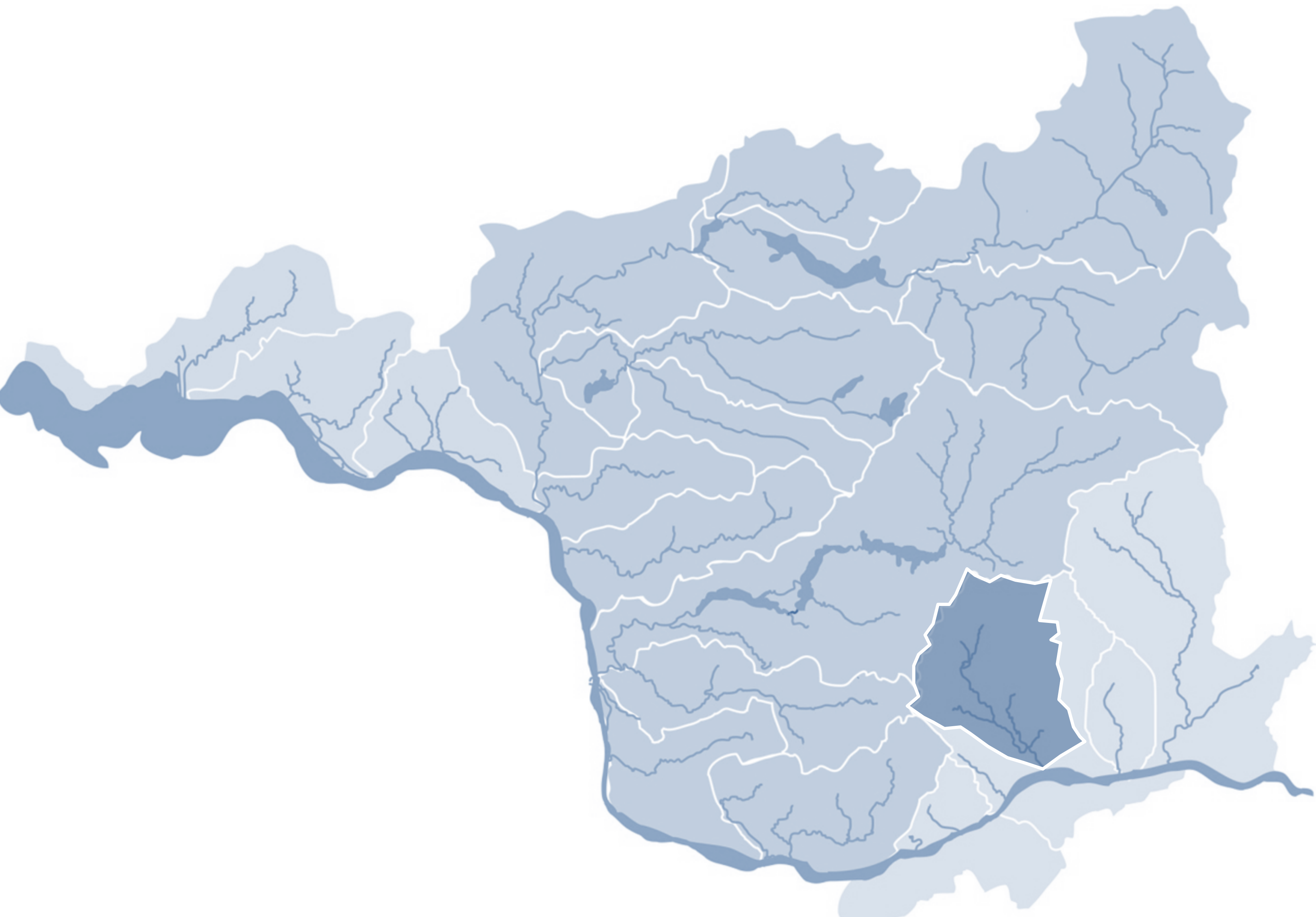
P. WIND SUBBASIN



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P.1. Executive Summary

Figure P-1. Map of the Wind River.

This Plan describes a vision, strategy, and actions for recovery of listed salmon, steelhead, and trout species to healthy and harvestable levels, and mitigation of the effects of the Columbia River hydropower system in Washington lower Columbia River subbasins. Recovery of listed species and hydropower mitigation is accomplished at a regional scale. This Plan for the Wind River Subbasin describes implementation of the regional approach within this subbasin, as well as assessments of local fish populations, limiting factors, and ongoing activities that underlie local recovery or mitigation actions. The Plan was developed in a partnership between the Lower Columbia Fish Recovery Board (LCFRB), Northwest Power and Conservation Council (NPCC), federal agencies, state agencies, tribal nations, local governments, and others.

The Wind River is one of twelve major NPCC subbasins in the Washington portion of the Lower Columbia Region. This subbasin historically supported abundant fall Chinook, winter steelhead, chum, and coho. Today, numbers of naturally spawning salmon and steelhead have plummeted to levels far below historical numbers. Chinook, coho, steelhead and chum have been listed as Threatened under the Endangered Species Act. The decline has occurred over decades and the reasons are many. Freshwater and estuary habitat quality has been reduced by agricultural and forestry practices. Key habitats have been isolated or eliminated through Bonneville Pool inundation, channel modifications, and floodplain disconnection. Altered habitat conditions have increased predation. Competition and interbreeding with domesticated or non-local hatchery fish has reduced productivity. Hydropower construction and operation has altered flows, habitat, and migration conditions. Fish are harvested in fresh and saltwater fisheries.

Wind River coho and summer steelhead will need to be restored to a high level of viability to meet regional recovery objectives. This means that the populations are productive, abundant, exhibit multiple life history strategies, and utilize significant portions of the subbasin.

In recent years, agencies, local governments, and other entities have actively addressed the various threats to salmon and steelhead, but much remains to be done. One thing is clear: no single threat is responsible for the decline in these populations. All threats and limiting factors must be reduced if recovery is to be achieved. An effective recovery plan must also reflect a realistic balance within physical, technical, social, cultural and economic constraints. The decisions that govern how this balance is attained will shape the region's future in terms of watershed health, economic vitality, and quality of life.

This Plan represents the current best estimation of necessary actions for recovery and mitigation based on thorough research and analysis of the various threats and limiting factors that impact Wind River fish populations. Specific strategies, measures, actions and priorities have been developed to address these threats and limiting factors. The specified strategies identify the best long term and short term avenues for achieving fish restoration and mitigation goals. While it is understood that data, models, and theories have their limitations and growing knowledge will certainly spawn new strategies, the LCFRB is confident that by implementation of the recommended actions in this Plan, the population goals in the Wind River Basin can be achieved. Success will depend on implementation of these strategies at the program and project level. It remains uncertain what level of effort will need to be invested in each area of impact to ensure the desired result. The answer to the question of precisely how much is enough is currently beyond our understanding of the species and ecosystems and can only be answered through ongoing monitoring and adaptive management against the backdrop of what is socially possible.

