0.0%	1.5	0.1 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		50 ha	0.0%	2.7	0.1 %	44,848 ha	127 %
North Pacific Montane Massive Bedrock, Cliff and Talus		185 ha	0.3%	23.6	1.0 %	18,742 ha	118 %
North Pacific Maritime Mesic Subalpine Parkland		409 ha	0.3%	21.1	0.9 %	46,402 ha	112 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		0 ha	0.0%	0.0	0.0 %	12,529 ha	127 %
Montane composite		30 ha	0.0%	2.4	0.1 %	30,002 ha	123 %
Alpine composite		5 ha	0.0%	1.4	0.1 %	8,126 ha	110 %
Aggregate lower elevation		113 ha	0.0%	0.6	0.0 %	421,069 ha	138 %
Aggregate higher elevation		1,352 ha	0.1%	6.5	0.3 %	496,454 ha	135 %

Tomyhoi Lake

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Species							
Insects							
Vidler's alpine *Erebia vidleri*	G4G5	1 occ	50.0%	2,396.7	100.0%	1 occ	200 %
Mammals							
Fisher *Martes pennanti*	G5	45 ha	0.0%		%	ha	%
Vascular Plants							
Arctic Aster *Aster sibiricus var. meritus*	G5T5	1 occ	16.7%	798.9	33.3%	3 occ	200 %

Tonga Ridge

Site No 141

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	99 %
			Agriculture	0 %	GAP 1	34 %	BC Provincial:	0 %	US State:	0 %
Area:	6,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	16,055	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	1 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio

Terrestrial

Terrestrial Ecological Systems

Target	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		47 ha	0.1%	2.8	0.4 %	12,529 ha	127 %
Aggregate higher elevation		2,341 ha	0.1%	3.5	0.5 %	496,454 ha	135 %
Montane composite		183 ha	0.2%	4.5	0.6 %	30,002 ha	123 %
Old Growth Forest		2,241 ha	0.3%	6.4	0.9 %	259,308 ha	165 %
North Pacific Lowland Riparian Forest and Shrubland		214 ha	0.4%	9.2	1.2 %	17,205 ha	171 %
North Pacific Maritime Mesic Subalpine Parkland		203 ha	0.1%	3.2	0.4 %	46,402 ha	112 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		269 ha	0.1%	2.5	0.3 %	78,777 ha	159 %
North Pacific Mesic Western Hemlock - Silver fir Forest		1 ha	0.0%	0.1	0.0 %	7,191 ha	207 %
North Pacific Montane Massive Bedrock, Cliff and Talus		28 ha	0.0%	1.1	0.2 %	18,742 ha	118 %

Tonga Ridge Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Montane Riparian Woodland and Shrubland		14 ha	0.1%	1.7	0.2 %	6,069 ha	158 %
North Pacific Mountain Hemlock Forest		322 ha	0.2%	5.3	0.7 %	44,848 ha	127 %
Aggregate lower elevation		3,335 ha	0.2%	5.8	0.8 %	421,069 ha	138 %
Species							
Birds							
Bald eagle roosts *Haliaeetus leucocephalus*	G5	1 rst	0.7%	41.0	5.6 %	9 rst	472 %
Northern spotted owl Nests *Strix occidentalis caurina*	G3T3	1 nst	0.3%	4.4	0.6 %	169 nst	194 %
Mammals							
Townsend's big-eared bat *Coryhorhinus townsendii*	G4	1 occ	16.7%	245.8	33.3 %	3 occ	200 %
Mountain goat *Oreamos americanus*	G5	2,270 ha	0.4%	8.8	1.2 %	189,856 ha	135 %
Fisher *Martes pennanti*	G5	1,664 ha	0.3%		%	ha	%
Vascular Plants							
Small Northern Bog-orchid *Platanthera obtusata*	G5	1 occ	25.0%	368.7	50.0 %	2 occ	200 %

Tretheway

Site No 142

Northeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	1,235	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		369 ha	0.0%	13.7	0.1 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		13 ha	0.0%	2.7	0.0 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		4 ha	0.0%	7.0	0.1 %	6,069 ha	158 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		1 ha	0.0%	0.6	0.0 %	12,529 ha	127 %
Aggregate lower elevation		266 ha	0.0%	6.1	0.1 %	421,069 ha	138 %
Aggregate higher elevation		229 ha	0.0%	4.4	0.0 %	496,454 ha	135 %
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	73 ha	0.0%	5.8	0.1 %	119,141 ha	200 %

Tzoonie

Site No 143

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	4,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	11,115	ac	Open Water	1 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		1,321 ha	0.2%	5.4	0.5 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		240 ha	0.2%	5.7	0.5 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		114 ha	0.6%	20.0	1.9 %	6,069 ha	158 %
North Pacific Montane Massive Bedrock, Cliff and Talus		53 ha	0.1%	3.0	0.3 %	18,742 ha	118 %
North Pacific Mesic Western Hemlock - Silver fir Forest		264 ha	1.1%	39.1	3.7 %	7,191 ha	207 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		117 ha	0.0%	1.6	0.1 %	78,777 ha	159 %
Aggregate lower elevation		117 ha	0.0%	0.3	0.0 %	421,069 ha	138 %
Aggregate higher elevation		3,539 ha	0.2%	7.6	0.7 %	496,454 ha	135 %
Species							
Birds							

Tzoonie

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	740 ha	0.3%	6.6	0.6 %	119,141 ha	200 %
Mammals							
Mountain goat *Oreamos americanus*	G5	690 ha	0.1%	3.9	0.4 %	189,856 ha	135 %

Freshwater

Freshwater Ecological Systems

small,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem shallow - tributary shallow		2,117 ha	2.1%	101.6	7.0 %	30,404 ha	99 %

Upper Lillooet

Site No 144

Northeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	72 %	BC Provincial:	100 %	US State:	0 %
Area:	16,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	40,755	ac	Open Water	3 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Alpine composite		803 ha	3.0%	28.7	9.9 %	8,126 ha	110 %
Aggregate lower elevation		3,677 ha	0.3%	2.5	0.9 %	421,069 ha	138 %
Old Growth Forest		4,670 ha	0.5%	5.2	1.8 %	259,308 ha	165 %
Montane composite		1,859 ha	1.9%	18.0	6.2 %	30,002 ha	123 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		60 ha	0.1%	1.4	0.5 %	12,529 ha	127 %
North Pacific Maritime Mesic Subalpine Parkland		414 ha	0.3%	2.6	0.9 %	46,402 ha	112 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		0 ha	0.0%	0.0	0.0 %	78,777 ha	159 %
North Pacific Montane Riparian Woodland and Shrubland		316 ha	1.6%	15.1	5.2 %	6,069 ha	158 %
North Pacific Mountain Hemlock Forest		213 ha	0.1%	1.4	0.5 %	44,848 ha	127 %

Upper Lillooet

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Aggregate higher elevation		6,805 ha	0.4%	4.0	1.4 %	496,454 ha	135 %
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	566 ha	0.2%	1.4	0.5 %	119,141 ha	200 %
Mammals							
Mountain goat *Oreamos americanus*	G5	1,714 ha	0.3%	2.6	0.9 %	189,856 ha	135 %
Vascular Plants							
Olney's Bulrush *Schoenoplectus americanus*	G5	1 occ	50.0%	290.5	100.0 %	1 occ	200 %
Marginal Wood Fern *Dryopteris marginalis*	G5	1 occ	31.0%	180.1	62.0 %	1 occ	200 %
Blunt-sepaled Starwort *Stellaria obtusa*	G5	1 occ	32.0%	185.9	64.0 %	1 occ	200 %
Plant Communities							
Populus balsamifera ssp. trichocarpa / Salix sitchensis - Rubus parviflorus Community *Populus balsamifera ssp. trichocarpa / Salix sitchensis - Rubus parviflorus*		313 ha	50.0%	290.1	99.9 %	313 ha	200 %
Other Ecological Features							
Hot Spring		4 occ	15.4%	89.4	30.8 %	13 occ	200 %

Upper NF Stillaguamish

Site No 145

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	41 %
			Agriculture	3 %	GAP 1	1 %	BC Provincial:	0 %	US State:	29 %
Area:	15,500	ha	Developed	1 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	38,285	ac	Open Water	0 %	GAP 3	1 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	29 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		126 ha	0.3%	3.1	1.0 %	12,529 ha	127 %
Aggregate higher elevation		441 ha	0.0%	0.3	0.1 %	496,454 ha	135 %
Montane composite		1,038 ha	1.0%	10.7	3.5 %	30,002 ha	123 %
Old Growth Forest		2,489 ha	0.3%	3.0	1.0 %	259,308 ha	165 %
North Pacific Lowland Riparian Forest and Shrubland		975 ha	1.7%	17.5	5.7 %	17,205 ha	171 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		3,735 ha	2.0%	20.3	6.6 %	56,808 ha	131 %
North Pacific Maritime Mesic Subalpine Parkland		44 ha	0.0%	0.3	0.1 %	46,402 ha	112 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		814 ha	0.3%	3.2	1.0 %	78,777 ha	159 %
North Pacific Mesic Western Hemlock - Silver fir Forest		0 ha	0.0%	0.0	0.0 %	7,191 ha	207 %

Upper NF Stillaguamish

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Montane Massive Bedrock, Cliff and Talus		126 ha	0.2%	2.1	0.7 %	18,742 ha	118 %
North Pacific Mountain Hemlock Forest		74 ha	0.0%	0.5	0.2 %	44,848 ha	127 %
Aggregate lower elevation		10,724 ha	0.8%	7.9	2.5 %	421,069 ha	138 %
Species							
Birds							
Bald eagle nests *Haliaeetus leucocephalus*	G5	1 nst	1.1%	28.1	9.1 %	11 nst	473 %
Northern spotted owl Nests *Strix occidentalis caurina*	G3T3	1 nst	0.3%	1.8	0.6 %	169 nst	194 %
Great blue heron *Ardia herodius fannini*	G5T4	3 occ	12.5%	77.3	25.0 %	12 occ	200 %
Bald eagle roosts *Haliaeetus leucocephalus*	G5	2 rst	2.4%	57.4	18.6 %	9 rst	472 %
Mammals							
Townsend's big-eared bat *Coryhorhinus townsendii*	G4	1 occ	16.7%	103.1	33.3 %	3 occ	200 %
Gray wolf *Canis lupus*	G4	0 occ	0.8%	5.2	1.7 %	12 occ	196 %
Fisher *Martes pennanti*	G5	3,395 ha	0.7%		%	ha	%

Upper Skagit

Site No 146

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	99 %
			Agriculture	0 %	GAP 1	99 %	BC Provincial:	0 %	US State:	0 %
Area:	19,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	48,165	ac	Open Water	1 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	1 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
North Pacific Lowland Riparian Forest and Shrubland		314 ha	0.5%	4.5	1.8 %	17,205 ha	171 %
Aggregate higher elevation		6,098 ha	0.4%	3.0	1.2 %	496,454 ha	135 %
Aggregate lower elevation		9,671 ha	0.7%	5.6	2.3 %	421,069 ha	138 %
Alpine composite		35 ha	0.1%	1.1	0.4 %	8,126 ha	110 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		43 ha	0.1%	0.9	0.3 %	12,529 ha	127 %
Old Growth Forest		4,259 ha	0.5%	4.0	1.6 %	259,308 ha	165 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		2,318 ha	1.2%	10.0	4.1 %	56,808 ha	131 %
North Pacific Maritime Mesic Subalpine Parkland		1,789 ha	1.2%	9.5	3.9 %	46,402 ha	112 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		183 ha	0.1%	0.6	0.2 %	78,777 ha	159 %

Upper Skagit

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Montane Massive Bedrock, Cliff and Talus		1,313 ha	2.1%	17.2	7.0 %	18,742 ha	118 %
North Pacific Montane Riparian Woodland and Shrubland		25 ha	0.1%	1.0	0.4 %	6,069 ha	158 %
North Pacific Mountain Hemlock Forest		1,083 ha	0.7%	5.9	2.4 %	44,848 ha	127 %
Montane composite		1,008 ha	1.0%	8.3	3.4 %	30,002 ha	123 %
Species							
Birds							
Peregrine falcon *Falco peregrinus anatum*	G4T3	1 nst	2.4%	11.7	4.8 %	21 nst	198 %
Mammals							
Fisher *Martes pennanti*	G5	4,752 ha	0.9%		%	ha	%
Vascular Plants							
Small Northern Bog-orchid *Platanthera obtusata*	G5	1 occ	25.0%	122.9	50.0 %	2 occ	200 %
Large-awn Sedge *Carex macrochaeta*	G5	1 occ	50.0%	245.8	100.0 %	1 occ	200 %

Upper Skykomish

Site No 147

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	95 %
			Agriculture	0 %	GAP 1	1 %	BC Provincial:	0 %	US State:	2 %
Area:	7,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	18,525	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	3 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		49 ha	0.1%	2.5	0.4 %	12,529 ha	127 %
Aggregate higher elevation		1,257 ha	0.1%	1.6	0.3 %	496,454 ha	135 %
Montane composite		1,300 ha	1.3%	27.7	4.3 %	30,002 ha	123 %
Old Growth Forest		2,444 ha	0.3%	6.0	0.9 %	259,308 ha	165 %
North Pacific Lowland Riparian Forest and Shrubland		229 ha	0.4%	8.5	1.3 %	17,205 ha	171 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		334 ha	0.2%	3.8	0.6 %	56,808 ha	131 %
North Pacific Maritime Mesic Subalpine Parkland		56 ha	0.0%	0.8	0.1 %	46,402 ha	112 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		319 ha	0.1%	2.6	0.4 %	78,777 ha	159 %
North Pacific Montane Massive Bedrock, Cliff and Talus		31 ha	0.0%	1.0	0.2 %	18,742 ha	118 %

Upper Skykomish Targets known in this Conservation Area:	GRank	Abundance		% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal		% of Goal Captured by Portfolio
North Pacific Montane Riparian Woodland and Shrubland		2	ha	0.0%	0.2	0.0%	6,069	ha	158 %
North Pacific Mountain Hemlock Forest		250	ha	0.2%	3.6	0.6%	44,848	ha	127 %
Aggregate lower elevation		4,351	ha	0.3%	6.6	1.0%	421,069	ha	138 %
<u>Species</u>									
<u>Birds</u>									
Bald eagle roosts *Haliaeetus leucocephalus*	G5	1	rst	1.4%	71.0	11.1%	9	rst	472 %
Red breasted sapsucker *Sphyrapicus ruber*	G5	1	occ	5.0%	63.9	10.0%	10	occ	199 %
Northern spotted owl Nests *Strix occidentalis caurina*	G3T3	1	nst	0.3%	3.8	0.6%	169	nst	194 %
Northern goshawk *Accipiter gentilis laingi*	G5	1	occ	1.6%	20.0	3.1%	32	occ	194 %
Harlequin duck *Histrionicus histrionicus*	G4	1	occ	2.3%	64.4	10.1%	13	occ	253 %
<u>Mammals</u>									
Mountain goat *Oreamos americanus*	G5	99	ha	0.0%	0.3	0.1%	189,856	ha	135 %
Fisher *Martes pennanti*	G5	2,444	ha	0.5%		%		ha	%

Urquhart

Site No 148

Northeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	5,500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	13,585	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		1,486 ha	0.2%	5.0	0.6 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		736 ha	0.5%	14.3	1.6 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		21 ha	0.1%	3.0	0.3 %	6,069 ha	158 %
North Pacific Maritime Mesic Subalpine Parkland		513 ha	0.3%	9.6	1.1 %	46,402 ha	112 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		60 ha	0.1%	4.1	0.5 %	12,529 ha	127 %
Alpine composite		88 ha	0.3%	9.5	1.1 %	8,126 ha	110 %
Aggregate lower elevation		1,342 ha	0.1%	2.8	0.3 %	421,069 ha	138 %
Aggregate higher elevation		3,939 ha	0.2%	6.9	0.8 %	496,454 ha	135 %
Species							
Birds							

Urquhart

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Northern spotted owl *Strix occidentalis caurina*	G3T3	1 occ	0.9%	20.2	2.3 %	25 occ	204 %
Mammals							
Mountain goat *Oreamos americanus*	G5	1,180 ha	0.2%	5.4	0.6 %	189,856 ha	135 %
Freshwater							
Species							
Fishes							
Steelhead Salmon (winter) *Oncorhynchus mykiss*	G5	6 km	11.1%	38.6	11.1 %	53 km	89 %
Freshwater Ecological Systems							
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow a		5,798 ha	1.0%	11.7	3.4 %	172,507 ha	96 %

Uztlius

Site No 149

Southeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	1,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	2,470	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland		99 ha	0.1%	10.0	0.2 %	47,698 ha	104 %
Old Growth Forest		38 ha	0.0%	0.7	0.0 %	259,308 ha	165 %
North Pacific Montane Riparian Woodland and Shrubland		2 ha	0.0%	1.5	0.0 %	6,069 ha	158 %
North Pacific Lowland Riparian Forest and Shrubland		21 ha	0.0%	5.8	0.1 %	17,205 ha	171 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		35 ha	0.1%	13.2	0.3 %	12,529 ha	127 %
Aggregate lower elevation		736 ha	0.1%	8.4	0.2 %	421,069 ha	138 %
Species							
Birds							
Northern spotted owl Nests *Strix occidentalis caurina*	G3T3	1 nst	0.3%	28.4	0.6 %	169 nst	194 %
Northern spotted owl *Strix occidentalis caurina*	G3T3	0 occ	0.4%	49.9	1.0 %	25 occ	204 %

Uztlius

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Mammals							
Mtn beaver rainieri *Aplodontia rufa rainieri*	G5T4	1 occ	1.7 %	368.7	7.7 %	13 occ	199 %

Van Zandt Ridge

Site No 150

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	10 %	GAP 1	0 %	BC Provincial:	0 %	US State:	66 %
Area:	5,500	ha	Developed	0 %	GAP 2	1 %	Can Indigenous:	0 %	US Local:	0 %
	13,585	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	33 %
									US NGO	1 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		168 ha	0.0%	0.6	0.1 %	259,308 ha	165 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		236 ha	0.1%	2.6	0.3 %	78,777 ha	159 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		1,635 ha	0.9%	25.1	2.9 %	56,808 ha	131 %
North Pacific Lowland Riparian Forest and Shrubland		282 ha	0.5%	14.3	1.6 %	17,205 ha	171 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		16 ha	0.0%	1.1	0.1 %	12,529 ha	127 %
Montane composite		1 ha	0.0%	0.0	0.0 %	30,002 ha	123 %
Aggregate lower elevation		4,482 ha	0.3%	9.3	1.1 %	421,069 ha	138 %
Species							
Birds							
Peregrine falcon *Falco peregrinus anatum*	G4T3	1 nst	2.4%	41.5	4.8 %	21 nst	198 %

Van Zandt Ridge

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Marbled murrelet *Brachyramphus marmoratus*	G3G4	2 occ	1.3%	22.5	2.6 %	77 occ	194 %
Great blue heron *Ardia herodius fannini*	G5T4	1 occ	4.2%	72.6	8.3 %	12 occ	200 %
Bald eagle roosts *Haliaeetus leucocephalus*	G5	1 rst	1.4%	96.8	11.1 %	9 rst	472 %
Mammals							
Wolverine *Gulo gulo*	G4	1 occ	10.0%	174.3	20.0 %	5 occ	198 %
Roosevelt elk *Cervus canadensis*	G5T4	1,773 ha	1.1%	31.9	3.7 %	48,392 ha	147 %
Fisher *Martes pennanti*	G5	368 ha	0.1%		%	ha	%

Vancouver River

Site No 151

Southern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	7,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	17,290	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
North Pacific Mesic Western Hemlock - Silver fir Forest		297 ha	1.2%	28.3	4.1 %	7,191 ha	207 %
North Pacific Montane Riparian Woodland and Shrubland		144 ha	0.7%	16.2	2.4 %	6,069 ha	158 %
North Pacific Mountain Hemlock Forest		515 ha	0.3%	7.9	1.1 %	44,848 ha	127 %
Old Growth Forest		3,555 ha	0.4%	9.4	1.4 %	259,308 ha	165 %
Aggregate higher elevation		6,793 ha	0.4%	9.4	1.4 %	496,454 ha	135 %
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	1,498 ha	0.5%	8.6	1.3 %	119,141 ha	200 %
Mammals							
Mountain goat *Oreamos americanus*	G5	901 ha	0.1%	3.3	0.5 %	189,856 ha	135 %

Vancouver River

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Fishes							
Chum Salmon (SALMON ECOREGION) *Oncorhynchus keta*	G5	12 km	2.0%	14.8	4.1 %	297 km	101 %
Chinook Salmon (NO RUN INFO.) *Oncorhynchus tshawytscha*	G5	2 km	0.7%	5.2	1.4 %	166 km	139 %
Coastal Cutthroat Trout, Clarki Subspecies (anadromous) *Oncorhynchus clarki clarki*	G4	2 km	1.9%	22.9	6.3 %	38 km	178 %
Coho Salmon *Oncorhynchus kisutch*	G4	17 km	1.5%	10.8	3.0 %	578 km	100 %
Cutthroat Trout, Clarkil Subspecies *Oncorhynchus clarkil clarkil*	G4	18 km	1.4%	17.4	4.8 %	368 km	146 %
Dolly Varden (anadromous) *Salvelinus malma*	G5	5 km	7.5%	91.3	25.1 %	21 km	294 %
Pink Salmon, no run info (SALMON ECOREGION) *Oncorhynchus gorbuscha*	G5	10 km	2.6%	18.8	5.2 %	191 km	115 %
Steelhead Salmon (no run info) *Oncorhynchus mykiss*	G5	10 km	1.7%	12.3	3.4 %	291 km	100 %
Steelhead Salmon (winter) *Oncorhynchus mykiss*	G5	7 km	12.2%	44.5	12.2 %	61 km	100 %
Freshwater Ecological Systems							
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow a		7,580 ha	1.5%	18.1	5.0 %	152,453 ha	114 %
intermediate,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem shallow - tributary shallow b		916 ha	4.6%	56.1	15.4 %	5,933 ha	98 %

Vuich

Site No 152

Southeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	100 %	US State:	0 %
Area:	500	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	1,235	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland		500 ha	0.3%	100.4	1.0 %	47,698 ha	104 %
Old Growth Forest		14 ha	0.0%	0.5	0.0 %	259,308 ha	165 %
Species							
Mammals							
Mtn beaver rainieri *Aplodontia rufa rainieri*	G5T4	1 occ	1.7%	737.5	7.7 %	13 occ	199 %

West Pasayten

Site No 153

Southeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	100 %
			Agriculture	0 %	GAP 1	76 %	BC Provincial:	0 %	US State:	0 %
Area:	50,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	123,501	ac	Open Water	0 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Aggregate lower elevation		2,840 ha	0.2%	0.6	0.7 %	421,069 ha	138 %
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland		24,566 ha	15.5%	49.4	51.5 %	47,698 ha	104 %
Aggregate higher elevation		9,902 ha	0.6%	1.9	2.0 %	496,454 ha	135 %
Alpine composite		1,762 ha	6.5%	20.8	21.7 %	8,126 ha	110 %
East Cascades Mesic Montane Mixed Conifer Forest		142 ha	0.3%	0.9	1.0 %	14,376 ha	116 %
Montane composite		394 ha	0.4%	1.3	1.3 %	30,002 ha	123 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		67 ha	0.2%	0.5	0.5 %	12,529 ha	127 %
North Pacific Lowland Riparian Forest and Shrubland		69 ha	0.1%	0.4	0.4 %	17,205 ha	171 %
Old Growth Forest		279 ha	0.0%	0.1	0.1 %	259,308 ha	165 %

West Pasayten

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
North Pacific Montane Massive Bedrock, Cliff and Talus		1,262 ha	2.0%	6.5	6.7 %	18,742 ha	118 %
North Pacific Montane Riparian Woodland and Shrubland		318 ha	1.6%	5.0	5.2 %	6,069 ha	158 %
North Pacific Mountain Hemlock Forest		1,427 ha	1.0%	3.1	3.2 %	44,848 ha	127 %
Northern Interior Spruce-Fir woodland and forest		291 ha	39.7%	126.7	132.1 %	220 ha	135 %
Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest		58 ha	4.9%	15.6	16.3 %	355 ha	245 %
Northern Rocky Mountain Subalpine Dry Parkland		5,536 ha	21.7%	69.2	72.2 %	7,664 ha	109 %
North Pacific Maritime Mesic Subalpine Parkland		2,475 ha	1.6%	5.1	5.3 %	46,402 ha	112 %
Species							
Amphibians							
Western toad ts *Bufo boreas*	G4	1 occ	3.9%	13.7	14.3 %	7 occ	256 %
Birds							
Northern spotted owl Nests *Strix occidentalis caurina*	G3T3	2 nst	0.6%	1.1	1.2 %	169 nst	194 %
White-tailed ptarmigan *Lagopus leucurus*	G5	1 occ	12.5%	24.0	25.0 %	4 occ	200 %
Insects							
Melissa arctic *Oeneis melissa*	G5	1 occ	25.0%	47.9	50.0 %	2 occ	200 %
Arctic blue *Plebejus glandon*	G5	2 occ	24.9%	47.7	49.8 %	4 occ	200 %
Astarte fritillary *Boloria astarte*	G5	1 occ	25.0%	47.9	50.0 %	2 occ	200 %
common branded skipper *Hesperia comma*	G5	1 occ	16.7%	32.0	33.3 %	3 occ	200 %
lustrous copper *Lycaena cuprea henryae*	G5	1 occ	50.0%	95.9	100.0 %	1 occ	200 %
Mammals							
Wolverine *Gulo gulo*	G4	1 occ	5.0%	9.6	10.0 %	5 occ	198 %
Fisher *Martes pennanti*	G5	2,215 ha	0.4%		%	ha	%

West Pasayten

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Gray wolf *Canis lupus*	G4	1 occ	3.5%	6.6	6.9 %	12 occ	196 %
Lynx *Lynx canadensis*	G5	8,624 ha	3.2%	10.2	10.6 %	81,154 ha	140 %
Mountain goat *Oreamos americanus*	G5	5,067 ha	0.8%	2.6	2.7 %	189,856 ha	135 %
Nonvascular Plants							
Luminous Moss *Schistostega pennata*	G3G5	1 occ	16.7%	32.0	33.3 %	3 occ	200 %
Vascular Plants							
Triangular-lobed Moonwort *Botrychium ascendens*	G2G3	2 occ	25.0%	47.9	50.0 %	4 occ	200 %
Skunk Polemonium *Polemonium viscosum*	G5	1 occ	50.0%	95.9	100.0 %	1 occ	200 %

Yale

Site No 154

Northeastern Pacific Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	0 %
			Agriculture	0 %	GAP 1	0 %	BC Provincial:	75 %	US State:	0 %
Area:	7,000	ha	Developed	1 %	GAP 2	0 %	Can Indigenous:	3 %	US Local:	0 %
	17,290	ac	Open Water	3 %	GAP 3	0 %	Can Private:	23 %	US Indigenous:	0 %
					GAP 4	24 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Old Growth Forest		453 ha	0.1%	1.2	0.2 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		52 ha	0.0%	0.8	0.1 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		2 ha	0.0%	0.2	0.0 %	6,069 ha	158 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		634 ha	0.2%	5.5	0.8 %	78,777 ha	159 %
North Pacific Lowland Riparian Forest and Shrubland		54 ha	0.1%	2.1	0.3 %	17,205 ha	171 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		292 ha	0.7%	16.0	2.3 %	12,529 ha	127 %
Aggregate lower elevation		5,785 ha	0.4%	9.4	1.4 %	421,069 ha	138 %
Aggregate higher elevation		369 ha	0.0%	0.5	0.1 %	496,454 ha	135 %
Species							
Birds							

Yale

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Northern spotted owl *Strix occidentalis caurina*	G3T3	1 occ	0.8%	15.1	2.2 %	25 occ	204 %
Mammals							
Mountain goat *Oreamos americanus*	G5	227 ha	0.0%	0.8	0.1 %	189,856 ha	135 %
Plant Communities							
Quercus garryana - Acer macrophyllum - Prunus spp. Community *Quercus garryana - Acer macrophyllum - Prunus spp.*		312 ha	50.0%	683.6	99.8 %	313 ha	200 %

Yawning Glacier

Site No 155

Northwestern Cascade Ranges

Terrestrial Site			Land Use/Land Cover		GAP Management Status		Land Ownership			
									US Federal	100 %
			Agriculture	0 %	GAP 1	100 %	BC Provincial:	0 %	US State:	0 %
Area:	4,000	ha	Developed	0 %	GAP 2	0 %	Can Indigenous:	0 %	US Local:	0 %
	9,880	ac	Open Water	9 %	GAP 3	0 %	Can Private:	0 %	US Indigenous:	0 %
					GAP 4	0 %	Can NGO:	0 %	US Private	0 %
									US NGO	0 %

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland		4 ha	0.0%	0.1	0.0 %	47,698 ha	104 %
Old Growth Forest		30 ha	0.0%	0.1	0.0 %	259,308 ha	165 %
North Pacific Mountain Hemlock Forest		40 ha	0.0%	1.1	0.1 %	44,848 ha	127 %
North Pacific Montane Riparian Woodland and Shrubland		16 ha	0.1%	3.1	0.3 %	6,069 ha	158 %
North Pacific Montane Massive Bedrock, Cliff and Talus		304 ha	0.5%	19.4	1.6 %	18,742 ha	118 %
North Pacific Maritime Mesic Subalpine Parkland		1,437 ha	0.9%	37.1	3.1 %	46,402 ha	112 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		1 ha	0.0%	0.1	0.0 %	12,529 ha	127 %
Montane composite		208 ha	0.2%	8.3	0.7 %	30,002 ha	123 %
Alpine composite		42 ha	0.2%	6.2	0.5 %	8,126 ha	110 %

Yawning Glacier

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in Ecoregion	Relative Abundance	Contribution to Ecoregional Goal	Ecoregion Goal	% of Goal Captured by Portfolio
Aggregate lower elevation		111 ha	0.0%	0.3	0.0%	421,069 ha	138 %
Aggregate higher elevation		1,866 ha	0.1%	4.5	0.4%	496,454 ha	135 %
<u>Species</u>							
<u>Mammals</u>							
Lynx *Lynx canadensis*	G5	1,795 ha	0.7%	26.5	2.2%	81,154 ha	140 %
Fisher *Martes pennanti*	G5	6 ha	0.0%		%	ha	%

Bacon Creek

Site No 70

Puget Sound EDU

Freshwater Site

Area: 13,227 ha

32,671 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Fishes							
Bull Trout - Coastal and Puget Sound habitat *Salvelinus confluentus pop. 3*	G3T2Q	360 score	3.6%	0.9	7.3 %	4,931 score	104 %
Chinook - Puget Sound habitat *Oncorhynchus tshawytscha pop. 15*	G5T2Q	30 score	0.9%	0.2	1.8 %	1,644 score	127 %
Chum Salmon - Pacific Coast habitat *Onchorhynchus keta pop. 5*	G5T3Q	89 score	0.7%	0.2	1.3 %	6,796 score	128 %
Coho Salmon - Puget Sound/Straight of Georgia habitat *Onchorhynchus kisutch pop. 5*	G4T3Q	355 score	1.0%	0.3	2.0 %	17,434 score	116 %
Pink Salmon - Odd-year habitat *Onchorhynchus gorbuscha*	G5	115 score	1.2%	0.3	2.4 %	4,818 score	109 %
Sockeye Salmon - Baker River habitat *Onchorhynchus nerka pop. 5*	G5T3Q	135 score	43.6%	11.1	87.2 %	155 score	100 %
Steelhead - Puget Sound habitat *Onchorhynchus mykiss*	G5	259 score	1.1%	0.3	2.2 %	11,552 score	115 %
Freshwater Ecological Systems							
Cascades tributary headwaters - granitic, low to mid elevation		0 occ	0.1%	0.1	0.5 %	8 occ	113 %
North Cascades headwaters - granitic , mid to high elevation, moderate to high gradient		10 occ	8.4%	3.5	27.8 %	36 occ	103 %

Baker River

Site No 69

Puget Sound EDU

Freshwater Site

Area: 23,888 ha

59,005 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Fishes							
Bull Trout - Coastal and Puget Sound habitat *Salvelinus confluentus pop. 3*	G3T2Q	330 score	3.3%	0.5	6.7 %	4,931 score	104 %
Chinook - Puget Sound habitat *Oncorhynchus tshawytscha pop. 15*	G5T2Q	1 score	0.0%	0.0	0.0 %	1,644 score	127 %
Chum Salmon - Pacific Coast habitat *Onchorhynchus keta pop. 5*	G5T3Q	4 score	0.0%	0.0	0.1 %	6,796 score	128 %
Coastal Cutthroat Trout - Puget Sound habitat *Oncorhynchus clarki clarki pop. 7*	G4T3Q	68 score	0.2%	0.0	0.5 %	14,075 score	105 %
Coho Salmon - Puget Sound/Straight of Georgia habitat *Onchorhynchus kisutch pop. 5*	G4T3Q	280 score	0.8%	0.1	1.6 %	17,434 score	116 %
Pink Salmon - Odd-year habitat *Onchorhynchus gorbuscha*	G5	46 score	0.5%	0.1	1.0 %	4,818 score	109 %
Sockeye Salmon - Baker River habitat *Onchorhynchus nerka pop. 5*	G5T3Q	174 score	56.3%	7.9	112.6 %	155 score	100 %
Steelhead - Puget Sound habitat *Onchorhynchus mykiss*	G5	193 score	0.8%	0.1	1.7 %	11,552 score	115 %
Freshwater Ecological Systems							
Cascade foothills headwaters - glacial drift and alluvium , low to mid elevation, mixed gradient		0 occ	0.5%	0.1	1.7 %	5 occ	180 %
Cascades headwaters, sedimentary, mid elevation		1 occ	5.3%	1.2	16.7 %	6 occ	133 %
Cascades tributary headwaters - granitic, low to mid elevation		1 occ	2.9%	0.7	10.2 %	8 occ	113 %
North Cascades - mafic , mid elevation, mixed gradient		3 occ	17.6%	4.2	60.0 %	5 occ	200 %

Baker River

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
North Cascades headwaters - granitic , mid to high elevation, moderate to high gradient		1 occ	0.8%	0.2	2.8%	36 occ	103 %
North Cascades headwaters - mostly volcanic, mid to high elevation, moderate to high gradient		1 occ	7.7%	1.8	25.0%	4 occ	100 %
Northern Cascades headwaters - sandstone, moderate to high elevation, moderate to high gradient		1 occ	3.4%	0.8	11.1%	9 occ	111 %
Puget uplands and islands headwaters - glacial drift, low to mid elevation, low to moderate gradient		1 occ	1.3%	0.3	4.3%	23 occ	161 %

Boundary

Site No 57

Lower Fraser EDU

Freshwater Site

Area: 71,284 ha

176,071 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Fishes							
Bull Trout *Salvelinus confluentus*	G3	92 km	15.8%	8.9	31.7 %	292 km	106 %
Chinook Salmon (no run info) *Oncorhynchus tshawytscha*	G5	130 km	15.7%	8.8	31.3 %	414 km	149 %
Chum Salmon (Fraser XAN Ecoregion) *Oncorhynchus keta*	G5	181 km	17.3%	9.8	34.6 %	523 km	137 %
Coastal Cutthroat Trout, Clarki Subspecies (anadromous) *Oncorhynchus clarki clarki*	G4	42 km	15.2%	14.3	50.5 %	83 km	239 %
Coho Salmon *Oncorhynchus kisutch*	G4	208 km	13.1%	7.4	26.2 %	792 km	132 %
Cutthroat Trout, Clarkil Subspecies *Oncorhynchus clarkiI clarkiI*	G4	223 km	15.2%	14.3	50.5 %	442 km	215 %
Dolly Varden *Salvelinus malma*	G5	9 km	1.3%	1.2	4.2 %	217 km	185 %
Eulachon *Thaleichthys pacificus*	G5	103 km	65.3%	62.0	219.6 %	47 km	319 %
Green Sturgeon *Acipenser medirostris*	G3	25 km	94.8%	86.6	306.5 %	8 km	307 %
Kokanee *Oncorhynchus nerka*	G5	0 km	0.3%	0.2	0.7 %	71 km	116 %
Nooksack Dace *Rhinichthys sp. 4*	G3	0 km	0.1%	0.1	0.5 %	13 km	343 %
Pink Salmon, no run info (Fraser XAN Ecoregion) *Oncorhynchus gorbuscha*	G5	116 km	14.6%	8.2	29.1 %	399 km	149 %
Salish Sucker (km) *Catostomus sp. 4*	G1	0 km	0.1%	0.1	0.3 %	23 km	215 %
Sockeye Salmon *Oncorhynchus nerka*	G5	120 km	15.7%	8.9	31.4 %	383 km	148 %