P.1.1. Key Priorities

Many actions, programs, and projects will make necessary contributions to recovery and mitigation in the Wind River Subbasin. The following list identifies the most immediate priorities.

1. Reduce Passage Mortality at Bonneville Dam and Mitigate for Effects of Reservoir Inundation

Anadromous fish populations in the Wind River are affected by Bonneville Dam operations including inundation of historically available key habitat in the lower river and dam passage effects. Almost a mile of spawning habitat was inundated by Bonneville Pool. This loss of key habitat is particularly significant due to the naturally limited amount of suitable habitat in the lower basin for fall Chinook, chum, and coho. Upstream and downstream fish passage facilities are operated at Bonneville Dam in the mainstem Columbia River but significant mortality and migration delay occurs. Adults are typically delayed in the tailrace but most eventually find and use fish ladders. A varying percentage of adults do not pass successfully or pass but fall back over the spillway. Juvenile passage mortality results primarily from passage through dam turbines rather than spillway or fish bypass systems. Anadromous fish populations will benefit from regional recovery measures and actions identified for operations of Bonneville Dam with respect to fish passage. The suite of in-subbasin and out-of-subbasin actions will help to mitigate for habitat loss and dam passage impacts.

2. Protect Intact Forests in Headwater Basins

Portions of the Wind Subbasin, particularly those protected through Wilderness and Late Successional Reserve designations, are heavily forested with relatively intact landscape conditions that support functioning watershed processes. Streams are unaltered, road densities are low, and riparian areas and uplands are characterized by mature forests. Existing legal designations and management policy are expected to continue to offer protection to these lands.

3. Manage Forest Lands to Protect and Restore Watershed Processes

The majority of the Wind Subbasin has been managed for commercial timber production and has experienced intensive past forest practices activities. Proper forest management is critical to fish recovery. Past forest practices have reduced fish habitat quantity and quality by altering stream flow, increasing fine sediment, and degrading riparian zones. In addition, forest road culverts have blocked fish passage in small tributary streams. Effective implementation of new forest practices through the Department of Natural Resources’ Habitat Conservation Plan (state lands), Forest Practices Rules (private lands), and the Northwest Forest Plan (federal lands) are expected to substantially improve conditions by restoring passage, protecting riparian conditions, reducing fine sediment inputs, lowering water temperatures, improving flows, and restoring habitat diversity. Improvements will benefit all species, particularly summer steelhead.

4. Manage Growth and Development to Protect Watershed Processes and Habitat Conditions

The human population in the basin is relatively low, but it is projected to grow by 50% in the next twenty years. The local economy is also in transition with reduced reliance on forest products. Population growth will primarily occur in the lower basin in and around Carson, WA and along the lower and middle mainstem Wind River in privately owned areas. This growth will result in the conversion of forest land to residential uses, with potential impacts to habitat conditions. Land-use changes will provide a variety of risks to terrestrial and aquatic habitats. Careful land-use planning will be necessary to protect and restore natural fish populations and habitats and will also present opportunities to preserve the rural character and local economic base of the basin. The assessments illustrate the overwhelming importance of the Wind River canyon and Panther Creek canyon reaches for summer steelhead juvenile rearing. These reaches have been relatively protected from riparian impacts due to the steepness of the canyons and lack of near-stream roadways. Effective recovery of steelhead will require that no further degradation of these important reaches occurs. An additional concern is development adjacent to the lower mainstem Wind that has altered natural runoff processes, resulting in severe erosion and sedimentation of stream channels. These processes are exacerbated by highly erodable soils. Implementing stormwater runoff controls and working to restore existing runoff and erosion problems will benefit fish habitat in lower river reaches. Targeting conditions along the lower river could provide important benefits to winter steelhead and fall Chinook, which typically do not ascend Shipherd Falls at river mile 2.

5. Restore Floodplain Function, Riparian Function and Stream Habitat Diversity

The middle mainstem Wind upstream of the Trout Creek confluence and extending into National Forest Land consists of a broad alluvial floodplain valley that has been impacted by land-use activities including past agricultural practices, residential development and associated channel modifications. Construction of levees, bank stabilization, and riparian vegetation removal have heavily impacted fish habitat in these areas. Removing or modifying channel control and containment structures to reconnect the stream and its floodplain, where this is feasible and can be done without increasing risks of substantial flood damage, will restore normal habitat-forming processes to reestablish habitat complexity, off-channel habitats, and conditions favorable to steelhead spawning and rearing. Partially restoring normal floodplain functions will also help control downstream flooding and provide wetland and riparian habitats critical to other fish, wildlife, and plant species. Existing floodplain function and riparian areas will be protected through local land use ordinances and partnerships with landowners. Restoration will be achieved by working with willing landowners, non-governmental organizations, conservation districts, and state and federal agencies.

6. Evaluate and Address Passage Issues at Hemlock Dam and Lake and Other Barriers

Hemlock Dam and Lake on Trout Creek are believed to create passage issues for adult and juvenile steelhead. Dam removal is currently being evaluated as a means to improve passage conditions and allow for the restoration of aquatic habitat at the existing dam and lakesite. Other passage barriers in the basin are located on small tributaries and are not believed to block a significant portion of habitat. Passage restoration projects should focus only on cases where it can be demonstrated that there is good potential benefit. Further assessment and prioritization of passage barriers is needed throughout the basin.

7. Align Hatchery Priorities with Conservation Objectives

Hatcheries throughout the Columbia basin historically focused on producing fish for fisheries as mitigation for hydropower development and widespread habitat degradation. Emphasis of hatchery production without regard for natural populations can pose risks to natural population viability. Hatchery priorities must be aligned to conserve natural populations, enhance natural fish recovery, and avoid impeding progress toward recovery while continuing to provide fishing benefits. Hatchery programs in the Wind Basin will produce and/or acclimate spring Chinook for use in the subbasin. Spring Chinook hatchery programs continue to support harvest as part of Columbia Basin Hydrosystem mitigation.

8. Manage Fishery Impacts so they do not Impede Progress Toward Recovery

This near-term strategy involves limiting fishery impacts on natural populations to ameliorate extinction risks until a combination of measures can restore fishable natural populations. There is no directed Columbia River or tributary harvest of ESA-listed Wind River salmon and steelhead. This practice will continue until the populations are sufficiently recovered to withstand such pressure and remain self-sustaining. Some Wind River salmon and steelhead are incidentally taken in mainstem Columbia River and ocean mixed stock fisheries for strong wild and hatchery runs of fall Chinook and coho. These fisheries will be managed with strict limits to ensure this incidental take does not threaten the recovery of wild populations including those from the Wind. Steelhead and chum will continue to be protected from significant fishery impacts in the Columbia River and are not subject to ocean fisheries. Selective fisheries for marked hatchery steelhead and coho (and fall Chinook after mass marking occurs) will be a critical tool for limiting wild fish impacts. State and federal legislative bodies will be encouraged to develop funding necessary to implement mass-marking of Fall Chinook, thus enabling a selective fishery with lower impacts on wild fish. State and federal fisheries managers will better incorporate Lower Columbia indicator populations into fisheries impact models.

9. Reduce Out-of-Subbasin Impacts so that the Benefits of In-Basin Actions can be Realized

Wind River salmon and steelhead are exposed to a variety of human and natural threats in migrations outside of the subbasin. Out-of-subbasin impacts include drastic habitat changes in the Columbia River estuary, effects of Columbia Basin hydropower operation on mainstem, estuary, and nearshore ocean conditions, interactions with introduced animal and plant species, and altered natural predation patterns by northern pikeminnow, birds, seals, and sea lions. A variety of restoration and management actions are needed to reduce out-of-subbasin effects so that the benefits of in-subbasin actions can be realized. To ensure equivalent sharing of the recovery and mitigation burden, impacts in each area of effect (habitat, hydropower, etc.) should be reduced in proportion to their significance to species of interest.

P.2. Background

This Plan describes a vision and framework for rebuilding salmon and steelhead populations in Washington's Wind River Subbasin. The Plan addresses subbasin elements of a regional recovery plan for Chinook salmon, chum salmon, coho salmon, and steelhead listed as Threatened under the federal Endangered Species Act (ESA). The Plan also serves as the subbasin plan for the Northwest Power and Conservation Council (NPCC) Fish and Wildlife Program to address effects of construction and operation of the Federal Columbia River Power System.

Development of this Plan was led and coordinated by the Washington Lower Columbia Fish Recovery Board (LCFRB). The LCFRB was established by state statue (RCW 77.85.200) in 1998 to oversee and coordinate salmon and steelhead recovery efforts in the lower Columbia region of Washington. It is comprised of representatives from the state legislature, city and county governments, the Cowlitz Tribe, private property owners, hydro project operators, the environmental community, and concerned citizens. A variety of partners representing federal agencies, tribal governments, Washington state agencies, regional organizations, and local governments participated in the process through involvement on the LCFRB, a Recovery Planning Steering Committee, planning working groups, public outreach, and other coordinated efforts.

The planning process integrated four interrelated initiatives to produce a single Recovery/Subbasin Plan for Washington subbasins of the lower Columbia:

- Endangered Species Act recovery planning for listed salmon and trout.
- Northwest Power and Conservation Council (NPCC) fish and wildlife subbasin planning for eight full and three partial subbasins.
- Watershed planning pursuant to the Washington Watershed Management Act, RCW 90-82.
- Habitat protection and restoration pursuant to the Washington Salmon Recovery Act, RCW 77.85.

This integrated approach ensures consistency and compatibility of goals, objectives, strategies, priorities and actions; eliminates redundancy in the collection and analysis of data; and establishes the framework for a partnership of federal, state, tribal and local governments under which agencies can effectively and efficiently coordinate planning and implement efforts.

The Plan includes an assessment of limiting factors and threats to key fish species, an inventory of related projects and programs, and a management plan to guide actions to address specific factors and threats. The assessment includes a description of the subbasin, focal fish species, current conditions, and evaluations of factors affecting focal fish species inside and outside the subbasin. This assessment forms the scientific and technical foundation for developing a subbasin vision, objectives, strategies, and measures. The inventory summarizes current and planned fish and habitat protection, restoration, and artificial protection activities and programs. This inventory illustrates current management direction and existing tools for Plan implementation. The management plan details biological objectives, strategies, measures, actions, and expected effects consistent with the planning process goals and the corresponding subbasin vision.

P.3. Assessment

P.3.1.Subbasin Description

Topography & Geology

The Wind River subbasin covers about 143,504 acres (224 mi^2) in central Skamania County. The headwaters of the mainstem arise in the McClellan Meadows area in the southern Gifford Pinchot National Forest (GPNF). The major tributaries in the basin include the Little Wind River, Bear Creek, Panther Creek, Trout Creek, Trapper Creek, Dry Creek, Falls Creek, and Paradise Creek. Elevation in the basin ranges from 80 to 3,900 feet. The northwest portion of the basin is steep and the northeast portion is relatively flat and consists of high elevation meadows. Trout Creek, a major tributary to the west, has a broad alluvial bench (Trout Creek Flats) in the upper central portion of the basin. A broad alluvial valley extends along several miles of the middle mainstem before entering into a steep V-shaped canyon in the lower 20 miles of stream. The lower southeast portion of the basin, including the Panther Creek and Little Wind River basins, is quite steep. Shipherd Falls, actually a set of four 10-15 foot falls, is located at approximately RM 2 and historically blocked all anadromous fish except for steelhead, until it was laddered in the 1950s.

Basin geologic history consists of old and new volcanic activity combined with more recent glacial and alluvial processes. The older basalt flows date back 12 to 25 million years, while the newer ones emanating from Trout Creek Hill are as recent as 300,000 years ago. The older material, which makes up most of the basin, is the most susceptible to erosion due to weathering into finer material. Relatively recent glacial activity contributed glacial sediments and has shaped river valleys. Alluvial deposits from the massive Bretz Floods, which originated from eastern Washington during the late Pleistocene, have resulted in highly erodable soils in portions of the lower basin.

Climate

The climate is marine-influenced, consisting of cool, wet winters and warm, dry summers. Mean annual precipitation is 109 inches at Stabler. Most of the precipitation falls from November through April (WRCC 2003). 70% of the basin is in the rain-on-snow zone, with low elevation areas in the rain-dominated zone and the highest elevation areas in the snow-dominated zone.

Land Use, Ownership, and Cover

The subbasin is 93% forested. Non-forested lands include alpine meadows in the upper northeast basin and areas of development in lower elevation, privately-owned areas. Forest stands above 3,500 feet are generally in the Pacific silver fir plant association, while lower elevation areas tend to be in the Hemlock zone. Approximately 9.6% of the land is private, while almost all of the remainder lies within the GPNF. Forestry land uses dominate the subbasin. The percentage of the forest in late-successional forest stages has decreased from 83,500 acres to 31,800 acres since pre-settlement times. This change is attributed to timber harvest and forest fires (USFS 1996). The largest population centers are the towns of Carson and Stabler. Carson draws its water supply from Bear Creek, a Wind River tributary. The year 2000 population of the subbasin was estimated at 2,096 persons and is expected to increase to 3,077 by 2020 (Greenberg and Callahan 2003). The State of Washington owns, and the Washington State Department of Natural Resources (DNR) manages the beds of all navigable waters within the subbasin.

Any proposed use of those lands must be approved in advance by the DNR. Land ownership and land cover/land use are illustrated in Figure P-2 and Figure P-3.

Human Disturbance Trends

The year 2000 population of the subbasin was estimated at 2,096 persons and is expected to increase to 3,077 by 2020 (Greenberg and Callahan 2003).Continued population growth will increase pressures for conversion of forestry and agricultural land uses to residential uses, with potential impacts to habitat conditions.