Boundary

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Steelhead Salmon (no run info) *Oncorhynchus mykiss*	G5	23 km	3.5%	2.0	6.9 %	330 km	121 %
Threespine stickleback *Gasterosteus aculeatus*	G5	207 km	28.8%	27.2	96.4 %	215 km	246 %
Western Brook Lamprey *Lampetra richardsoni*	G4G5	64 km	45.8%	43.1	152.5 %	42 km	234 %
White Sturgeon *Acipenser transmontanus*	G4	84 km	25.0%	23.6	83.6 %	100 km	306 %
Insects							
Autumn Meadowhawk *Sympetrum vicinum*	G5	4 occ	50.0%	14.1	50.0 %	8 occ	100 %
Beaverpond Baskettail *Epitheca canis*	G5	0 occ	6.6%	1.9	6.6 %	5 occ	100 %
Blue Dasher *Pachydiplax longipennis*	G5	2 occ	100.0%	28.2	100.0 %	2 occ	100 %
Freshwater Ecological Systems							
intermediate,geology_hard_sediments,elevation_low,gradient_mainstem shallow - tributary shallow		7,937 ha	7.8%	7.3	25.9 %	30,620 ha	100 %
large,geology_intrusive-metamorphic,elevation_low,gradient_mainstem steep_tributary moderate		63,347 ha	33.3%	31.4	111.0 %	57,071 ha	333 %

Cascade River

Site No 75

Puget Sound EDU

Freshwater Site

Area: 41,874 ha

103,429 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Fishes							
Bull Trout - Coastal and Puget Sound habitat *Salvelinus confluentus pop. 3*	G3T2Q	286 score	2.9%	0.2	5.8 %	4,931 score	104 %
Chinook - Puget Sound habitat *Oncorhynchus tshawytscha pop. 15*	G5T2Q	197 score	6.0%	0.5	12.0 %	1,644 score	127 %
Chum Salmon - Pacific Coast habitat *Onchorhynchus keta pop. 5*	G5T3Q	25 score	0.2%	0.0	0.4 %	6,796 score	128 %
Coho Salmon - Puget Sound/Straight of Georgia habitat *Onchorhynchus kisutch pop. 5*	G4T3Q	183 score	0.5%	0.0	1.0 %	17,434 score	116 %
Pink Salmon - Odd-year habitat *Onchorhynchus gorbuscha*	G5	80 score	0.8%	0.1	1.7 %	4,818 score	109 %
Steelhead - Puget Sound habitat *Onchorhynchus mykiss*	G5	200 score	0.9%	0.1	1.7 %	11,552 score	115 %
Freshwater Ecological Systems							
North Cascades headwaters - granitic , mid to high elevation, moderate to high gradient		7 occ	6.3%	0.8	20.8 %	36 occ	103 %

Cheekamus River

Site No 35

Southern Coastal Streams EDU

Freshwater Site

Area: 52,199 ha

128,931 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Fishes							
Chum Salmon (Puget XAN Ecoregion) *Oncorhynchus keta*	G5	5 km	0.8%	0.9	1.6 %	297 km	101 %
Coho Salmon *Oncorhynchus kisutch*	G4	5 km	0.4%	0.5	0.8 %	578 km	100 %
Cutthroat Trout, Clarkil Subspecies *Oncorhynchus clarkiI clarkiI*	G4	24 km	2.0%	3.9	6.5 %	368 km	146 %
Dolly Varden *Salvelinus malma*	G5	23 km	2.5%	5.0	8.4 %	274 km	162 %
Dolly Varden *Salvelinus malma*	G5	0 km	0.0%	0.0	0.0 %	217 km	185 %
Kokanee *Oncorhynchus nerka*	G5	14 km	5.5%	6.6	11.1 %	129 km	120 %
Sockeye Salmon *Oncorhynchus nerka*	G5	10 km	5.1%	6.0	10.1 %	99 km	98 %
Steelhead Salmon (no run info) *Oncorhynchus mykiss*	G5	3 km	0.5%	0.6	1.0 %	291 km	100 %
Threespine stickleback *Gasterosteus aculeatus*	G5	24 km	12.3%	24.1	40.8 %	58 km	189 %
Insects							
Stonefly gregsoni *Bolshecapnia gregsoni*	G2	1 occ	50.0%	29.6	50.0 %	2 occ	100 %
Freshwater Ecological Systems							
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary moderate b		52,199 ha	17.7%	34.9	58.9 %	88,565 ha	247 %

Cheekye

Site No 41

Southern Coastal Streams EDU

Freshwater Site

Area: 828 ha

2,045 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Freshwater Ecological Systems							
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow d		828 ha	5.4 %	665.4	17.8 %	4,642 ha	95 %

Chehalis River

Site No 51

Lower Fraser EDU

Freshwater Site

Area: 21,562 ha

53,258 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Amphibians							
Coastal tailed frog *Ascaphus truei*	G4	1 occ	0.9%	7.2	7.7 %	13 occ	400 %
Fishes							
Bull Trout *Salvelinus confluentus*	G3	17 km	3.0%	5.5	5.9 %	292 km	106 %
Chinook Salmon (no run info) *Oncorhynchus tshawytscha*	G5	4 km	0.5%	1.0	1.0 %	414 km	149 %
Chum Salmon (Fraser XAN Ecoregion) *Oncorhynchus keta*	G5	13 km	1.3%	2.3	2.5 %	523 km	137 %
Coastal Cutthroat Trout, Clarki Subspecies (anadromous) *Oncorhynchus clarki clarki*	G4	4 km	1.5%	4.8	5.1 %	83 km	239 %
Coho Salmon *Oncorhynchus kisutch*	G4	13 km	0.9%	1.6	1.7 %	792 km	132 %
Cutthroat Trout, Clarkil Subspecies *Oncorhynchus clarkil clarkil*	G4	5 km	0.3%	1.0	1.0 %	442 km	215 %
Dolly Varden *Salvelinus malma*	G5	13 km	1.8%	5.6	6.0 %	217 km	185 %
Pink Salmon, no run info (Fraser XAN Ecoregion) *Oncorhynchus gorbuscha*	G5	4 km	0.5%	1.0	1.1 %	399 km	149 %
Sockeye Salmon *Oncorhynchus nerka*	G5	13 km	1.7%	3.1	3.4 %	383 km	148 %
Steelhead Salmon (no run info) *Oncorhynchus mykiss*	G5	14 km	2.2%	4.1	4.4 %	330 km	121 %
Steelhead Salmon (summer) *Oncorhynchus mykiss*	G5	13 km	31.7%	29.4	31.5 %	41 km	92 %
Steelhead Salmon (winter) *Oncorhynchus mykiss*	G5	13 km	24.4%	22.7	24.3 %	53 km	89 %
Freshwater Ecological Systems							

Chehalis River

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
intermediate,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem steep - tributary steep		21,562 ha	8.6%	26.9	28.8 %	74,970 ha	180 %

Chilliwack River

Site No 58
Lower Fraser EDU

Freshwater Site
Area: 78,100 ha
192,907 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Aggregate higher elevation		7,715 ha	0.5%	4.3	1.6 %	496,454 ha	135 %
Aggregate lower elevation		6,097 ha	0.4%	4.0	1.4 %	421,069 ha	138 %
Alpine composite		53 ha	0.2%	1.8	0.7 %	8,126 ha	110 %
Montane composite		597 ha	0.6%	5.4	2.0 %	30,002 ha	123 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		310 ha	0.7%	6.8	2.5 %	12,529 ha	127 %
North Pacific Lowland Riparian Forest and Shrubland		312 ha	0.5%	5.0	1.8 %	17,205 ha	171 %
North Pacific Maritime Mesic Subalpine Parkland		1,776 ha	1.1%	10.5	3.8 %	46,402 ha	112 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		12 ha	0.0%	0.0	0.0 %	78,777 ha	159 %
North Pacific Montane Massive Bedrock, Cliff and Talus		918 ha	1.5%	13.4	4.9 %	18,742 ha	118 %
North Pacific Montane Riparian Woodland and Shrubland		62 ha	0.3%	2.8	1.0 %	6,069 ha	158 %
North Pacific Mountain Hemlock Forest		655 ha	0.4%	4.0	1.5 %	44,848 ha	127 %
Old Growth Forest		3,319 ha	0.4%	3.5	1.3 %	259,308 ha	165 %
Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland		0 ha	0.0%	0.0	0.0 %	47,698 ha	104 %
Species							
Birds							

Chilliwack River

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Northern spotted owl *Strix occidentalis caurina*	G3T3	2 occ	2.4%	17.5	6.4 %	25 occ	204 %
Mammals							
Fisher *Martes pennanti*	G5	2,347 ha	0.5%		%	ha	%
Gray wolf *Canis lupus*	G4	0 occ	0.6%	3.2	1.2 %	12 occ	196 %
Vascular Plants							
Cascade Parsley Fern *Cryptogramma cascadensis*	G5	1 occ	12.5%	54.8	20.0 %	5 occ	156 %
Cliff Paintbrush *Castilleja rupicola*	G2G3	1 occ	9.1%	45.7	16.7 %	6 occ	183 %
Short-fruited Smelowskia *Smelowskia ovalis*	G5	1 occ	10.0%	54.8	20.0 %	5 occ	200 %
Freshwater							
Species							
Amphibians							
Coastal tailed frog *Ascaphus truei*	G4	15 occ	13.4%	29.3	113.8 %	13 occ	400 %
Pacific Giant Salamander *Dicamptodon tenebrosus*	G5	11 occ	49.7%	22.6	87.8 %	13 occ	96 %
Red-legged frog *Rana aurora*	G4	4 occ	19.0%	5.4	21.1 %	19 occ	95 %
Western toad *Bufo boreas*	G4	5 occ	45.5%	11.7	45.5 %	11 occ	100 %
Fishes							
Bull Trout *Salvelinus confluentus*	G3	29 km	5.1%	2.6	10.1 %	292 km	106 %
Chinook Salmon (no run info) *Oncorhynchus tshawytscha*	G5	45 km	5.5%	2.8	11.0 %	414 km	149 %
Chum Salmon (Fraser XAN Ecoregion) *Oncorhynchus keta*	G5	73 km	7.0%	3.6	14.0 %	523 km	137 %
Coho Salmon *Oncorhynchus kisutch*	G4	96 km	6.1%	3.1	12.1 %	792 km	132 %
Cultus Lake Sculpin *Cottus sp. 2*	G1	636 ha	100.0%	85.8	332.8 %	191 ha	333 %
Cutthroat Trout, Clarkil Subspecies *Oncorhynchus clarkiI clarkiI*	G4	57 km	3.9%	3.3	13.0 %	442 km	215 %

Chilliwack River

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Dolly Varden *Salvelinus malma*	G5	34 km	4.7%	4.1	15.8 %	217 km	185 %
Kokanee *Oncorhynchus nerka*	G5	24 km	17.0%	8.7	33.7 %	71 km	116 %
Pink Salmon, no run info (Fraser XAN Ecoregion) *Oncorhynchus gorbuscha*	G5	58 km	7.2%	3.7	14.4 %	399 km	149 %
Salish Sucker (km) *Catostomus sp. 4*	G1	9 km	11.5%	10.0	39.0 %	23 km	215 %
Sockeye Salmon *Oncorhynchus nerka*	G5	11 km	1.5%	0.8	3.0 %	383 km	148 %
Sockeye Salmon (Cultus Lake) *Oncorhynchus nerka*	G5	13 km	100.0%	25.4	98.4 %	13 km	98 %
Steelhead Salmon (no run info) *Oncorhynchus mykiss*	G5	50 km	7.5%	3.9	15.1 %	330 km	121 %
Threespine stickleback *Gasterosteus aculeatus*	G5	16 km	2.3%	2.0	7.7 %	215 km	246 %
Western Brook Lamprey *Lampetra richardsoni*	G4G5	9 km	6.2%	5.3	20.5 %	42 km	234 %
<u>Insects</u>							
Autumn Meadowhawk *Sympetrum vicinum*	G5	1 occ	12.5%	3.2	12.5 %	8 occ	100 %
Emma's Dancer (nez Perce) *Argia emma*	G5	1 occ	20.0%	5.2	20.0 %	5 occ	100 %
Spring Stonefly trictura *Cascadoperla trictura*	G3G4	2 occ	100.0%	25.7	99.5 %	2 occ	100 %
Stonefly tibilalis *Setvena tibilalis*	G4	1 occ	100.0%	25.8	100.0 %	1 occ	100 %
Stonefly vedderensis *Isocapnia vedderensis*	G4	2 occ	66.7%	17.2	66.7 %	3 occ	100 %
<u>Mammals</u>							
Pacific water Shrew *Sorex bendirii*	G4	1 occ	9.1%	2.6	10.0 %	10 occ	100 %
<u>Freshwater Ecological Systems</u>							
intermediate,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem steep - tributary steep		26,820 ha	10.7%	9.2	35.8 %	74,970 ha	180 %
intermediate,geology_intrusive - metamorphic,elevation_low,gradient_mainstem shallow - tributary shallow		8,287 ha	34.3%	29.5	114.5 %	7,238 ha	145 %

Chilliwack River

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow a		31,618 ha	5.5%	4.7	18.3 %	172,507 ha	96 %
small,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem shallow - tributary shallow		11,375 ha	40.6%	34.9	135.4 %	8,399 ha	135 %

Coquihalla River

Site No 46

Lower Fraser EDU

Freshwater Site

Area: 32,874 ha

81,199 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Amphibians							
Coastal tailed frog *Ascaphus truei*	G4	4 occ	3.6%	18.8	30.8 %	13 occ	400 %
Fishes							
Bull Trout *Salvelinus confluentus*	G3	11 km	2.0%	2.4	3.9 %	292 km	106 %
Chinook Salmon (no run info) *Oncorhynchus tshawytscha*	G5	9 km	1.1%	1.3	2.1 %	414 km	149 %
Chum Salmon (Fraser XAN Ecoregion) *Oncorhynchus keta*	G5	8 km	0.7%	0.9	1.4 %	523 km	137 %
Coho Salmon *Oncorhynchus kisutch*	G4	28 km	1.8%	2.2	3.5 %	792 km	132 %
Cutthroat Trout, Clarkil Subspecies *Oncorhynchus clarkiI clarkiI*	G4	1 km	0.1%	0.2	0.3 %	442 km	215 %
Dolly Varden *Salvelinus malma*	G5	36 km	5.1%	10.3	16.8 %	217 km	185 %
Kokanee *Oncorhynchus nerka*	G5	1 km	0.9%	1.1	1.8 %	71 km	116 %
Pink Salmon, no run info (Fraser XAN Ecoregion) *Oncorhynchus gorbuscha*	G5	23 km	2.9%	3.6	5.8 %	399 km	149 %
Sockeye Salmon *Oncorhynchus nerka*	G5	6 km	0.8%	1.0	1.7 %	383 km	148 %
Steelhead Salmon (no run info) *Oncorhynchus mykiss*	G5	23 km	3.5%	4.2	6.9 %	330 km	121 %
Steelhead Salmon (summer) *Oncorhynchus mykiss*	G5	24 km	58.2%	35.3	57.7 %	41 km	92 %
Threespine stickleback *Gasterosteus aculeatus*	G5	3 km	0.4%	0.7	1.2 %	215 km	246 %
Freshwater Ecological Systems							

Coquihalla River

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow a		32,874 ha	5.7%	11.7	19.1 %	172,507 ha	96 %

Coquitlam River

Site No 50

Lower Fraser EDU

Freshwater Site

Area: 24,598 ha

60,756 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Amphibians							
Coastal tailed frog *Ascaphus truei*	G4	1 occ	0.9 %	6.3	7.7 %	13 occ	400 %
Fishes							
Chinook Salmon (no run info) *Oncorhynchus tshawytscha*	G5	3 km	0.3 %	0.5	0.7 %	414 km	149 %
Chum Salmon (Fraser XAN Ecoregion) *Oncorhynchus keta*	G5	13 km	1.3 %	2.1	2.6 %	523 km	137 %
Coastal Cutthroat Trout, Clarki Subspecies (anadromous) *Oncorhynchus clarki clarki*	G4	7 km	2.4 %	6.4	7.8 %	83 km	239 %
Coho Salmon *Oncorhynchus kisutch*	G4	31 km	2.0 %	3.3	4.0 %	792 km	132 %
Cutthroat Trout, Clarkil Subspecies *Oncorhynchus clarkiI clarkiI*	G4	18 km	1.2 %	3.3	4.0 %	442 km	215 %
Dolly Varden *Salvelinus malma*	G5	19 km	2.7 %	7.3	8.9 %	217 km	185 %
Pink Salmon, no run info (Fraser XAN Ecoregion) *Oncorhynchus gorbuscha*	G5	5 km	0.7 %	1.1	1.4 %	399 km	149 %
Sockeye Salmon *Oncorhynchus nerka*	G5	3 km	0.4 %	0.6	0.7 %	383 km	148 %
Steelhead Salmon (no run info) *Oncorhynchus mykiss*	G5	16 km	2.4 %	3.9	4.8 %	330 km	121 %
Insects							
Beaverpond Baskettail *Epitheca canis*	G5	1 occ	20.0 %	16.4	20.0 %	5 occ	100 %
Mammals							
Pacific water Shrew *Sorex bendirii*	G4	2 occ	18.1 %	16.3	19.9 %	10 occ	100 %
Freshwater Ecological Systems							

Coquitlam River

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
intermediate,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem steep - tributary steep		23,956 ha	9.6%	26.2	32.0 %	74,970 ha	180 %
large,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem shallow - tributary shallow		641 ha	15.7%	42.9	52.4 %	1,224 ha	132 %

Cypress

Site No 55

Southern Coastal Streams EDU

Freshwater Site

Area: 1,266 ha

3,127 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Fishes							
Cutthroat Trout, Clarkil Subspecies *Oncorhynchus clarkil clarkil*	G4	1 km	0.0%	3.3	0.1 %	368 km	146 %
Steelhead Salmon (no run info) *Oncorhynchus mykiss*	G5	1 km	0.1%	4.2	0.2 %	291 km	100 %
Insects							
Black Petaltail *Tanypteryx hageni*	G4	1 occ	100.0%	2,439.6	100.0 %	1 occ	100 %
Freshwater Ecological Systems							
intermediate,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem steep - tributary steep		1,266 ha	0.3%	20.9	0.9 %	147,682 ha	97 %

Fraser

Site No 28

Lower Fraser EDU

Freshwater Site

Area: 92,629 ha

228,794 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Amphibians							
Coastal tailed frog *Ascaphus truei*	G4	8 occ	7.3%	13.4	61.5 %	13 occ	400 %
Western toad *Bufo boreas*	G4	1 occ	9.1%	2.0	9.1 %	11 occ	100 %
Fishes							
Bull Trout *Salvelinus confluentus*	G3	22 km	3.7%	1.6	7.4 %	292 km	106 %
Chinook Salmon (no run info) *Oncorhynchus tshawytscha*	G5	90 km	10.9%	4.7	21.8 %	414 km	149 %
Chum Salmon (Fraser XAN Ecoregion) *Oncorhynchus keta*	G5	68 km	6.5%	2.8	13.1 %	523 km	137 %
Coho Salmon *Oncorhynchus kisutch*	G4	87 km	5.5%	2.4	11.0 %	792 km	132 %
Cutthroat Trout, Clarkil Subspecies *Oncorhynchus clarkil clarkil*	G4	44 km	3.0%	2.1	9.9 %	442 km	215 %
Dolly Varden *Salvelinus malma*	G5	3 km	0.4%	0.3	1.4 %	217 km	185 %
Pink Salmon, no run info (Fraser XAN Ecoregion) *Oncorhynchus gorbuscha*	G5	85 km	10.6%	4.6	21.3 %	399 km	149 %
Sockeye Salmon *Oncorhynchus nerka*	G5	43 km	5.6%	2.4	11.3 %	383 km	148 %
Steelhead Salmon (no run info) *Oncorhynchus mykiss*	G5	13 km	2.0%	0.9	4.0 %	330 km	121 %
Steelhead Salmon (summer) *Oncorhynchus mykiss*	G5	0 km	0.4%	0.1	0.4 %	41 km	92 %
Threespine stickleback *Gasterosteus aculeatus*	G5	2 km	0.3%	0.2	1.0 %	215 km	246 %
White Sturgeon *Acipenser transmontanus*	G4	840 ha	97.5%	70.8	325.5 %	258 ha	325 %

Fraser

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
White Sturgeon *Acipenser transmontanus*	G4	75 km	22.4%	16.3	74.8%	100 km	306 %
Insects							
Autumn Meadowhawk *Sympetrum vicinum*	G5	1 occ	12.5%	2.7	12.5%	8 occ	100 %
Freshwater Ecological Systems							
large,geology_intrusive-metamorphic,elevation_low,gradient_mainstem steep_tributary moderate		88,722 ha	46.6%	33.8	155.5%	57,071 ha	333 %
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem moderate - tributary moderate b		3,907 ha	4.4%	3.2	14.7%	26,645 ha	100 %

Fraser Valley

Site No 52

Lower Fraser EDU

Freshwater Site

Area: 41,368 ha
102,179 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Amphibians							
Coastal tailed frog *Ascaphus truei*	G4	3 occ	2.3%	9.4	19.2 %	13 occ	400 %
Pacific Giant Salamander *Dicamptodon tenebrosus*	G5	1 occ	4.4%	3.7	7.7 %	13 occ	96 %
Red-legged frog *Rana aurora*	G4	7 occ	33.3%	17.9	36.8 %	19 occ	95 %
Western toad *Bufo boreas*	G4	3 occ	27.3%	13.3	27.3 %	11 occ	100 %
Fishes							
Bull Trout *Salvelinus confluentus*	G3	25 km	4.3%	4.2	8.7 %	292 km	106 %
Chinook Salmon (no run info) *Oncorhynchus tshawytscha*	G5	72 km	8.8%	8.5	17.5 %	414 km	149 %
Chum Salmon (Fraser XAN Ecoregion) *Oncorhynchus keta*	G5	95 km	9.1%	8.9	18.2 %	523 km	137 %
Coastal Cutthroat Trout, Clarki Subspecies (anadromous) *Oncorhynchus clarki clarki*	G4	2 km	0.7%	1.1	2.3 %	83 km	239 %
Coho Salmon *Oncorhynchus kisutch*	G4	106 km	6.7%	6.5	13.4 %	792 km	132 %
Cutthroat Trout, Clarkil Subspecies *Oncorhynchus clarkil clarkil*	G4	102 km	6.9%	11.2	23.0 %	442 km	215 %
Dolly Varden *Salvelinus malma*	G5	0 km	0.1%	0.1	0.2 %	217 km	185 %
Kokanee *Oncorhynchus nerka*	G5	2 km	1.5%	1.5	3.1 %	71 km	116 %
Mountain Sucker (ha) *Catostomus platyrhynchus*	G5	3 ha	100.0%	152.1	312.5 %	1 ha	313 %
Mountain Sucker (km) *Catostomus platyrhynchus*	G5	55 km	72.7%	116.8	240.1 %	23 km	325 %

Fraser Valley

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Nooksack Dace *Rhinichthys sp. 4*	G3	38 km	84.7%	141.5	290.7 %	13 km	343 %
Pink Salmon, no run info (Fraser XAN Ecoregion) *Oncorhynchus gorbuscha*	G5	81 km	10.1%	9.8	20.2 %	399 km	149 %
Pygmy Longfin Smelt/Harrison/Pitt Lake Smelt *Spirinchus sp. 1*	G1Q	0 ha	0.0%	0.0	0.0 %	8,181 ha	333 %
Salish Sucker (km) *Catostomus sp. 4*	G1	15 km	18.8%	31.0	63.7 %	23 km	215 %
Sockeye Salmon *Oncorhynchus nerka*	G5	78 km	10.1%	9.9	20.3 %	383 km	148 %
Steelhead Salmon (no run info) *Oncorhynchus mykiss*	G5	6 km	0.9%	0.8	1.7 %	330 km	121 %
Steelhead Salmon (winter) *Oncorhynchus mykiss*	G5	0 km	0.5%	0.2	0.5 %	53 km	89 %
Threespine stickleback *Gasterosteus aculeatus*	G5	87 km	12.1%	19.7	40.6 %	215 km	246 %
Western Brook Lamprey *Lampetra richardsoni*	G4G5	3 km	2.2%	3.5	7.2 %	42 km	234 %
White Sturgeon *Acipenser transmontanus*	G4	94 km	28.1%	45.8	94.0 %	100 km	306 %
Insects							
Autumn Meadowhawk *Sympetrum vicinum*	G5	1 occ	12.5%	6.1	12.5 %	8 occ	100 %
Stonefly vedderensis *Isocapnia vedderensis*	G4	1 occ	33.3%	16.2	33.3 %	3 occ	100 %
Western Pondhawk *Erythemis collocata*	G5	1 occ	100.0%	48.7	100.0 %	1 occ	100 %
Freshwater Ecological Systems							
intermediate,geology_intrusive - metamorphic,elevation_low,gradient_mainstem shallow - tributary shallow		2,230 ha	9.2%	15.0	30.8 %	7,238 ha	145 %
large,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem shallow - tributary shallow		969 ha	23.7%	38.5	79.2 %	1,224 ha	132 %
large,geology_intrusive-metamorphic,elevation_low,gradient_mainstem steep_tributary moderate		38,170 ha	20.1%	32.6	66.9 %	57,071 ha	333 %

Friday Creek

Site No 72

Puget Sound EDU

Freshwater Site

Area: 9,219 ha

22,770 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Fishes							
Chum Salmon - Pacific Coast habitat *Onchorhynchus keta pop. 5*	G5T3Q	117 score	0.9 %	0.3	1.7 %	6,796 score	128 %
Coastal Cutthroat Trout - Puget Sound habitat *Oncorhynchus clarki clarki pop. 7*	G4T3Q	91 score	0.3 %	0.1	0.6 %	14,075 score	105 %
Coho Salmon - Puget Sound/Straight of Georgia habitat *Onchorhynchus kisutch pop. 5*	G4T3Q	365 score	1.0 %	0.4	2.1 %	17,434 score	116 %
Steelhead - Puget Sound habitat *Onchorhynchus mykiss*	G5	105 score	0.5 %	0.2	0.9 %	11,552 score	115 %
Freshwater Ecological Systems							
Cascade foothills headwaters - glacial drift, mid elevations, mixed gradient		3 occ	26.1 %	17.5	95.9 %	3 occ	133 %
Northern Cascades headwaters - sandstone, moderate to high elevation, moderate to high gradient		0 occ	0.1 %	0.1	0.5 %	9 occ	111 %
Puget uplands and islands headwaters - glacial drift, low to mid elevation, low to moderate gradient		0 occ	0.1 %	0.1	0.4 %	23 occ	161 %

Goodell Creek

Site No 65

Puget Sound EDU

Freshwater Site

Area: 10,203 ha

25,201 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Fishes							
Bull Trout - Coastal and Puget Sound habitat *Salvelinus confluentus pop. 3*	G3T2Q	144 score	1.5%	0.5	2.9 %	4,931 score	104 %
Chinook - Puget Sound habitat *Oncorhynchus tshawytscha pop. 15*	G5T2Q	30 score	0.9%	0.3	1.8 %	1,644 score	127 %
Chum Salmon - Pacific Coast habitat *Onchorhynchus keta pop. 5*	G5T3Q	95 score	0.7%	0.2	1.4 %	6,796 score	128 %
Coho Salmon - Puget Sound/Straight of Georgia habitat *Onchorhynchus kisutch pop. 5*	G4T3Q	114 score	0.3%	0.1	0.7 %	17,434 score	116 %
Pink Salmon - Odd-year habitat *Onchorhynchus gorbuscha*	G5	97 score	1.0%	0.3	2.0 %	4,818 score	109 %
Steelhead - Puget Sound habitat *Onchorhynchus mykiss*	G5	140 score	0.6%	0.2	1.2 %	11,552 score	115 %
Freshwater Ecological Systems							
North Cascades headwaters - granitic , mid to high elevation, moderate to high gradient		2 occ	1.7%	0.9	5.6 %	36 occ	103 %

Gorge Lake Tributaries

Site No 66
Puget Sound EDU

Freshwater Site
Area: 12,597 ha
31,115 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Fishes							
Bull Trout - Coastal and Puget Sound habitat *Salvelinus confluentus pop. 3*	G3T2Q	128 score	1.3%	0.3	2.6 %	4,931 score	104 %
Chum Salmon - Pacific Coast habitat *Onchorhynchus keta pop. 5*	G5T3Q	8 score	0.1%	0.0	0.1 %	6,796 score	128 %
Coastal Cutthroat Trout - Puget Sound habitat *Oncorhynchus clarki clarki pop. 7*	G4T3Q	29 score	0.1%	0.0	0.2 %	14,075 score	105 %
Coho Salmon - Puget Sound/Straight of Georgia habitat *Onchorhynchus kisutch pop. 5*	G4T3Q	9 score	0.0%	0.0	0.0 %	17,434 score	116 %
Pink Salmon - Odd-year habitat *Onchorhynchus gorbuscha*	G5	9 score	0.1%	0.0	0.2 %	4,818 score	109 %
Steelhead - Puget Sound habitat *Onchorhynchus mykiss*	G5	8 score	0.0%	0.0	0.1 %	11,552 score	115 %
Freshwater Ecological Systems							
North Cascades headwaters - granitic , mid to high elevation, moderate to high gradient		7 occ	5.9%	2.6	19.4 %	36 occ	103 %

Harrison Lake

Site No 40

Lower Fraser EDU

Freshwater Site

Area: 85,491 ha

211,162 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Aggregate higher elevation		3,680 ha	0.2%	2.5	0.7 %	496,454 ha	135 %
Aggregate lower elevation		9,038 ha	0.6%	7.1	2.1 %	421,069 ha	138 %
Alpine composite		114 ha	0.4%	4.6	1.4 %	8,126 ha	110 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		452 ha	1.1%	11.9	3.6 %	12,529 ha	127 %
North Pacific Lowland Riparian Forest and Shrubland		55 ha	0.1%	1.0	0.3 %	17,205 ha	171 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		691 ha	0.3%	2.9	0.9 %	78,777 ha	159 %
North Pacific Montane Massive Bedrock, Cliff and Talus		4 ha	0.0%	0.1	0.0 %	18,742 ha	118 %
North Pacific Montane Riparian Woodland and Shrubland		11 ha	0.1%	0.6	0.2 %	6,069 ha	158 %
North Pacific Mountain Hemlock Forest		825 ha	0.6%	6.1	1.8 %	44,848 ha	127 %
Old Growth Forest		4,428 ha	0.5%	5.6	1.7 %	259,308 ha	165 %
Species							
Birds							
Northern spotted owl *Strix occidentalis caurina*	G3T3	1 occ	1.5%	13.2	4.0 %	25 occ	204 %
Mammals							
Mountain goat *Oreamos americanus*	G5	968 ha	0.2%	1.7	0.5 %	189,856 ha	135 %
Other Ecological Features							

Harrison Lake

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Hot Spring		1 occ	3.8%	25.4	7.7 %	13 occ	200 %
Freshwater							
Species							
Amphibians							
Coastal tailed frog *Ascaphus truei*	G4	1 occ	0.9%	1.8	7.7 %	13 occ	400 %
Red-legged frog *Rana aurora*	G4	3 occ	14.3%	3.7	15.8 %	19 occ	95 %
Fishes							
Bull Trout *Salvelinus confluentus*	G3	1 km	0.2%	0.1	0.3 %	292 km	106 %
Chinook Salmon (no run info) *Oncorhynchus tshawytscha*	G5	92 km	11.2%	5.3	22.3 %	414 km	149 %
Chum Salmon (Fraser XAN Ecoregion) *Oncorhynchus keta*	G5	99 km	9.5%	4.5	19.0 %	523 km	137 %
Coastal Cutthroat Trout, Clarki Subspecies (anadromous) *Oncorhynchus clarki clarki*	G4	89 km	32.3%	25.3	107.6 %	83 km	239 %
Coho Salmon *Oncorhynchus kisutch*	G4	121 km	7.6%	3.6	15.3 %	792 km	132 %
Cutthroat Trout, Clarkil Subspecies *Oncorhynchus clarkiI clarkiI*	G4	139 km	9.4%	7.4	31.5 %	442 km	215 %
Dolly Varden *Salvelinus malma*	G5	100 km	13.9%	10.9	46.2 %	217 km	185 %
Mountain Sucker (km) *Catostomus platyrhynchus*	G5	20 km	25.8%	20.1	85.3 %	23 km	325 %
Pink Salmon, no run info (Fraser XAN Ecoregion) *Oncorhynchus gorbuscha*	G5	95 km	11.9%	5.6	23.7 %	399 km	149 %
Pygmy Longfin Smelt/Harrison/Pitt Lake Smelt *Spirinchus sp. 1*	G1Q	21,930 ha	80.4%	63.1	268.1 %	8,181 ha	333 %
Salish Sucker (km) *Catostomus sp. 4*	G1	7 km	9.5%	7.5	32.0 %	23 km	215 %
Sockeye Salmon *Oncorhynchus nerka*	G5	110 km	14.3%	6.8	28.7 %	383 km	148 %
Steelhead Salmon (no run info) *Oncorhynchus mykiss*	G5	110 km	16.6%	7.8	33.3 %	330 km	121 %
Steelhead Salmon (summer) *Oncorhynchus mykiss*	G5	1 km	2.4%	0.6	2.4 %	41 km	92 %

Harrison Lake

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Steelhead Salmon (winter) *Oncorhynchus mykiss*	G5	28 km	52.9%	12.4	52.7 %	53 km	89 %
Threespine stickleback *Gasterosteus aculeatus*	G5	96 km	13.3%	10.5	44.7 %	215 km	246 %
Insects							
Stonefly fraseri *Isocapnia fraseri*	G1	1 occ	100.0%	23.6	100.0 %	1 occ	100 %
Stonefly sasquatchi *Bolshecapnia sasquatchi*	G3	1 occ	100.0%	23.6	100.0 %	1 occ	100 %
Mammals							
Pacific water Shrew *Sorex bendirii*	G4	1 occ	9.1%	2.4	10.0 %	10 occ	100 %
Freshwater Ecological Systems							
intermediate,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem shallow - tributary shallow a		71,585 ha	72.5%	56.9	241.7 %	29,617 ha	256 %
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem moderate - tributary moderate b		13,906 ha	15.7%	12.3	52.2 %	26,645 ha	100 %

Hotham Sound

Site No 36

Southern Coastal Streams EDU

Freshwater Site

Area: 30,612 ha

75,611 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Fishes							
Chum Salmon (Puget XAN Ecoregion) *Oncorhynchus keta*	G5	2 km	0.3%	0.6	0.6 %	297 km	101 %
Coho Salmon *Oncorhynchus kisutch*	G4	2 km	0.2%	0.3	0.3 %	578 km	100 %
Cutthroat Trout, Clarkil Subspecies *Oncorhynchus clarkil clarkil*	G4	8 km	0.6%	2.2	2.1 %	368 km	146 %
Pink Salmon, no run info (Puget XAN Ecoregion) *Oncorhynchus gorbuscha*	G5	1 km	0.3%	0.6	0.6 %	191 km	115 %
Steelhead Salmon (no run info) *Oncorhynchus mykiss*	G5	7 km	1.2%	2.3	2.3 %	291 km	100 %
Threespine stickleback *Gasterosteus aculeatus*	G5	7 km	3.5%	11.7	11.6 %	58 km	189 %
Freshwater Ecological Systems							
intermediate,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem steep - tributary steep		12,223 ha	2.5%	8.4	8.3 %	147,682 ha	97 %
large,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem shallow - tributary shallow		18,389 ha	11.4%	38.3	38.0 %	48,414 ha	97 %