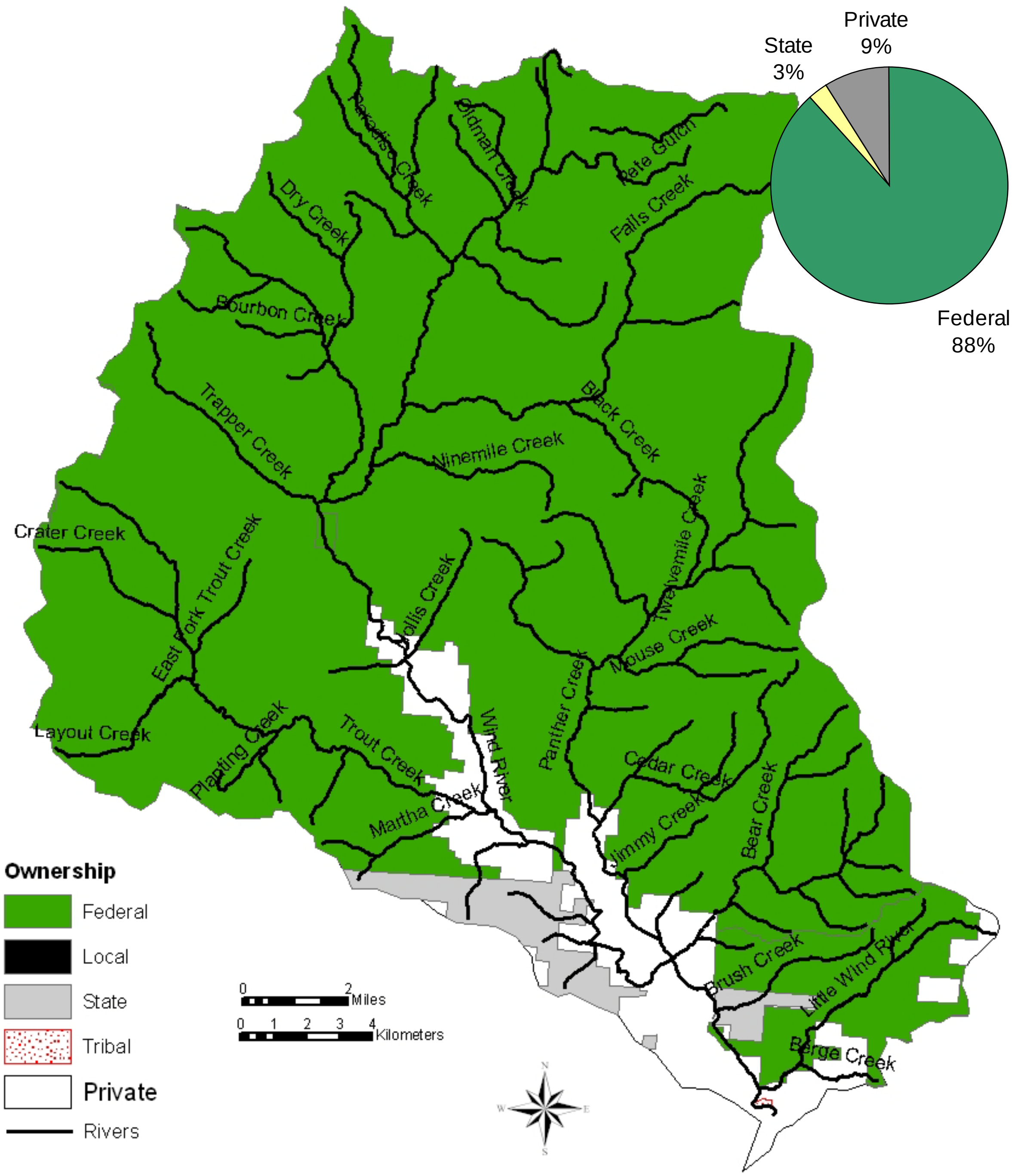


Figure P-2. Landownership within the Wind River subbasin. Data is WDNR data that was obtained from the Interior Columbia Basin Ecosystem Management Project (ICBEMP).