Hutchinson Creek

Site No 67

Puget Sound EDU

Freshwater Site

Area: 6,333 ha

15,642 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Fishes							
Bull Trout - Coastal and Puget Sound habitat *Salvelinus confluentus pop. 3*	G3T2Q	235 score	2.4%	1.3	4.8 %	4,931 score	104 %
Chinook - Puget Sound habitat *Oncorhynchus tshawytscha pop. 15*	G5T2Q	15 score	0.5%	0.2	0.9 %	1,644 score	127 %
Chum Salmon - Pacific Coast habitat *Onchorhynchus keta pop. 5*	G5T3Q	109 score	0.8%	0.4	1.6 %	6,796 score	128 %
Coastal Cutthroat Trout - Puget Sound habitat *Oncorhynchus clarki clarki pop. 7*	G4T3Q	9 score	0.0%	0.0	0.1 %	14,075 score	105 %
Coho Salmon - Puget Sound/Straight of Georgia habitat *Onchorhynchus kisutch pop. 5*	G4T3Q	210 score	0.6%	0.3	1.2 %	17,434 score	116 %
Pink Salmon - Odd-year habitat *Onchorhynchus gorbuscha*	G5	171 score	1.8%	0.9	3.5 %	4,818 score	109 %
Salish Sucker *Catostomus Sp 4*	GQ	1 occ	7.7%	6.6	25.0 %	4 occ	325 %
Steelhead - Puget Sound habitat *Onchorhynchus mykiss*	G5	262 score	1.1%	0.6	2.3 %	11,552 score	115 %
Freshwater Ecological Systems							
Cascades headwaters, sedimentary, mid elevation		2 occ	10.5%	8.9	33.3 %	6 occ	133 %
Cascades tributary headwaters - granitic, low to mid elevation		1 occ	3.6%	3.3	12.5 %	8 occ	113 %

Illabot Creek

Site No 76

Puget Sound EDU

Freshwater Site

Area: 11,167 ha

27,582 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Fishes							
Bull Trout - Coastal and Puget Sound habitat *Salvelinus confluentus pop. 3*	G3T2Q	473 score	4.8%	1.4	9.6 %	4,931 score	104 %
Chinook - Puget Sound habitat *Oncorhynchus tshawytscha pop. 15*	G5T2Q	260 score	7.9%	2.4	15.8 %	1,644 score	127 %
Chum Salmon - Pacific Coast habitat *Onchorhynchus keta pop. 5*	G5T3Q	451 score	3.3%	1.0	6.6 %	6,796 score	128 %
Coho Salmon - Puget Sound/Straight of Georgia habitat *Onchorhynchus kisutch pop. 5*	G4T3Q	666 score	1.9%	0.6	3.8 %	17,434 score	116 %
Pink Salmon - Odd-year habitat *Onchorhynchus gorbuscha*	G5	402 score	4.2%	1.3	8.3 %	4,818 score	109 %
Salish Sucker *Catostomus Sp 4*	GQ	1 occ	7.7%	3.8	25.0 %	4 occ	325 %
Sockeye Salmon - Baker River habitat *Onchorhynchus nerka pop. 5*	G5T3Q	0 score	0.0%	0.0	0.0 %	155 score	100 %
Steelhead - Puget Sound habitat *Onchorhynchus mykiss*	G5	561 score	2.4%	0.7	4.9 %	11,552 score	115 %
Freshwater Ecological Systems							
Cascades tributary headwaters - granitic, low to mid elevation		1 occ	3.6%	1.9	12.5 %	8 occ	113 %
North Cascades headwaters - granitic , mid to high elevation, moderate to high gradient		9 occ	7.6%	3.8	25.0 %	36 occ	103 %

Jim Creek

Site No 83

Puget Sound EDU

Freshwater Site

Area: 12,247 ha

30,250 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Fishes							
Bull Trout - Coastal and Puget Sound habitat *Salvelinus confluentus pop. 3*	G3T2Q	223 score	2.3%	0.6	4.5 %	4,931 score	104 %
Chinook - Puget Sound habitat *Oncorhynchus tshawytscha pop. 15*	G5T2Q	33 score	1.0%	0.3	2.0 %	1,644 score	127 %
Chum Salmon - Pacific Coast habitat *Onchorhynchus keta pop. 5*	G5T3Q	355 score	2.6%	0.7	5.2 %	6,796 score	128 %
Coastal Cutthroat Trout - Puget Sound habitat *Oncorhynchus clarki clarki pop. 7*	G4T3Q	565 score	2.0%	0.6	4.0 %	14,075 score	105 %
Coho Salmon - Puget Sound/Straight of Georgia habitat *Onchorhynchus kisutch pop. 5*	G4T3Q	705 score	2.0%	0.6	4.0 %	17,434 score	116 %
Pacific Lamprey habitat *Lampetra tridentata*	G5	3 ha	6.3%	2.9	20.9 %	15 ha	273 %
Pink Salmon - Odd-year habitat *Onchorhynchus gorbuscha*	G5	310 score	3.2%	0.9	6.4 %	4,818 score	109 %
River Lamprey habitat *Lampetra ayresi*	G4	3 ha	52.3%	21.6	157.0 %	2 ha	300 %
Salish Sucker *Catostomus Sp 4*	GQ	1 occ	7.7%	3.4	25.0 %	4 occ	325 %
Steelhead - Puget Sound habitat *Onchorhynchus mykiss*	G5	548 score	2.4%	0.7	4.7 %	11,552 score	115 %
Western Brook Lamprey habitat *Lamptera richardsoni*	G5	51 ha	7.1%	3.3	23.8 %	212 ha	308 %
Freshwater Ecological Systems							
Cascade foothills headwaters - glacial drift and alluvium , low to mid elevation, mixed gradient		3 occ	16.7%	8.2	60.0 %	5 occ	180 %
Cascades headwaters, sedimentary, mid elevation		1 occ	5.3%	2.3	16.7 %	6 occ	133 %

Jim Creek

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Cascades tributary headwaters - granitic, low to mid elevation		1 occ	3.6%	1.7	12.5%	8 occ	113 %
North Cascades - mafic , mid elevation, mixed gradient		1 occ	5.9%	2.7	20.0%	5 occ	200 %
Puget uplands and islands headwaters - glacial drift, low to mid elevation, low to moderate gradient		1 occ	1.7%	0.8	5.6%	23 occ	161 %

Lillooet River

Site No 17

Lower Fraser EDU

Freshwater Site

Area: 203,259 ha

502,049 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Amphibians							
Coastal tailed frog *Ascaphus truei*	G4	5 occ	4.5%	3.8	38.5 %	13 occ	400 %
Fishes							
Bull Trout *Salvelinus confluentus*	G3	23 km	3.9%	0.8	7.8 %	292 km	106 %
Chinook Salmon (no run info) *Oncorhynchus tshawytscha*	G5	77 km	9.4%	1.9	18.7 %	414 km	149 %
Chum Salmon (Fraser XAN Ecoregion) *Oncorhynchus keta*	G5	45 km	4.3%	0.8	8.5 %	523 km	137 %
Coho Salmon *Oncorhynchus kisutch*	G4	110 km	6.9%	1.4	13.9 %	792 km	132 %
Cutthroat Trout, Clarkil Subspecies *Oncorhynchus clarkil clarkil*	G4	104 km	7.1%	2.3	23.6 %	442 km	215 %
Dolly Varden *Salvelinus malma*	G5	56 km	7.8%	2.6	25.8 %	217 km	185 %
Kokanee *Oncorhynchus nerka*	G5	23 km	16.5%	3.3	32.8 %	71 km	116 %
Pink Salmon, no run info (Fraser XAN Ecoregion) *Oncorhynchus gorbuscha*	G5	44 km	5.6%	1.1	11.1 %	399 km	149 %
Sockeye Salmon *Oncorhynchus nerka*	G5	64 km	8.3%	1.7	16.7 %	383 km	148 %
Steelhead Salmon (no run info) *Oncorhynchus mykiss*	G5	35 km	5.3%	1.1	10.7 %	330 km	121 %
Insects							
Vivid Dancer *Argia vivida*	G5	2 occ	100.0%	9.9	100.0 %	2 occ	100 %
Freshwater Ecological Systems							

Lillooet River

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem moderate - tributary moderate a		25,647 ha	28.9%	9.5	96.3 %	26,644 ha	96 %
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary moderate a		3,219 ha	43.5%	14.4	145.1 %	2,219 ha	145 %
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary moderate b		149,646 ha	50.8%	16.8	169.2 %	88,420 ha	169 %
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary moderate c		19,373 ha	24.7%	8.2	82.4 %	23,524 ha	99 %
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow b		3,895 ha	2.4%	0.8	7.9 %	49,361 ha	72 %
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow d		1,479 ha	40.6%	13.4	135.2 %	1,094 ha	135 %

Nahatlatch

Site No 34

Lower Fraser EDU

Freshwater Site

Area: 28,976 ha

71,570 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Aggregate higher elevation		373 ha	0.0%	7.2	0.1 %	496,454 ha	135 %
Alpine composite		102 ha	0.4%	120.3	1.3 %	8,126 ha	110 %
Montane composite		4 ha	0.0%	1.4	0.0 %	30,002 ha	123 %
North Pacific Maritime Mesic Subalpine Parkland		29 ha	0.0%	6.0	0.1 %	46,402 ha	112 %
North Pacific Montane Riparian Woodland and Shrubland		1 ha	0.0%	1.4	0.0 %	6,069 ha	158 %
North Pacific Mountain Hemlock Forest		20 ha	0.0%	4.3	0.0 %	44,848 ha	127 %
Old Growth Forest		65 ha	0.0%	2.4	0.0 %	259,308 ha	165 %
Freshwater							
Species							
Fishes							
Bull Trout *Salvelinus confluentus*	G3	1 km	0.2%	0.3	0.5 %	292 km	106 %
Coho Salmon *Oncorhynchus kisutch*	G4	1 km	0.1%	0.1	0.2 %	792 km	132 %
Freshwater Ecological Systems							
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow b		28,976 ha	17.6%	40.8	58.7 %	49,361 ha	72 %

Narrows

Site No 48

Southern Coastal Streams EDU

Freshwater Site

Area: 899 ha

2,219 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Freshwater Ecological Systems							
intermediate,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem shallow - tributary shallow b		899 ha	4.5%	520.6	15.1 %	5,933 ha	98 %

Nookachamps Creek

Site No 77

Puget Sound EDU

Freshwater Site

Area: 18,976 ha

46,871 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Fishes							
Bull Trout - Coastal and Puget Sound habitat *Salvelinus confluentus pop. 3*	G3T2Q	309 score	3.1%	0.6	6.3 %	4,931 score	104 %
Chinook - Puget Sound habitat *Oncorhynchus tshawytscha pop. 15*	G5T2Q	353 score	10.7%	1.9	21.5 %	1,644 score	127 %
Chum Salmon - Pacific Coast habitat *Onchorhynchus keta pop. 5*	G5T3Q	278 score	2.0%	0.4	4.1 %	6,796 score	128 %
Coho Salmon - Puget Sound/Straight of Georgia habitat *Onchorhynchus kisutch pop. 5*	G4T3Q	641 score	1.8%	0.3	3.7 %	17,434 score	116 %
Pink Salmon - Odd-year habitat *Onchorhynchus gorbuscha*	G5	258 score	2.7%	0.5	5.4 %	4,818 score	109 %
Steelhead - Puget Sound habitat *Onchorhynchus mykiss*	G5	343 score	1.5%	0.3	3.0 %	11,552 score	115 %
Vascular Plants							
Leafy Pondweed habitat *Potamogeton foliosus*	G5	3 ha	5.9%	1.7	19.6 %	16 ha	294 %
Freshwater Ecological Systems							
Puget lowland headwaters north - glacial drift, low elevation, low to moderate gradient		0 occ	0.4%	0.1	1.3 %	6 occ	100 %
Puget uplands and islands headwaters - glacial drift, low to mid elevation, low to moderate gradient		3 occ	4.1%	1.2	13.6 %	23 occ	161 %

Nooksack Confluence

Site No 64

Puget Sound EDU

Freshwater Site

Area: 19,629 ha

48,483 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Fishes							
Bull Trout - Coastal and Puget Sound habitat *Salvelinus confluentus pop. 3*	G3T2Q	717 score	7.3%	1.2	14.5 %	4,931 score	104 %
Chinook - Puget Sound habitat *Oncorhynchus tshawytscha pop. 15*	G5T2Q	51 score	1.5%	0.3	3.1 %	1,644 score	127 %
Chum Salmon - Pacific Coast habitat *Onchorhynchus keta pop. 5*	G5T3Q	1,558 score	11.5%	2.0	22.9 %	6,796 score	128 %
Coastal Cutthroat Trout - Puget Sound habitat *Oncorhynchus clarki clarki pop. 7*	G4T3Q	272 score	1.0%	0.2	1.9 %	14,075 score	105 %
Coho Salmon - Puget Sound/Straight of Georgia habitat *Onchorhynchus kisutch pop. 5*	G4T3Q	2,671 score	7.7%	1.3	15.3 %	17,434 score	116 %
Pacific Lamprey habitat *Lampetra tridentata*	G5	3 ha	6.3%	1.8	20.9 %	15 ha	273 %
Pink Salmon - Odd-year habitat *Onchorhynchus gorbuscha*	G5	789 score	8.2%	1.4	16.4 %	4,818 score	109 %
Salish Sucker *Catostomus Sp 4*	GQ	1 occ	7.7%	2.1	25.0 %	4 occ	325 %
Steelhead - Puget Sound habitat *Onchorhynchus mykiss*	G5	1,472 score	6.4%	1.1	12.7 %	11,552 score	115 %
Western Brook Lamprey habitat *Lamptera richardsoni*	G5	51 ha	7.1%	2.0	23.8 %	212 ha	308 %
Freshwater Ecological Systems							
Cascade foothills headwaters - glacial drift and alluvium , low to mid elevation, mixed gradient		2 occ	11.1%	3.4	40.0 %	5 occ	180 %
Cascades headwaters, sedimentary, mid elevation		6 occ	30.5%	8.3	96.7 %	6 occ	133 %
Cascades tributary headwaters - granitic, low to mid elevation		1 occ	3.6%	1.1	12.5 %	8 occ	113 %

Nooksack Confluence

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Fraser/Nooksack coastal plain - sandstone, low elevation, low gradient		1 occ	7.1%	2.2	26.1%	3 occ	100 %
Nooksack coastal plain headwaters - glacial drift and outwash, low elevation, low to moderate gradient		8 occ	62.2%	17.3	202.2%	4 occ	200 %
Northern Cascades headwaters - sandstone, moderate to high elevation, moderate to high gradient		1 occ	3.4%	1.0	11.1%	9 occ	111 %
Puget uplands and islands headwaters - glacial drift, low to mid elevation, low to moderate gradient		1 occ	1.3%	0.4	4.3%	23 occ	161 %

North Fork Stilliguamish

Site No 81

Puget Sound EDU

Freshwater Site

Area: 50,519 ha

124,781 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Fishes							
Bull Trout - Coastal and Puget Sound habitat *Salvelinus confluentus pop. 3*	G3T2Q	555 score	5.6%	0.4	11.2 %	4,931 score	104 %
Chinook - Puget Sound habitat *Oncorhynchus tshawytscha pop. 15*	G5T2Q	128 score	3.9%	0.3	7.8 %	1,644 score	127 %
Chum Salmon - Pacific Coast habitat *Onchorhynchus keta pop. 5*	G5T3Q	625 score	4.6%	0.3	9.2 %	6,796 score	128 %
Coastal Cutthroat Trout - Puget Sound habitat *Oncorhynchus clarki clarki pop. 7*	G4T3Q	618 score	2.2%	0.1	4.4 %	14,075 score	105 %
Coho Salmon - Puget Sound/Straight of Georgia habitat *Onchorhynchus kisutch pop. 5*	G4T3Q	1,238 score	3.5%	0.2	7.1 %	17,434 score	116 %
Pink Salmon - Odd-year habitat *Onchorhynchus gorbuscha*	G5	547 score	5.7%	0.4	11.4 %	4,818 score	109 %
Sockeye Salmon - Baker River habitat *Onchorhynchus nerka pop. 5*	G5T3Q	0 score	0.0%	0.0	0.0 %	155 score	100 %
Steelhead - Puget Sound habitat *Onchorhynchus mykiss*	G5	1,014 score	4.4%	0.3	8.8 %	11,552 score	115 %
Freshwater Ecological Systems							
Cascade foothills headwaters - glacial drift and alluvium , low to mid elevation, mixed gradient		1 occ	5.6%	0.7	20.0 %	5 occ	180 %
Cascades headwaters, sedimentary, mid elevation		0 occ	0.2%	0.0	0.5 %	6 occ	133 %
Cascades tributary headwaters - granitic, low to mid elevation		3 occ	10.7%	1.2	37.5 %	8 occ	113 %
North Cascades - mafic , mid elevation, mixed gradient		1 occ	5.9%	0.7	20.0 %	5 occ	200 %

North Fork Stilliguamish

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
North Cascades headwaters - granitic , mid to high elevation, moderate to high gradient		1 occ	0.8%	0.1	2.8 %	36 occ	103 %
Puget uplands and islands headwaters - glacial drift, low to mid elevation, low to moderate gradient		2 occ	2.1%	0.2	7.0 %	23 occ	161 %

Pilchuck Creek

Site No 80
Puget Sound EDU

Freshwater Site
Area: 21,463 ha
53,014 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Fishes							
Chinook - Puget Sound habitat *Oncorhynchus tshawytscha pop. 15*	G5T2Q	10 score	0.3%	0.0	0.6 %	1,644 score	127 %
Chum Salmon - Pacific Coast habitat *Onchorhynchus keta pop. 5*	G5T3Q	18 score	0.1%	0.0	0.3 %	6,796 score	128 %
Coastal Cutthroat Trout - Puget Sound habitat *Oncorhynchus clarki clarki pop. 7*	G4T3Q	412 score	1.5%	0.2	2.9 %	14,075 score	105 %
Coho Salmon - Puget Sound/Straight of Georgia habitat *Onchorhynchus kisutch pop. 5*	G4T3Q	270 score	0.8%	0.1	1.5 %	17,434 score	116 %
Pink Salmon - Odd-year habitat *Onchorhynchus gorbuscha*	G5	94 score	1.0%	0.2	1.9 %	4,818 score	109 %
Steelhead - Puget Sound habitat *Onchorhynchus mykiss*	G5	194 score	0.8%	0.1	1.7 %	11,552 score	115 %
Vascular Plants							
Water Lobelia *Lobelia dortmanna*	G4G5	1 occ	14.3%	0.6	7.7 %	13 occ	54 %
Freshwater Ecological Systems							
Cascade foothills headwaters - glacial drift and alluvium , low to mid elevation, mixed gradient		1 occ	5.6%	1.6	20.0 %	5 occ	180 %
North Cascades - mafic , mid elevation, mixed gradient		1 occ	5.9%	1.6	20.0 %	5 occ	200 %
Puget uplands and islands headwaters - glacial drift, low to mid elevation, low to moderate gradient		2 occ	3.2%	0.8	10.7 %	23 occ	161 %

Pilchuck River

Site No 93

Puget Sound EDU

Freshwater Site

Area: 16,930 ha
41,817 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Fishes							
Bull Trout - Coastal and Puget Sound habitat *Salvelinus confluentus pop. 3*	G3T2Q	552 score	5.6%	1.1	11.2 %	4,931 score	104 %
Chinook - Puget Sound habitat *Oncorhynchus tshawytscha pop. 15*	G5T2Q	28 score	0.9%	0.2	1.7 %	1,644 score	127 %
Chum Salmon - Pacific Coast habitat *Onchorhynchus keta pop. 5*	G5T3Q	223 score	1.6%	0.3	3.3 %	6,796 score	128 %
Coastal Cutthroat Trout - Puget Sound habitat *Oncorhynchus clarki clarki pop. 7*	G4T3Q	1,067 score	3.8%	0.8	7.6 %	14,075 score	105 %
Coho Salmon - Puget Sound/Straight of Georgia habitat *Onchorhynchus kisutch pop. 5*	G4T3Q	1,321 score	3.8%	0.8	7.6 %	17,434 score	116 %
Pink Salmon - Even-year habitat *Onchorhynchus gorbuscha*	GQ	14 score	2.8%	0.6	5.7 %	250 score	194 %
Pink Salmon - Odd-year habitat *Onchorhynchus gorbuscha*	G5	196 score	2.0%	0.4	4.1 %	4,818 score	109 %
Salish Sucker *Catostomus Sp 4*	GQ	1 occ	7.7%	2.5	25.0 %	4 occ	325 %
Steelhead - Puget Sound habitat *Onchorhynchus mykiss*	G5	927 score	4.0%	0.8	8.0 %	11,552 score	115 %
Freshwater Ecological Systems							
Cascade foothills headwaters - glacial drift and alluvium , low to mid elevation, mixed gradient		1 occ	5.6%	2.0	20.0 %	5 occ	180 %
Northern Cascades headwaters - sandstone, moderate to high elevation, moderate to high gradient		0 occ	0.1%	0.0	0.4 %	9 occ	111 %
Puget uplands and islands headwaters - glacial drift, low to mid elevation, low to moderate gradient		7 occ	9.3%	3.1	30.8 %	23 occ	161 %

Pitt River

Site No 39

Lower Fraser EDU

Freshwater Site

Area: 105,071 ha

259,526 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Amphibians							
Coastal tailed frog *Ascaphus truei*	G4	4 occ	3.6%	5.9	30.8 %	13 occ	400 %
Red-legged frog *Rana aurora*	G4	1 occ	4.8%	1.0	5.3 %	19 occ	95 %
Western toad *Bufo boreas*	G4	1 occ	9.1%	1.7	9.1 %	11 occ	100 %
Fishes							
Bull Trout *Salvelinus confluentus*	G3	47 km	8.1%	3.1	16.2 %	292 km	106 %
Chinook Salmon (no run info) *Oncorhynchus tshawytscha*	G5	76 km	9.2%	3.5	18.3 %	414 km	149 %
Chum Salmon (Fraser XAN Ecoregion) *Oncorhynchus keta*	G5	84 km	8.0%	3.1	16.0 %	523 km	137 %
Coastal Cutthroat Trout, Clarki Subspecies (anadromous) *Oncorhynchus clarki clarki*	G4	6 km	2.3%	1.5	7.6 %	83 km	239 %
Coho Salmon *Oncorhynchus kisutch*	G4	125 km	7.9%	3.0	15.8 %	792 km	132 %
Cutthroat Trout, Clarkil Subspecies *Oncorhynchus clarkil clarkil*	G4	119 km	8.1%	5.1	26.8 %	442 km	215 %
Dolly Varden *Salvelinus malma*	G5	66 km	9.2%	5.8	30.5 %	217 km	185 %
Eulachon *Thaleichthys pacificus*	G5	47 km	29.5%	19.0	99.3 %	47 km	319 %
Pink Salmon, no run info (Fraser XAN Ecoregion) *Oncorhynchus gorbuscha*	G5	73 km	9.2%	3.5	18.3 %	399 km	149 %
Pygmy Longfin Smelt/Harrison/Pitt Lake Smelt *Spirinchus sp. 1*	G1Q	5,326 ha	19.5%	12.5	65.1 %	8,181 ha	333 %
Sockeye Salmon *Oncorhynchus nerka*	G5	69 km	9.0%	3.5	18.0 %	383 km	148 %

Pitt River

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Steelhead Salmon (no run info) *Oncorhynchus mykiss*	G5	83 km	12.5%	4.8	25.1 %	330 km	121 %
Threespine stickleback *Gasterosteus aculeatus*	G5	67 km	9.3%	6.0	31.2 %	215 km	246 %
Western Brook Lamprey *Lampetra richardsoni*	G4G5	23 km	16.2%	10.3	53.9 %	42 km	234 %
White Sturgeon *Acipenser transmontanus*	G4	54 km	16.1%	10.3	53.8 %	100 km	306 %
Insects							
Autumn Meadowhawk *Sympetrum vicinum*	G5	1 occ	12.5%	2.4	12.5 %	8 occ	100 %
Beaverpond Baskettail *Epitheca canis*	G5	3 occ	53.3%	10.2	53.2 %	5 occ	100 %
Emma's Dancer (nez Perce) *Argia emma*	G5	3 occ	60.0%	11.5	60.0 %	5 occ	100 %
Grappletail *Octogomphus specularis*	G4	2 occ	50.0%	9.6	50.0 %	4 occ	100 %
Mammals							
Pacific water Shrew *Sorex bendirii*	G4	3 occ	27.3%	5.7	30.0 %	10 occ	100 %
Freshwater Ecological Systems							
intermediate,geology_hard_sediments,elevation_low,gradient_mainstem shallow - tributary shallow		4,251 ha	4.2%	2.7	13.9 %	30,620 ha	100 %
intermediate,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem shallow - tributary shallow a		4,106 ha	4.2%	2.7	13.9 %	29,617 ha	256 %
intermediate,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem shallow - tributary shallow b		313 ha	100.0%	63.8	332.7 %	94 ha	333 %
intermediate,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem steep - tributary steep		5,989 ha	2.4%	1.5	8.0 %	74,970 ha	180 %
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem moderate - tributary moderate b		5,493 ha	6.2%	4.0	20.6 %	26,645 ha	100 %

Pitt River

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary moderate c		3,960 ha	5.1%	3.2	16.8%	23,524 ha	99 %
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow a		76,701 ha	13.3%	8.5	44.5%	172,507 ha	96 %
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow c		4,258 ha	28.9%	18.5	96.4%	4,418 ha	96 %

Powell Lake

Site No 32

Southern Coastal Streams EDU

Freshwater Site

Area: 97,992 ha

242,040 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Fishes							
Chinook Salmon (no run info) *Oncorhynchus tshawytscha*	G5	12 km	3.5%	2.2	6.9 %	166 km	139 %
Chum Salmon (Puget XAN Ecoregion) *Oncorhynchus keta*	G5	13 km	2.2%	1.4	4.3 %	297 km	101 %
Coho Salmon *Oncorhynchus kisutch*	G4	48 km	4.2%	2.6	8.4 %	578 km	100 %
Cutthroat Trout, Clarkil Subspecies *Oncorhynchus clarkil clarkil*	G4	161 km	13.1%	13.8	43.8 %	368 km	146 %
Dolly Varden *Salvelinus malma*	G5	76 km	8.4%	8.8	27.9 %	274 km	162 %
Kokanee *Oncorhynchus nerka*	G5	102 km	39.5%	24.9	79.0 %	129 km	120 %
Pink Salmon, no run info (Puget XAN Ecoregion) *Oncorhynchus gorbuscha*	G5	12 km	3.0%	1.9	6.0 %	191 km	115 %
Sockeye Salmon *Oncorhynchus nerka*	G5	5 km	2.7%	1.7	5.4 %	99 km	98 %
Steelhead Salmon (no run info) *Oncorhynchus mykiss*	G5	18 km	3.1%	2.0	6.2 %	291 km	100 %
Steelhead Salmon (winter) *Oncorhynchus mykiss*	G5	12 km	18.9%	6.0	18.9 %	61 km	100 %
Threespine stickleback *Gasterosteus aculeatus*	G5	8 km	3.9%	4.1	13.1 %	58 km	189 %
Western Brook Lamprey *Lampetra richardsoni*	G4G5	8 km	52.5%	59.8	189.6 %	4 km	190 %
Insects							
Blue Dasher *Pachydiplax longipennis*	G5	1 occ	16.7%	5.3	16.7 %	6 occ	83 %
Freshwater Ecological Systems							

Powell Lake

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
intermediate,geology_hard_sediments,elevation_low,gradient_mainstem shallow - tributary shallow		20,572 ha	5.4%	5.7	18.0%	114,239 ha	104 %
intermediate,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem shallow - tributary shallow a		49,676 ha	35.8%	37.6	119.3%	41,624 ha	128 %
intermediate,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem steep - tributary steep		27,744 ha	5.6%	5.9	18.8%	147,682 ha	97 %

Sauk River

Site No 79

Puget Sound EDU

Freshwater Site

Area: 22,000 ha

54,340 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Fishes							
Bull Trout - Coastal and Puget Sound habitat *Salvelinus confluentus pop. 3*	G3T2Q	368 score	3.7%	0.6	7.5 %	4,931 score	104 %
Chinook - Puget Sound habitat *Oncorhynchus tshawytscha pop. 15*	G5T2Q	137 score	4.2%	0.6	8.4 %	1,644 score	127 %
Chum Salmon - Pacific Coast habitat *Onchorhynchus keta pop. 5*	G5T3Q	335 score	2.5%	0.4	4.9 %	6,796 score	128 %
Coastal Cutthroat Trout - Puget Sound habitat *Oncorhynchus clarki clarki pop. 7*	G4T3Q	40 score	0.1%	0.0	0.3 %	14,075 score	105 %
Coho Salmon - Puget Sound/Straight of Georgia habitat *Onchorhynchus kisutch pop. 5*	G4T3Q	712 score	2.0%	0.3	4.1 %	17,434 score	116 %
Pink Salmon - Odd-year habitat *Onchorhynchus gorbuscha*	G5	430 score	4.5%	0.7	8.9 %	4,818 score	109 %
Salish Sucker *Catostomus Sp 4*	GQ	1 occ	7.7%	1.9	25.0 %	4 occ	325 %
Steelhead - Puget Sound habitat *Onchorhynchus mykiss*	G5	493 score	2.1%	0.3	4.3 %	11,552 score	115 %
Freshwater Ecological Systems							
Cascades tributary headwaters - granitic, low to mid elevation		1 occ	3.6%	1.0	12.5 %	8 occ	113 %
North Cascades - mafic , mid elevation, mixed gradient		1 occ	5.9%	1.5	20.0 %	5 occ	200 %
North Cascades headwaters - granitic , mid to high elevation, moderate to high gradient		2 occ	1.7%	0.4	5.6 %	36 occ	103 %
Northern Cascades headwaters - sandstone, moderate to high elevation, moderate to high gradient		1 occ	3.9%	0.9	12.4 %	9 occ	111 %

Sechelt Peninsula

Site No 47

Southern Coastal Streams EDU

Freshwater Site

Area: 50,554 ha

124,868 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Aggregate higher elevation		2,772 ha	0.2%	1.4	0.6 %	496,454 ha	135 %
Aggregate lower elevation		13,335 ha	1.0%	7.8	3.2 %	421,069 ha	138 %
North Pacific Lowland Riparian Forest and Shrubland		98 ha	0.2%	1.4	0.6 %	17,205 ha	171 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		4,254 ha	2.2%	18.4	7.5 %	56,808 ha	131 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		9,081 ha	3.5%	28.3	11.5 %	78,777 ha	159 %
North Pacific Mesic Western Hemlock - Silver fir Forest		45 ha	0.2%	1.5	0.6 %	7,191 ha	207 %
North Pacific Mountain Hemlock Forest		3 ha	0.0%	0.0	0.0 %	44,848 ha	127 %
Old Growth Forest		960 ha	0.1%	0.9	0.4 %	259,308 ha	165 %
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	1,915 ha	0.7%	4.0	1.6 %	119,141 ha	200 %
Mollusks							
Conical Spot *Punctum randolphii*	G4	1 occ	2.6%	18.9	7.7 %	13 occ	231 %
Other Ecological Features							
Karst SM		149 ha	0.2%	2.7	1.1 %	13,584 ha	233 %

Sechelt Peninsula

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Fishes							
Chum Salmon (Puget XAN Ecoregion) *Oncorhynchus keta*	G5	14 km	2.3%	2.9	4.7 %	297 km	101 %
Coastal Cutthroat Trout, Clarki Subspecies (anadromous) *Oncorhynchus clarki clarki*	G4	8 km	6.0%	12.2	20.0 %	38 km	178 %
Coho Salmon *Oncorhynchus kisutch*	G4	42 km	3.6%	4.4	7.3 %	578 km	100 %
Cutthroat Trout, Clarkil Subspecies *Oncorhynchus clarkiI clarkiI*	G4	71 km	5.8%	11.8	19.3 %	368 km	146 %
Dolly Varden *Salvelinus malma*	G5	2 km	0.3%	0.5	0.9 %	274 km	162 %
Kokanee *Oncorhynchus nerka*	G5	15 km	5.8%	7.0	11.5 %	129 km	120 %
Sockeye Salmon (Sakinaw Lake) *Oncorhynchus nerka*	G5	14 km	100.0%	60.4	98.9 %	14 km	99 %
Steelhead Salmon (no run info) *Oncorhynchus mykiss*	G5	14 km	2.4%	2.9	4.8 %	291 km	100 %
Threespine stickleback *Gasterosteus aculeatus*	G5	19 km	9.7%	19.6	32.1 %	58 km	189 %
Insects							
Blue Dasher *Pachydiplax longipennis*	G5	1 occ	16.7%	10.2	16.7 %	6 occ	83 %
Western Pondhawk *Erythemis collocata*	G5	1 occ	50.0%	30.6	50.0 %	2 occ	100 %
Freshwater Ecological Systems							
intermediate,geology_hard_sediments,elevation_low,gradient_mainstem shallow - tributary shallow		7,439 ha	2.0%	4.0	6.5 %	114,239 ha	104 %
intermediate,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem steep - tributary steep		7,280 ha	1.5%	3.0	4.9 %	147,682 ha	97 %
intermediate,geology_intrusive - metamorphic,elevation_low,gradient_mainstem shallow - tributary shallow		35,835 ha	20.7%	42.1	68.8 %	52,060 ha	120 %

Seymour River

Site No 49

Southern Coastal Streams EDU

Freshwater Site

Area: 15,896 ha

39,263 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Amphibians							
Coastal tailed frog *Ascaphus truei*	G4	2 occ	3.7%	29.9	15.4 %	13 occ	177 %
Fishes							
Chinook Salmon (no run info) *Oncorhynchus tshawytscha*	G5	4 km	1.2%	4.7	2.4 %	166 km	139 %
Chum Salmon (Puget XAN Ecoregion) *Oncorhynchus keta*	G5	4 km	0.7%	2.6	1.3 %	297 km	101 %
Coastal Cutthroat Trout, Clarki Subspecies (anadromous) *Oncorhynchus clarki clarki*	G4	4 km	3.5%	23.0	11.8 %	38 km	178 %
Coho Salmon *Oncorhynchus kisutch*	G4	7 km	0.6%	2.4	1.2 %	578 km	100 %
Cutthroat Trout, Clarkil Subspecies *Oncorhynchus clarkiI clarkiI*	G4	7 km	0.6%	3.6	1.8 %	368 km	146 %
Dolly Varden *Salvelinus malma*	G5	16 km	1.7%	11.2	5.8 %	274 km	162 %
Steelhead Salmon (no run info) *Oncorhynchus mykiss*	G5	4 km	0.8%	3.0	1.5 %	291 km	100 %
Steelhead Salmon (winter) *Oncorhynchus mykiss*	G5	4 km	6.5%	12.7	6.5 %	61 km	100 %
Mammals							
Pacific water Shrew *Sorex bendirii*	G4	1 occ	100.0%	194.3	100.0 %	1 occ	100 %
Freshwater Ecological Systems							
intermediate,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem steep - tributary steep		15,896 ha	3.2%	20.9	10.8 %	147,682 ha	97 %