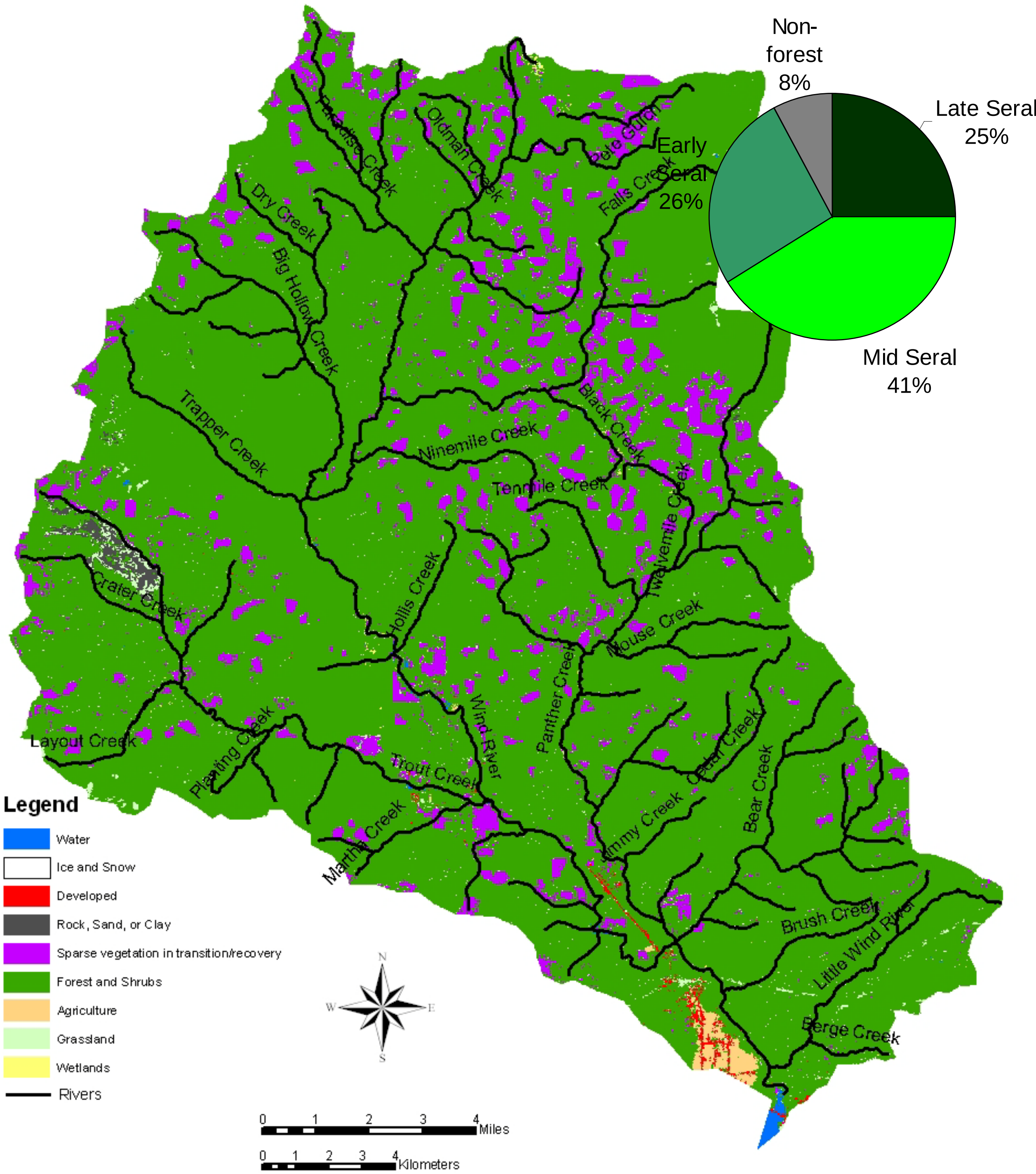


Figure P-3. Land cover within the Wind River subbasin. Vegetation cover (pie chart) derived from Landsat data based on methods in Lunetta et al. (1997). Mapped data was obtained from the USGS National Land Cover Dataset (NLCD).

P.3.2. Focal Fish Species

Listed salmon, steelhead, and trout species are focal species of this planning effort for the Wind Subbasin. Other species of interest were also identified as appropriate. Species were selected because they are listed or under consideration for listing under the U.S. Endangered Species Act or because viability or use is significantly affected by the Federal Columbia Hydropower system. Federal hydropower system effects are significant within the Wind River basin. The lower reach of the river has been inundated by Bonneville Reservoir, affecting chum and fall Chinook habitat, and salmon and steelhead are affected by passage obstacles at Bonneville Dam. Wind River anadromous species are also subject to hydro operation effects in the Columbia River, estuary, and nearshore ocean. The Wind ecosystem supports and depends on a wide variety of fish and wildlife in addition to designated focal species. A comprehensive ecosystem-based approach to salmon and steelhead recovery will provide significant benefits to other native species through restoration of landscape-level processes and habitat conditions. Other fish and wildlife species not directly addressed by this Plan are subject to a variety of other Federal, State, and local planning or management activities.

Focal salmonid species in Wind River watersheds include fall Chinook, chum, coho, summer steelhead and winter steelhead. Bull trout do not occur in the subbasin. Salmon and steelhead numbers have declined to only a fraction of historical levels (Table P-1). Extinction risks are significant for all focal species except summer steelhead – the current health or viability ranges from very low for chum, fall Chinook, and coho; and low for winter steelhead, and high for summer steelhead.

Other species of interest in the Wind River include coastal cutthroat trout and Pacific lamprey. These species have been affected by many of the same habitat factors that have reduced numbers of anadromous salmonids. Recovery actions targeting focal salmonid species are also expected to provide significant benefits for these other species. Cutthroat will benefit from improvements in stream habitat conditions for salmonids. Lamprey are expected to benefit from habitat improvements in the estuary, Columbia River, and mainstem, and in the Wind Subbasin, although specific spawning and rearing habitat requirements for lamprey are not well known. Brief summaries of the population characteristics and status follow. Additional information on life history, population characteristics, and status assessments may be found in Appendix A (focal species) and B (other species).

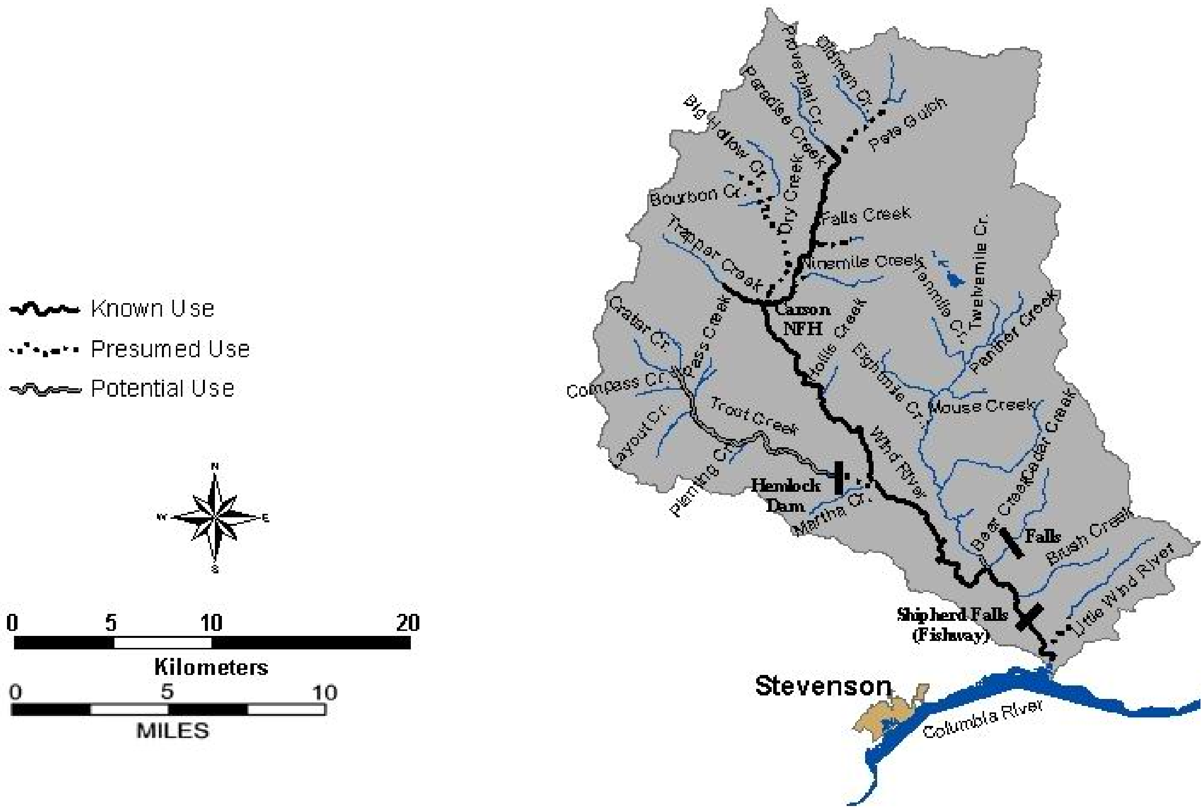
Table P-1. Status of focal salmonid and steelhead populations in the Wind River subbasin.