Silverhope Creek

Site No 53

Lower Fraser EDU

Freshwater Site

Area: 17,823 ha

44,024 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Amphibians							
Coastal tailed frog *Ascaphus truei*	G4	8 occ	7.0 %	66.6	58.9 %	13 occ	400 %
Fishes							
Bull Trout *Salvelinus confluentus*	G3	4 km	0.7 %	1.6	1.4 %	292 km	106 %
Chinook Salmon (no run info) *Oncorhynchus tshawytscha*	G5	6 km	0.8 %	1.7	1.5 %	414 km	149 %
Chum Salmon (Fraser XAN Ecoregion) *Oncorhynchus keta*	G5	2 km	0.2 %	0.5	0.5 %	523 km	137 %
Coho Salmon *Oncorhynchus kisutch*	G4	2 km	0.2 %	0.4	0.3 %	792 km	132 %
Cutthroat Trout, Clarkil Subspecies *Oncorhynchus clarkil clarkil*	G4	9 km	0.6 %	2.3	2.0 %	442 km	215 %
Dolly Varden *Salvelinus malma*	G5	2 km	0.2 %	0.8	0.7 %	217 km	185 %
Kokanee *Oncorhynchus nerka*	G5	2 km	1.1 %	2.5	2.2 %	71 km	116 %
Pink Salmon, no run info (Fraser XAN Ecoregion) *Oncorhynchus gorbuscha*	G5	9 km	1.1 %	2.5	2.2 %	399 km	149 %
Sockeye Salmon *Oncorhynchus nerka*	G5	9 km	1.2 %	2.6	2.3 %	383 km	148 %
Steelhead Salmon (no run info) *Oncorhynchus mykiss*	G5	4 km	0.6 %	1.4	1.2 %	330 km	121 %
Mammals							
Pacific water Shrew *Sorex bendirii*	G4	1 occ	9.1 %	11.3	10.0 %	10 occ	100 %
Freshwater Ecological Systems							

Silverhope Creek

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow a		17,823 ha	3.1 %	11.7	10.3 %	172,507 ha	96 %

Skagit Headwaters US

Site No 62

Puget Sound EDU

Freshwater Site

Area: 62,154 ha

153,521 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Fishes							
Bull Trout - Coastal and Puget Sound habitat *Salvelinus confluentus pop. 3*	G3T2Q	533 score	5.4 %	0.3	10.8 %	4,931 score	104 %
Coho Salmon - Puget Sound/Straight of Georgia habitat *Onchorhynchus kisutch pop. 5*	G4T3Q	30 score	0.1 %	0.0	0.2 %	17,434 score	116 %
Freshwater Ecological Systems							
North Cascades headwaters - granitic , mid to high elevation, moderate to high gradient		6 occ	5.1 %	0.5	16.9 %	36 occ	103 %
North Cascades headwaters - mostly volcanic, mid to high elevation, moderate to high gradient		4 occ	30.2 %	2.7	98.1 %	4 occ	100 %
Northern Cascades headwaters - sandstone, moderate to high elevation, moderate to high gradient		6 occ	20.7 %	1.8	66.7 %	9 occ	111 %

Skagit Mainstem

Site No 74

Puget Sound EDU

Freshwater Site

Area: 41,065 ha

101,432 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Fishes							
Bull Trout - Coastal and Puget Sound habitat *Salvelinus confluentus pop. 3*	G3T2Q	701 score	7.1%	0.6	14.2 %	4,931 score	104 %
Chinook - Puget Sound habitat *Oncorhynchus tshawytscha pop. 15*	G5T2Q	205 score	6.2%	0.5	12.5 %	1,644 score	127 %
Chum Salmon - Pacific Coast habitat *Onchorhynchus keta pop. 5*	G5T3Q	578 score	4.2%	0.3	8.5 %	6,796 score	128 %
Coastal Cutthroat Trout - Puget Sound habitat *Oncorhynchus clarki clarki pop. 7*	G4T3Q	16 score	0.1%	0.0	0.1 %	14,075 score	105 %
Coho Salmon - Puget Sound/Straight of Georgia habitat *Onchorhynchus kisutch pop. 5*	G4T3Q	1,335 score	3.8%	0.3	7.7 %	17,434 score	116 %
Pink Salmon - Odd-year habitat *Onchorhynchus gorbuscha*	G5	607 score	6.3%	0.5	12.6 %	4,818 score	109 %
Steelhead - Puget Sound habitat *Onchorhynchus mykiss*	G5	1,159 score	5.0%	0.4	10.0 %	11,552 score	115 %
Freshwater Ecological Systems							
Cascade foothills headwaters - glacial drift and alluvium , low to mid elevation, mixed gradient		9 occ	49.5%	7.3	178.2 %	5 occ	180 %
Cascades headwaters, sedimentary, mid elevation		3 occ	15.6%	2.0	49.5 %	6 occ	133 %
Cascades tributary headwaters - granitic, low to mid elevation		5 occ	17.7%	2.5	62.0 %	8 occ	113 %
North Cascades headwaters - granitic , mid to high elevation, moderate to high gradient		3 occ	2.5%	0.3	8.3 %	36 occ	103 %
Northern Cascades headwaters - sandstone, moderate to high elevation, moderate to high gradient		0 occ	0.6%	0.1	2.0 %	9 occ	111 %

Skagit Mainstem

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Puget uplands and islands headwaters - glacial drift, low to mid elevation, low to moderate gradient		2 occ	2.8%	0.4	9.4 %	23 occ	161 %

Skagit River

Site No 56

Puget Sound EDU

Freshwater Site

Area: 37,143 ha

91,743 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Freshwater Ecological Systems							
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem moderate - tributary moderate b		6,300 ha	28.0%	4.2	93.2 %	6,759 ha	93 %
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary moderate b		4,502 ha	34.2%	5.2	114.0 %	3,948 ha	114 %
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow a		18,091 ha	43.8%	6.6	145.9 %	12,399 ha	146 %
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow b		6,428 ha	29.0%	4.4	96.8 %	6,640 ha	97 %
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow d		727 ha	23.9%	3.6	79.7 %	912 ha	80 %
small,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem shallow - tributary shallow		1,095 ha	30.1%	4.5	100.2 %	1,092 ha	100 %

Skawkwa River

Site No 29

Southern Coastal Streams EDU

Freshwater Site

Area: 32,514 ha

80,308 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Fishes							
Bull Trout *Salvelinus confluentus*	G3	17 km	39.0 %	74.7	78.6 %	22 km	96 %
Chum Salmon (Puget XAN Ecoregion) *Oncorhynchus keta*	G5	23 km	3.8 %	7.2	7.6 %	297 km	101 %
Coho Salmon *Oncorhynchus kisutch*	G4	23 km	1.9 %	3.7	3.9 %	578 km	100 %
Cutthroat Trout, Clarkil Subspecies *Oncorhynchus clarkil clarkil*	G4	23 km	1.8 %	5.8	6.1 %	368 km	146 %
Dolly Varden *Salvelinus malma*	G5	34 km	3.7 %	11.7	12.3 %	274 km	162 %
Pink Salmon, no run info (Puget XAN Ecoregion) *Oncorhynchus gorbuscha*	G5	23 km	5.9 %	11.2	11.8 %	191 km	115 %
Steelhead Salmon (no run info) *Oncorhynchus mykiss*	G5	16 km	2.8 %	5.3	5.6 %	291 km	100 %
Freshwater Ecological Systems							
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow a		16,791 ha	3.3 %	10.5	11.0 %	152,453 ha	114 %
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow b		15,722 ha	5.2 %	16.4	17.2 %	91,190 ha	95 %

Skykomish River

Site No 100

Puget Sound EDU

Freshwater Site

Area: 42,614 ha

105,258 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Fishes							
Bull Trout - Coastal and Puget Sound habitat *Salvelinus confluentus pop. 3*	G3T2Q	735 score	7.5%	0.6	14.9 %	4,931 score	104 %
Chinook - Puget Sound habitat *Oncorhynchus tshawytscha pop. 15*	G5T2Q	142 score	4.3%	0.3	8.6 %	1,644 score	127 %
Chum Salmon - Pacific Coast habitat *Onchorhynchus keta pop. 5*	G5T3Q	1,071 score	7.9%	0.6	15.8 %	6,796 score	128 %
Coastal Cutthroat Trout - Puget Sound habitat *Oncorhynchus clarki clarki pop. 7*	G4T3Q	1,700 score	6.0%	0.5	12.1 %	14,075 score	105 %
Coho Salmon - Puget Sound/Straight of Georgia habitat *Onchorhynchus kisutch pop. 5*	G4T3Q	2,200 score	6.3%	0.5	12.6 %	17,434 score	116 %
Pink Salmon - Even-year habitat *Onchorhynchus gorbuscha*	GQ	476 score	95.3%	7.5	190.3 %	250 score	194 %
Pink Salmon - Odd-year habitat *Onchorhynchus gorbuscha*	G5	1,118 score	11.6%	0.9	23.2 %	4,818 score	109 %
Steelhead - Puget Sound habitat *Onchorhynchus mykiss*	G5	1,589 score	6.9%	0.5	13.8 %	11,552 score	115 %
Freshwater Ecological Systems							
Cascade foothills headwaters - glacial drift, mid elevations, mixed gradient		1 occ	9.1%	1.3	33.3 %	3 occ	133 %
Cascades headwaters, sedimentary, mid elevation		1 occ	5.3%	0.7	16.7 %	6 occ	133 %
Cascades tributary headwaters - granitic, low to mid elevation		1 occ	3.6%	0.5	12.5 %	8 occ	113 %
North Cascades - mafic , mid elevation, mixed gradient		6 occ	37.4%	5.0	127.1 %	5 occ	200 %
North Cascades headwaters - granitic , mid to high elevation, moderate to high gradient		3 occ	2.5%	0.3	8.3 %	36 occ	103 %

Skykomish River

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Puget uplands and islands headwaters - glacial drift, low to mid elevation, low to moderate gradient		6 occ	8.1%	1.1	26.7%	23 occ	161 %

Snoqualmie River

Site No 105

Puget Sound EDU

Freshwater Site

Area: 60,627 ha

149,749 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Fishes							
Bull Trout - Coastal and Puget Sound habitat *Salvelinus confluentus pop. 3*	G3T2Q	323 score	3.3%	0.2	6.5 %	4,931 score	104 %
Chinook - Puget Sound habitat *Oncorhynchus tshawytscha pop. 15*	G5T2Q	120 score	3.7%	0.2	7.3 %	1,644 score	127 %
Chum Salmon - Pacific Coast habitat *Onchorhynchus keta pop. 5*	G5T3Q	395 score	2.9%	0.2	5.8 %	6,796 score	128 %
Coastal Cutthroat Trout - Puget Sound habitat *Oncorhynchus clarki clarki pop. 7*	G4T3Q	750 score	2.7%	0.1	5.3 %	14,075 score	105 %
Coho Salmon - Puget Sound/Straight of Georgia habitat *Onchorhynchus kisutch pop. 5*	G4T3Q	1,258 score	3.6%	0.2	7.2 %	17,434 score	116 %
Olympic Mudminnow habitat *Novumbra hubbsi*	G3	9 ha	42.8%	2.4	85.6 %	11 ha	200 %
Pink Salmon - Odd-year habitat *Onchorhynchus gorbuscha*	G5	418 score	4.3%	0.2	8.7 %	4,818 score	109 %
Salish Sucker *Catostomus Sp 4*	GQ	1 occ	7.7%	0.7	25.0 %	4 occ	325 %
Steelhead - Puget Sound habitat *Onchorhynchus mykiss*	G5	829 score	3.6%	0.2	7.2 %	11,552 score	115 %
Freshwater Ecological Systems							
Cascade foothills headwaters - glacial drift, mid elevations, mixed gradient		3 occ	28.5%	2.9	104.4 %	3 occ	133 %
North Cascades - mafic , mid elevation, mixed gradient		0 occ	0.2%	0.0	0.7 %	5 occ	200 %
Puget uplands and islands headwaters - glacial drift, low to mid elevation, low to moderate gradient		7 occ	9.0%	0.8	29.8 %	23 occ	161 %
Communities							

Snoqualmie River

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
North Pacific Bog and Fen Community *North Pacific Bog and Fen*	GQ	2 occ	11.8%	0.7	25.0%	8 occ	188 %
North Pacific Shrub Swamp Community *North Pacific Shrub Swamp*	GQ	1 occ	14.3%	0.9	33.3%	3 occ	200 %

South Fork Stilliguamish

Site No 91

Puget Sound EDU

Freshwater Site

Area: 37,454 ha

92,512 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Fishes							
Bull Trout - Coastal and Puget Sound habitat *Salvelinus confluentus pop. 3*	G3T2Q	485 score	4.9%	0.4	9.8 %	4,931 score	104 %
Chinook - Puget Sound habitat *Oncorhynchus tshawytscha pop. 15*	G5T2Q	31 score	0.9%	0.1	1.9 %	1,644 score	127 %
Chum Salmon - Pacific Coast habitat *Onchorhynchus keta pop. 5*	G5T3Q	93 score	0.7%	0.1	1.4 %	6,796 score	128 %
Coastal Cutthroat Trout - Puget Sound habitat *Oncorhynchus clarki clarki pop. 7*	G4T3Q	355 score	1.3%	0.1	2.5 %	14,075 score	105 %
Coho Salmon - Puget Sound/Straight of Georgia habitat *Onchorhynchus kisutch pop. 5*	G4T3Q	584 score	1.7%	0.2	3.3 %	17,434 score	116 %
Pink Salmon - Odd-year habitat *Onchorhynchus gorbuscha*	G5	145 score	1.5%	0.1	3.0 %	4,818 score	109 %
Salish Sucker *Catostomus Sp 4*	GQ	1 occ	7.7%	1.1	25.0 %	4 occ	325 %
Steelhead - Puget Sound habitat *Onchorhynchus mykiss*	G5	628 score	2.7%	0.2	5.4 %	11,552 score	115 %
Freshwater Ecological Systems							
Cascades tributary headwaters - granitic, low to mid elevation		3 occ	10.7%	1.7	37.5 %	8 occ	113 %
North Cascades - mafic , mid elevation, mixed gradient		1 occ	5.9%	0.9	20.0 %	5 occ	200 %
North Cascades headwaters - granitic , mid to high elevation, moderate to high gradient		1 occ	0.8%	0.1	2.8 %	36 occ	103 %
Northern Cascades headwaters - sandstone, moderate to high elevation, moderate to high gradient		1 occ	3.4%	0.5	11.1 %	9 occ	111 %

South Fork Stilliguamish

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Puget uplands and islands headwaters - glacial drift, low to mid elevation, low to moderate gradient		1 occ	1.2%	0.2	4.1 %	23 occ	161 %

Squamish River

Site No 26

Southern Coastal Streams EDU

Freshwater Site

Area: 136,867 ha

338,061 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Amphibians							
Coastal tailed frog *Ascaphus truei*	G4	4 occ	7.4%	6.9	30.8 %	13 occ	177 %
Fishes							
Chinook Salmon (no run info) *Oncorhynchus tshawytscha*	G5	10 km	3.1%	1.4	6.3 %	166 km	139 %
Chum Salmon (Puget XAN Ecoregion) *Oncorhynchus keta*	G5	16 km	2.7%	1.2	5.4 %	297 km	101 %
Coastal Cutthroat Trout, Clarki Subspecies (anadromous) *Oncorhynchus clarki clarki*	G4	4 km	3.1%	2.3	10.3 %	38 km	178 %
Coho Salmon *Oncorhynchus kisutch*	G4	45 km	3.9%	1.7	7.7 %	578 km	100 %
Cutthroat Trout, Clarkil Subspecies *Oncorhynchus clarkil clarkil*	G4	17 km	1.4%	1.1	4.7 %	368 km	146 %
Dolly Varden *Salvelinus malma*	G5	14 km	1.6%	1.2	5.2 %	274 km	162 %
Green Sturgeon *Acipenser medirostris*	G3	4 km	100.0%	88.7	392.8 %	1 km	393 %
Kokanee *Oncorhynchus nerka*	G5	0 km	0.1%	0.0	0.1 %	129 km	120 %
Pink Salmon, no run info (Puget XAN Ecoregion) *Oncorhynchus gorbuscha*	G5	6 km	1.7%	0.8	3.4 %	191 km	115 %
Sockeye Salmon *Oncorhynchus nerka*	G5	2 km	1.2%	0.5	2.3 %	99 km	98 %
Steelhead Salmon (no run info) *Oncorhynchus mykiss*	G5	32 km	5.5%	2.5	11.0 %	291 km	100 %
Threespine stickleback *Gasterosteus aculeatus*	G5	8 km	4.1%	3.1	13.7 %	58 km	189 %
Freshwater Ecological Systems							

Squamish River

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem moderate - tributary moderate b		2,402 ha	1.9%	1.4	6.2 %	38,479 ha	101 %
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary moderate b		130,897 ha	44.3%	33.4	147.8 %	88,565 ha	247 %
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow d		3,568 ha	23.1%	17.3	76.9 %	4,642 ha	95 %

Stakawus Creek

Site No 37

Southern Coastal Streams EDU

Freshwater Site

Area: 1,826 ha

4,510 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Freshwater Ecological Systems							
intermediate,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem shallow - tributary shallow b		1,826 ha	9.2%	520.6	30.8 %	5,933 ha	98 %

Stave River

Site No 43

Lower Fraser EDU

Freshwater Site

Area: 62,066 ha

153,304 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Amphibians							
Coastal tailed frog *Ascaphus truei*	G4	2 occ	1.8%	5.0	15.4 %	13 occ	400 %
Fishes							
Bull Trout *Salvelinus confluentus*	G3	34 km	5.8%	3.8	11.6 %	292 km	106 %
Chinook Salmon (no run info) *Oncorhynchus tshawytscha*	G5	3 km	0.4%	0.2	0.8 %	414 km	149 %
Chum Salmon (Fraser XAN Ecoregion) *Oncorhynchus keta*	G5	5 km	0.5%	0.3	0.9 %	523 km	137 %
Coastal Cutthroat Trout, Clarki Subspecies (anadromous) *Oncorhynchus clarki clarki*	G4	42 km	15.0%	16.2	50.0 %	83 km	239 %
Coho Salmon *Oncorhynchus kisutch*	G4	6 km	0.4%	0.2	0.8 %	792 km	132 %
Cutthroat Trout, Clarkil Subspecies *Oncorhynchus clarkiI clarkiI*	G4	108 km	7.4%	7.9	24.5 %	442 km	215 %
Dolly Varden *Salvelinus malma*	G5	61 km	8.5%	9.1	28.2 %	217 km	185 %
Kokanee *Oncorhynchus nerka*	G5	30 km	21.1%	13.6	42.0 %	71 km	116 %
Pink Salmon, no run info (Fraser XAN Ecoregion) *Oncorhynchus gorbuscha*	G5	3 km	0.4%	0.3	0.8 %	399 km	149 %
Sockeye Salmon *Oncorhynchus nerka*	G5	36 km	4.6%	3.0	9.3 %	383 km	148 %
Steelhead Salmon (no run info) *Oncorhynchus mykiss*	G5	9 km	1.4%	0.9	2.7 %	330 km	121 %
Threespine stickleback *Gasterosteus aculeatus*	G5	49 km	6.8%	7.4	22.8 %	215 km	246 %
Insects							

Stave River

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Emma's Dancer (nez Perce) *Argia emma*	G5	1 occ	20.0%	6.5	20.0%	5 occ	100 %
Mammals							
Pacific water Shrew *Sorex bendirii*	G4	1 occ	9.1%	3.2	10.0%	10 occ	100 %
Freshwater Ecological Systems							
intermediate,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem steep - tributary steep		56,298 ha	22.5%	24.4	75.1%	74,970 ha	180 %
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem moderate - tributary moderate b		3,208 ha	3.6%	3.9	12.0%	26,645 ha	100 %
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow b		2,560 ha	1.6%	1.7	5.2%	49,361 ha	72 %

Suiattle Headwaters

Site No 82
Puget Sound EDU

Freshwater Site
Area: 10,119 ha
24,994 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Fishes							
Bull Trout - Coastal and Puget Sound habitat *Salvelinus confluentus pop. 3*	G3T2Q	382 score	3.9%	1.3	7.7 %	4,931 score	104 %
Chinook - Puget Sound habitat *Oncorhynchus tshawytscha pop. 15*	G5T2Q	14 score	0.4%	0.1	0.8 %	1,644 score	127 %
Chum Salmon - Pacific Coast habitat *Onchorhynchus keta pop. 5*	G5T3Q	0 score	0.0%	0.0	0.0 %	6,796 score	128 %
Coho Salmon - Puget Sound/Straight of Georgia habitat *Onchorhynchus kisutch pop. 5*	G4T3Q	132 score	0.4%	0.1	0.8 %	17,434 score	116 %
Pink Salmon - Odd-year habitat *Onchorhynchus gorbuscha*	G5	59 score	0.6%	0.2	1.2 %	4,818 score	109 %
Steelhead - Puget Sound habitat *Onchorhynchus mykiss*	G5	135 score	0.6%	0.2	1.2 %	11,552 score	115 %
Freshwater Ecological Systems							
North Cascades headwaters - granitic , mid to high elevation, moderate to high gradient		5 occ	4.3%	2.3	14.1 %	36 occ	103 %

Sumas

Site No 61

Lower Fraser EDU

Freshwater Site

Area: 13,869 ha

34,255 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Aggregate higher elevation		226 ha	0.0%	0.2	0.0 %	496,454 ha	135 %
Aggregate lower elevation		10,208 ha	0.7%	9.7	2.4 %	421,069 ha	138 %
Montane composite		77 ha	0.1%	1.0	0.3 %	30,002 ha	123 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		267 ha	0.6%	8.5	2.1 %	12,529 ha	127 %
North Pacific Lowland Riparian Forest and Shrubland		398 ha	0.7%	9.2	2.3 %	17,205 ha	171 %
North Pacific Maritime Dry-Mesic Douglas-Fir Western Hemlock Forest		4,075 ha	2.2%	28.7	7.2 %	56,808 ha	131 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		303 ha	0.1%	1.5	0.4 %	78,777 ha	159 %
North Pacific Montane Massive Bedrock, Cliff and Talus		3 ha	0.0%	0.1	0.0 %	18,742 ha	118 %
North Pacific Montane Riparian Woodland and Shrubland		1 ha	0.0%	0.1	0.0 %	6,069 ha	158 %
North Pacific Mountain Hemlock Forest		6 ha	0.0%	0.1	0.0 %	44,848 ha	127 %
Old Growth Forest		252 ha	0.0%	0.4	0.1 %	259,308 ha	165 %
Species							
Birds							
Bald eagle roosts *Haliaeetus leucocephalus*	G5	1 rst	1.1%	33.3	8.3 %	9 rst	472 %
Band-tailed pigeon *Columba fasciata*	G4	1 occ	9.9%	78.3	19.6 %	5 occ	199 %

Sumas

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Great blue heron *Ardia herodius fannini*	G5T4	1 occ	4.2%	33.3	8.3 %	12 occ	200 %
Marbled murrelet *Brachyramphus marmoratus*	G3G4	1 occ	0.7%	5.2	1.3 %	77 occ	194 %
Mammals							
Fisher *Martes pennanti*	G5	560 ha	0.1%		%	ha	%
Gray wolf *Canis lupus*	G4	0 occ	0.6%	4.7	1.2 %	12 occ	196 %
Roosevelt elk *Cervus canadensis*	G5T4	3,117 ha	1.9%	25.7	6.4 %	48,392 ha	147 %
Vascular Plants							
Lesser Bladderwort *Utricularia minor*	G5	1 occ	50.0%	399.5	100.0 %	1 occ	200 %
Communities							
Carex interior - Hypericum anagalloides Herbaceous Vegetation Community *Carex interior - Hypericum anagalloides Herbaceous Vegetation*	G2?Q	43 ha	50.0%	401.8	100.6 %	43 ha	201 %
Eriophorum chamissonis / Sphagnum spp. Herbaceous Vegetation Community *Eriophorum chamissonis / Sphagnum spp.*		43 ha	34.2%	274.2	68.7 %	63 ha	201 %
Thuja plicata - Tsuga heterophylla / Lysichiton americanus Forest Community *Thuja plicata - Tsuga heterophylla / Lysichiton americanus*	G2	3 ha	1.8%	14.4	3.6 %	95 ha	200 %
Freshwater							
Species							
Fishes							
Chum Salmon (Fraser XAN Ecoregion) *Oncorhynchus keta*	G5	25 km	2.4%	6.8	4.7 %	523 km	137 %
Coho Salmon *Oncorhynchus kisutch*	G4	81 km	5.1%	14.9	10.3 %	792 km	132 %
Freshwater Ecological Systems							
intermediate,geology_hard_sediments,elevation_low,gradient_mainstem shallow - tributary shallow		13,869 ha	13.6%	65.8	45.3 %	30,620 ha	100 %

Toba River

Site No 18

Southern Coastal Streams EDU

Freshwater Site

Area: 71,336 ha

176,199 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Fishes							
Chinook Salmon (no run info) *Oncorhynchus tshawytscha*	G5	24 km	7.2%	6.2	14.4 %	166 km	139 %
Coho Salmon *Oncorhynchus kisutch*	G4	54 km	4.7%	4.1	9.4 %	578 km	100 %
Cutthroat Trout, Clarkil Subspecies *Oncorhynchus clarkiI clarkiI*	G4	0 km	0.0%	0.0	0.0 %	368 km	146 %
Dolly Varden *Salvelinus malma*	G5	33 km	3.6%	5.2	12.1 %	274 km	162 %
Pink Salmon, no run info (Puget XAN Ecoregion) *Oncorhynchus gorbuscha*	G5	13 km	3.5%	3.0	7.0 %	191 km	115 %
Steelhead Salmon (no run info) *Oncorhynchus mykiss*	G5	10 km	1.8%	1.5	3.6 %	291 km	100 %
Freshwater Ecological Systems							
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow b		71,336 ha	23.5%	33.9	78.2 %	91,190 ha	95 %

Tzoonie

Site No 42

Southern Coastal Streams EDU

Freshwater Site

Area: 2,117 ha

5,230 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Aggregate higher elevation		3,539 ha	0.2%	7.6	0.7 %	496,454 ha	135 %
Aggregate lower elevation		117 ha	0.0%	0.3	0.0 %	421,069 ha	138 %
North Pacific Maritime Mesic-Wet Douglas-Fir Western Hemlock Forest		117 ha	0.0%	1.6	0.1 %	78,777 ha	159 %
North Pacific Mesic Western Hemlock - Silver fir Forest		264 ha	1.1%	39.1	3.7 %	7,191 ha	207 %
North Pacific Montane Massive Bedrock, Cliff and Talus		53 ha	0.1%	3.0	0.3 %	18,742 ha	118 %
North Pacific Montane Riparian Woodland and Shrubland		114 ha	0.6%	20.0	1.9 %	6,069 ha	158 %
North Pacific Mountain Hemlock Forest		240 ha	0.2%	5.7	0.5 %	44,848 ha	127 %
Old Growth Forest		1,321 ha	0.2%	5.4	0.5 %	259,308 ha	165 %
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	740 ha	0.3%	6.6	0.6 %	119,141 ha	200 %
Mammals							
Mountain goat *Oreamos americanus*	G5	690 ha	0.1%	3.9	0.4 %	189,856 ha	135 %
Freshwater							
Freshwater Ecological Systems							

Tzoonie

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
small,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem shallow - tributary shallow		2,117 ha	2.1%	101.6	7.0%	30,404 ha	99 %

Urquhart

Site No 44

Lower Fraser EDU

Freshwater Site

Area: 5,798 ha

14,322 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Aggregate higher elevation		3,939 ha	0.2%	6.9	0.8 %	496,454 ha	135 %
Aggregate lower elevation		1,342 ha	0.1%	2.8	0.3 %	421,069 ha	138 %
Alpine composite		88 ha	0.3%	9.5	1.1 %	8,126 ha	110 %
North Pacific Dry-Mesic Silver fir - Western Hemlock - Douglas Fir Forest		60 ha	0.1%	4.1	0.5 %	12,529 ha	127 %
North Pacific Maritime Mesic Subalpine Parkland		513 ha	0.3%	9.6	1.1 %	46,402 ha	112 %
North Pacific Montane Riparian Woodland and Shrubland		21 ha	0.1%	3.0	0.3 %	6,069 ha	158 %
North Pacific Mountain Hemlock Forest		736 ha	0.5%	14.3	1.6 %	44,848 ha	127 %
Old Growth Forest		1,486 ha	0.2%	5.0	0.6 %	259,308 ha	165 %
Species							
Birds							
Northern spotted owl *Strix occidentalis caurina*	G3T3	1 occ	0.9%	20.2	2.3 %	25 occ	204 %
Mammals							
Mountain goat *Oreamos americanus*	G5	1,180 ha	0.2%	5.4	0.6 %	189,856 ha	135 %
Freshwater							
Species							
Fishes							

Urquhart

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Steelhead Salmon (winter) *Oncorhynchus mykiss*	G5	6 km	11.1%	38.6	11.1%	53 km	89 %
Freshwater Ecological Systems							
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow a		5,798 ha	1.0%	11.7	3.4%	172,507 ha	96 %

Vancouver River

Site No 38

Southern Coastal Streams EDU

Freshwater Site

Area: 8,495 ha

20,983 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Terrestrial							
Terrestrial Ecological Systems							
Aggregate higher elevation		6,793 ha	0.4%	9.4	1.4 %	496,454 ha	135 %
North Pacific Mesic Western Hemlock - Silver fir Forest		297 ha	1.2%	28.3	4.1 %	7,191 ha	207 %
North Pacific Montane Riparian Woodland and Shrubland		144 ha	0.7%	16.2	2.4 %	6,069 ha	158 %
North Pacific Mountain Hemlock Forest		515 ha	0.3%	7.9	1.1 %	44,848 ha	127 %
Old Growth Forest		3,555 ha	0.4%	9.4	1.4 %	259,308 ha	165 %
Species							
Birds							
Marbled murrelet habitat *Brachyramphus marmoratus*	G3G4	1,498 ha	0.5%	8.6	1.3 %	119,141 ha	200 %
Mammals							
Mountain goat *Oreamos americanus*	G5	901 ha	0.1%	3.3	0.5 %	189,856 ha	135 %
Freshwater							
Species							
Fishes							
Chinook Salmon (no run info) *Oncorhynchus tshawytscha*	G5	2 km	0.7%	5.2	1.4 %	166 km	139 %
Chum Salmon (Puget XAN Ecoregion) *Oncorhynchus keta*	G5	12 km	2.0%	14.8	4.1 %	297 km	101 %
Coastal Cutthroat Trout, Clarki Subspecies (anadromous) *Oncorhynchus clarki clarki*	G4	2 km	1.9%	22.9	6.3 %	38 km	178 %

Vancouver River

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Coho Salmon *Oncorhynchus kisutch*	G4	17 km	1.5%	10.8	3.0 %	578 km	100 %
Cutthroat Trout, Clarkil Subspecies *Oncorhynchus clarkil clarkil*	G4	18 km	1.4%	17.4	4.8 %	368 km	146 %
Dolly Varden (anadromous) *Salvelinus malma*	G5	5 km	7.5%	91.3	25.1 %	21 km	294 %
Pink Salmon, no run info (Puget XAN Ecoregion) *Oncorhynchus gorbuscha*	G5	10 km	2.6%	18.8	5.2 %	191 km	115 %
Steelhead Salmon (no run info) *Oncorhynchus mykiss*	G5	10 km	1.7%	12.3	3.4 %	291 km	100 %
Steelhead Salmon (winter) *Oncorhynchus mykiss*	G5	7 km	12.2%	44.5	12.2 %	61 km	100 %
Freshwater Ecological Systems							
intermediate,geology_intrusive - metamorphic,elevation_intermediate,gradient_mainstem shallow - tributary shallow b		916 ha	4.6%	56.1	15.4 %	5,933 ha	98 %
small,geology_intrusive - metamorphic,elevation_high,gradient_mainstem shallow - tributary shallow a		7,580 ha	1.5%	18.1	5.0 %	152,453 ha	114 %

Whatcom Creek

Site No 68

Puget Sound EDU

Freshwater Site

Area: 14,538 ha

35,910 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Fishes							
Chum Salmon - Pacific Coast habitat *Onchorhynchus keta pop. 5*	G5T3Q	405 score	3.0%	0.7	6.0 %	6,796 score	128 %
Coastal Cutthroat Trout - Puget Sound habitat *Oncorhynchus clarki clarki pop. 7*	G4T3Q	60 score	0.2%	0.0	0.4 %	14,075 score	105 %
Coho Salmon - Puget Sound/Straight of Georgia habitat *Onchorhynchus kisutch pop. 5*	G4T3Q	736 score	2.1%	0.5	4.2 %	17,434 score	116 %
Pink Salmon - Odd-year habitat *Onchorhynchus gorbuscha*	G5	100 score	1.0%	0.2	2.1 %	4,818 score	109 %
Steelhead - Puget Sound habitat *Onchorhynchus mykiss*	G5	388 score	1.7%	0.4	3.4 %	11,552 score	115 %
Western Brook Lamprey habitat *Lamptera richardsoni*	G5	51 ha	7.1%	2.8	23.8 %	212 ha	308 %
Freshwater Ecological Systems							
Cascade foothills headwaters - glacial drift and alluvium , low to mid elevation, mixed gradient		0 occ	0.2%	0.1	0.7 %	5 occ	180 %
Cascade foothills headwaters - glacial drift, mid elevations, mixed gradient		0 occ	1.1%	0.5	4.1 %	3 occ	133 %
Cascades tributary headwaters - granitic, low to mid elevation		1 occ	3.6%	1.4	12.5 %	8 occ	113 %
Nooksack coastal plain headwaters - glacial drift and outwash, low elevation, low to moderate gradient		2 occ	14.0%	5.3	45.4 %	4 occ	200 %
Northern Cascades headwaters - sandstone, moderate to high elevation, moderate to high gradient		1 occ	3.3%	1.2	10.6 %	9 occ	111 %

Whatcom Creek

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Puget uplands and islands headwaters - glacial drift, low to mid elevation, low to moderate gradient		3 occ	4.0%	1.5	13.2 %	23 occ	161 %

White Chuck River

Site No 85

Puget Sound EDU

Freshwater Site

Area: 12,120 ha

29,936 ac

Targets known in this Conservation Area:	GRank	Abundance	% of Total Known in EDU	Relative Abundance	Contribution to EDU Goal	EDU Goal	% of Goal Captured by Portfolio
Freshwater							
Species							
Fishes							
Bull Trout - Coastal and Puget Sound habitat *Salvelinus confluentus pop. 3*	G3T2Q	166 score	1.7%	0.5	3.4 %	4,931 score	104 %
Chinook - Puget Sound habitat *Oncorhynchus tshawytscha pop. 15*	G5T2Q	16 score	0.5%	0.1	1.0 %	1,644 score	127 %
Chum Salmon - Pacific Coast habitat *Onchorhynchus keta pop. 5*	G5T3Q	3 score	0.0%	0.0	0.0 %	6,796 score	128 %
Coho Salmon - Puget Sound/Straight of Georgia habitat *Onchorhynchus kisutch pop. 5*	G4T3Q	170 score	0.5%	0.1	1.0 %	17,434 score	116 %
Pink Salmon - Odd-year habitat *Onchorhynchus gorbuscha*	G5	133 score	1.4%	0.4	2.8 %	4,818 score	109 %
Salish Sucker *Catostomus Sp 4*	GQ	1 occ	7.7%	3.5	25.0 %	4 occ	325 %
Steelhead - Puget Sound habitat *Onchorhynchus mykiss*	G5	143 score	0.6%	0.2	1.2 %	11,552 score	115 %
Freshwater Ecological Systems							
North Cascades headwaters - granitic , mid to high elevation, moderate to high gradient		3 occ	2.9%	1.3	9.6 %	36 occ	103 %
Northern Cascades headwaters - sandstone, moderate to high elevation, moderate to high gradient		1 occ	3.0%	1.4	9.8 %	9 occ	111 %

100% Post Consumer Waste