Species	Population	Recovery priority[1]	Viability		Improve-ment[4]	Abundance		
			Status[2]	Obj.[3]		Historic[5]	Current[6]	Target[7]
Fall Chinook (Tule)	Upper Gorge	Contributing	VL	M	>500%	n/a[8]	<50	1,200
Chum	Upper Gorge	Contributing	VL	M	>500%	11,000	<50	900
Winter Steelhead	Upper Gorge	Stabilizing	L	L	0%[9]	n/a[8]	200	200
Summer Steelhead	Wind	Primary	H	VH	0%[9]	n/a[8]	1,000	1,000
Coho	Upper Gorge	Primary	VL	H	400%	n/a[8]	<50	1,900

[1] Primary, Contributing, and Stabilizing designations reflect the relative contribution of a population to major population group recovery goals.
[2] Baseline viability is based on Technical Recovery Team viability rating approach.
[3] Viability objective is based on the scenario contribution.
[4] Improvement is the relative increase in population production required to reach the prescribed viability goal
[5] Historical population size inferred from presumed habitat conditions using Ecosystem Diagnosis and Treatment Model and NMFS back-of-envelope calculations.
[6] Approximate current annual range in number of naturally-produced fish returning to the watershed.
[7] Abundance target were estimated by population viability simulations based on viability goals.
[8] Historical abundance and recovery goal information is not available at this time due to a lack of information regarding population dynamics.
[9] Improvement increments are based on abundance and productivity, however, this population will require improvements in spatial structure or diversity to meet recovery objectives.

Spring Chinook—Wind Subbasin

ESA: Not listed (non-native species) **SASSI: Healthy 2002**

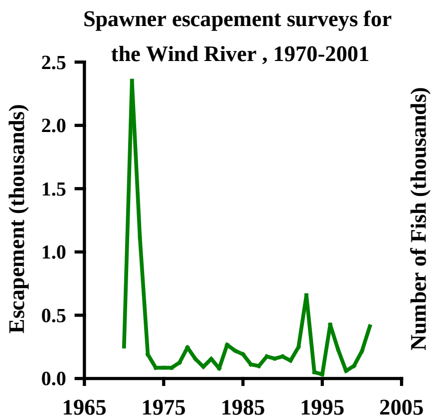


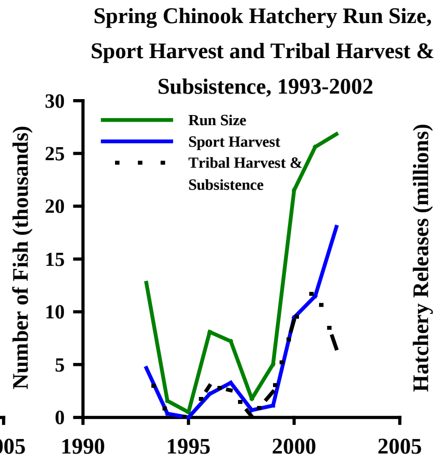
Distribution

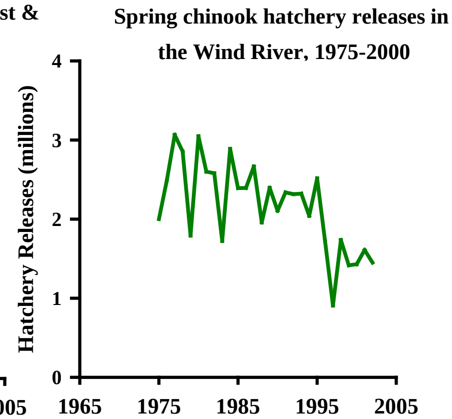
- Historically, spring Chinook were not found in the Wind River basin
- A ladder was constructed at Shipperd Falls (RM 2) in the 1956 as part of a spring Chinook introduction program, providing fish access to the upper watershed
- Currently, natural spawning occurs in limited numbers from the mouth of Paradise Creek (RM 25) downstream approximately 10 miles

Life History

- Spring Chinook return to the Wind River from March through June; spring Chinook counts peak at Bonneville Dam in late April
- Spawning in the Wind River occurs between early August and mid-September, with peak activity in late August
- Age ranges from 3-year old jacks to 6-year old adults, with 4- and 5-year olds usually the dominant age class (averages are 58.5% and 38.0%, respectively)
- Fry emerge between November and March, depending on time of egg deposition and water temperature; spring Chinook fry spend one full year in fresh water, and emigrate in their second spring as age-2 smolts.







Diversity

- Spring Chinook did not historically return to the Wind River
- Spring Chinook were introduced to the Wind River basin; brood stock is mixed upriver spring Chinook stock
- Allozyme analysis of Carson National Fish Hatchery (NFH) spring Chinook indicate they resemble upper Columbia River spring Chinook stocks in the Wenatchee, Entiat, and Methow basins

Abundance

- Wind River spawning escapements from 1970-2002 ranged from 26 in 1995 to 1,936 in 1971
- The average fish per mile from 1970-84 was 21; fish per mile ranged from 4-112
- Spring Chinook are not native to the Wind River basin; hatchery strays account for most spring Chinook spawning in the Wind River

Productivity & Persistence

- Smolt density model predicted natural production potential for the Wind River was 157,533 smolts
- Juvenile production from natural spawning is presumed to be low; population is not considered self-sustaining

Hatchery

- The state operated a salmon hatchery near the mouth of the Wind River from 1899-1938 to produce fall Chinook
- Carson NFH was constructed in 1937 at Tyee Springs (RM 18); hatchery releases of spring Chinook in the Wind River began in the 1930s; early attempts to introduce spring Chinook to the Wind basin were unsuccessful
- Spring Chinook releases into the Wind River 1972-1990 averaged 3,443,636
- Carson NFH brood stock was developed from spring Chinook from the Snake River and mid- and upper Columbia River collected at Bonneville Dam in the 1970s
- The current Carson hatchery program releases 1.6 million spring Chinook smolts annually into the Wind River

Harvest

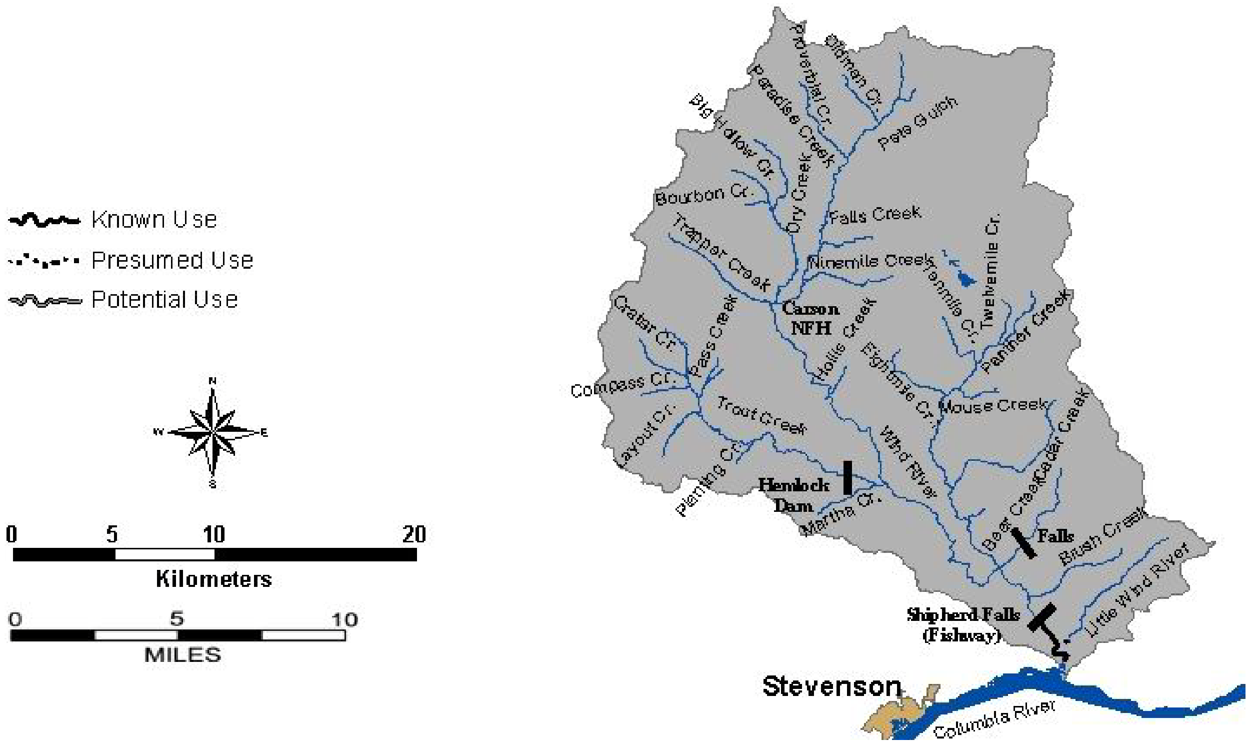
- Spring Chinook to harvested in ocean commercial and recreational fisheries from Oregon to Alaska, in addition to Columbia River commercial and sport fisheries

- CWT analysis indicated that upriver spring Chinook are impacted less by ocean fisheries than other Columbia River Chinook stocks; CWT recovery data suggest that Carson Hatchery spring Chinook are recovered primarily as recreational harvest, incidental commercial harvest, and hatchery escapement
- From 1938-1973, about 55% of upriver spring Chinook runs were harvested in directed Columbia River commercial and sport fisheries; from 1975-2000 (excluding 1977), no lower river fisheries have targeted upriver stocks and the combined Indian and non-Indian harvest rate was limited to 11% or less
- Beginning in 2001, selective fisheries and abundance based management agreement through *U.S. vs. Oregon* has enabled an increase in Columbia harvest of hatchery spring Chinook
- WDF and the Yakama Indian Nation negotiate an annual harvest plan for sharing the Little White Salmon Hatchery surplus between the sport fishery and the tribal commercial and subsistence fisheries in Drano Lake
- Sport harvest in the Wind River from 1993-2002 averaged 5,130; with a record 18,036 harvested in 2002
- Tribal harvest averaged 869 and tribal hatchery subsistence distributions averaged 3,189 from 1993-2002

Fall Chinook—Wind Subbasin

ESA: Threatened	SASSI: Critical 2002

The historical Wind River adult tule fall Chinook population is estimated from 2,500-3,500 fish. The current natural spawning number in the tributaries is 0 to 400 fish. There are also stray tule fall Chinook from Spring Creek Hatchery that spawn in the Wind. Natural spawning occurs primarily in the lower mainstem Wind downstream of Shipperd Falls (RM 2). The tule fall Chinook spawning time is from mid-September to early October. Juvenile rearing occurs near and downstream of the spawning areas. Juveniles migrate from the Bonneville tributaries in the spring and early summer of their first year.



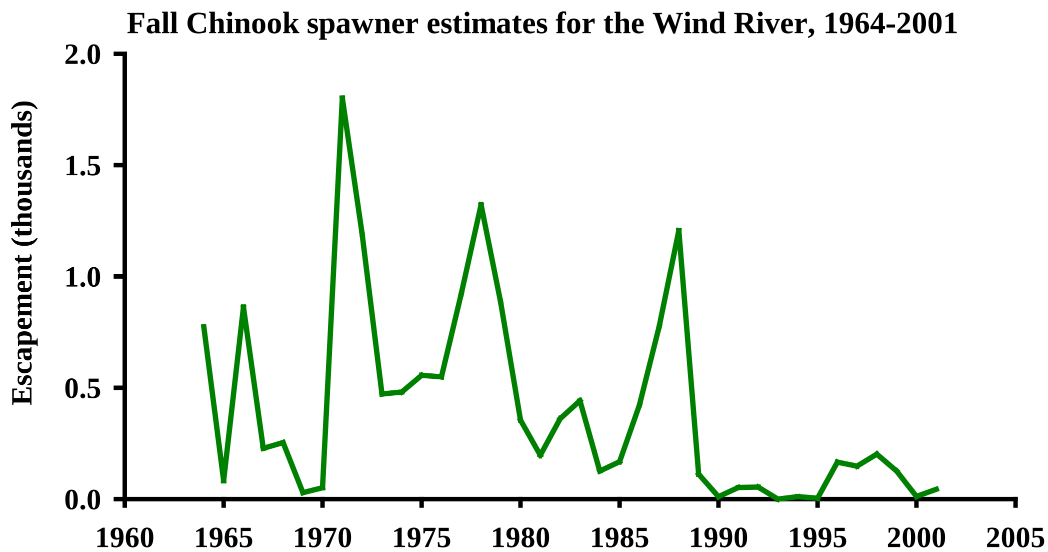
Distribution

- Historically, fall Chinook were limited to the lower Wind River; a ladder was constructed at Shipherd Falls (RM 2) in 1956, providing fish access to the upper watershed
- Fall Chinook have been observed up to the Carson NFH (RM 18), but the majority of spawning occurs in the lower two miles of the mainstem; spawning may also occur in the Little Wind River (RM 1)
- Completion of Bonneville Dam (1938) inundated the primary fall Chinook spawning areas in the lower Wind River

Life History

- Bonneville Pool tule stock fall Chinook upstream migration in the Columbia River occurs from August through September; peak counts at Bonneville Dam range from September 4-9
- Tule fall Chinook enter the Wind River in September
- Spawning in the Wind River generally occurs in September
- Age ranges from 2-year old jacks to 4-year old adults, but age 3- and 4-year old spawners predominate

- Fry emerge from January through March, depending on time of egg deposition and water temperature; fall Chinook fingerlings emigrate from the Wind River in spring



Diversity

- Considered a tule population in the lower Columbia River Evolutionarily Significant Unit (ESU)
- The Wind River fall Chinook stock was designated based on spawning distribution, spawning timing, river entry timing, appearance, and age composition
- Hybridization between native Wind River tule fall Chinook and Spring Creek NFH fall Chinook is likely

Abundance

- In the late 1930s, fall Chinook escapement to the Wind River basin was 200 fish
- WDFW (1951) estimated a 5-year average return of 1,500 fall Chinook
- Wind River, spawning escapements from 1964-2001 ranged from 0 to 1,845 (average 416)

Productivity & Persistence

- Fall Chinook smolt capacity was estimated at 206,608 for the Wind River basin
- Naturally produced fall Chinook fry are observed each year in the lower Wind River smolt trap, documenting successful natural spawning

Hatchery

- The state operated a salmon hatchery near the mouth of the Wind River from 1899 until 1938 when the hatchery was flooded by Bonneville Dam Reservoir
- The state hatchery produced only fall Chinook during 1899-1938, with egg take ranging from 1-4 million in most years, but as high as 10-20 million in some years; broodstock was taken directly from the Wind River
- Carson NFH was constructed in 1937 at Tyee Springs (RM 18); broodstock was developed primarily from Spring Creek NFH fall Chinook stock
- Total fall Chinook releases in the Wind River basin averaged 2 million from 1952-1976
- Fall Chinook hatchery releases into the Wind River were discontinued after 1976

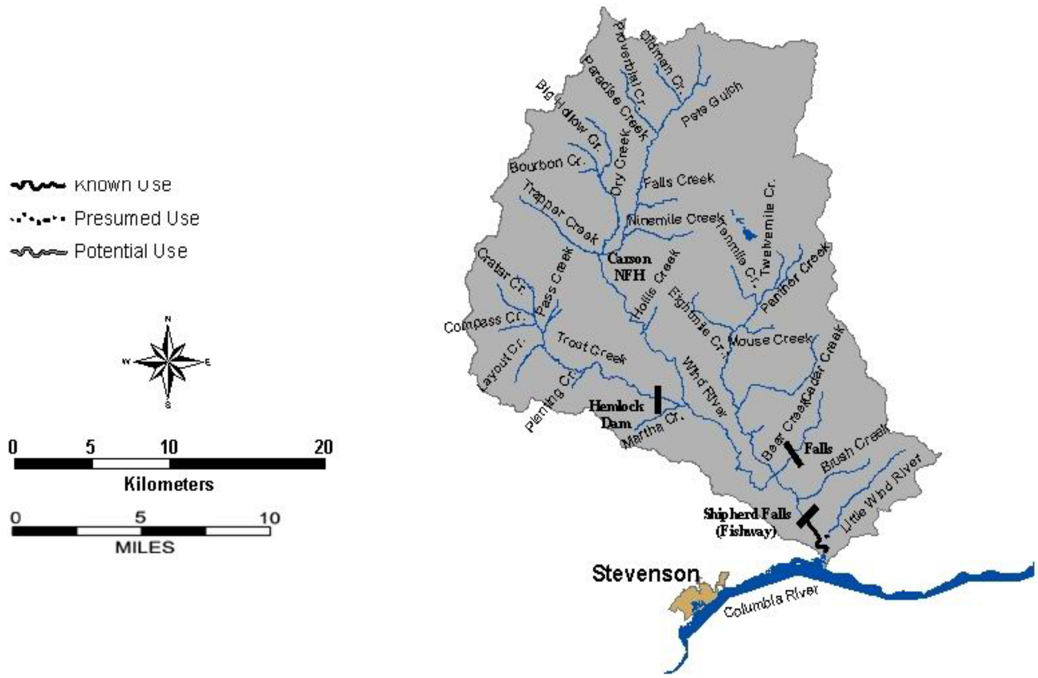
Harvest

- Fall Chinook are harvested in ocean commercial and recreational fisheries from Oregon to Alaska, in addition to Columbia River commercial gill net and sport fisheries
- Columbia River commercial harvest occurs in August and September, but flesh quality is low once tule Chinook move from salt water; the price is low compared to higher quality bright stock Chinook
- Fall Chinook destined for areas upstream of Bonneville Dam are harvested in August and September Treaty Indian commercial and subsistence fisheries
- Annual harvest dependent on management response to annual abundance in Pacific Salmon Commission (PSC) (U.S./Canada), Pacific Fisheries Management Council (PFMC) (U.S. ocean), and Columbia River Compact forums
- Ocean and lower Columbia River harvest limited to 49% due to Endangered Species Act (ESA) limit on Coweeman tules
- Fall Chinook originating upstream of Bonneville Dam are subject to Federal Court Agreements regarding Indian and non-Indian harvest sharing
- CWT data analysis of the 1971-1972 brood years from Spring Creek NFH indicates that the majority of Bonneville Pool Hatchery fall Chinook stock harvest occurred in British Columbia (28%) and Washington (38%) ocean commercial and recreational fisheries
- Bonneville Pool tule stock fall Chinook are important contributors to the Columbia River estuary (Buoy 10) sport fishery; in 1991, Bonneville Pool Hatchery fish comprised 25% of the Buoy 10 Chinook catch
- Sport harvest in the Wind River averaged 9 fall Chinook annually from 1977-1986

Mid-Columbia Bright Late Fall Chinook—Wind Subbasin

ESA: Threatened 1999	SASSI: Healthy 2002

The historical Wind River adult tule fall Chinook population is estimated from 2,500-3,500 fish. The current natural spawning number in the tributaries is 0 to 400 fish. However, there are significant numbers of upriver bright (URB) stock fall Chinook (not part of the lower Columbia ESU) that spawn in the lower Wind River. The URB spawners originated from strays produced at Little White Salmon and Bonneville hatcheries.



Distribution

- Completion of Bonneville Dam (1938) inundated the primary spawning areas in the lower Wind River; a ladder was constructed at Shipherd Falls (RM 2) in 1956, providing fish access to the upper watershed
- Fall Chinook have been observed up to the Carson NFH (RM 18), but the majority of spawning occurs in the lower two miles of the mainstem Wind River

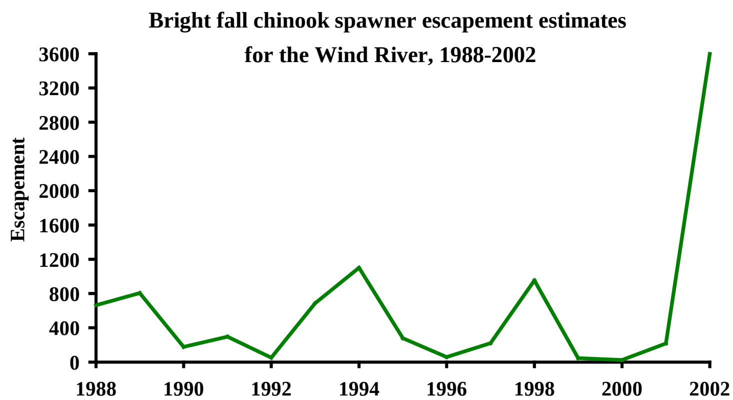
Life History

- Mid Columbia bright fall Chinook upstream migration in the Columbia River occurs from August to October; peak counts at Bonneville Dam range from September 4-9
- Mid Columbia bright fall Chinook enter the Wind River in late September to October
- Spawning in the Wind River occurs from late October through November, later than the Wind River tule fall Chinook stock
- Age ranges from 2-year old jacks to 6-year old adults, age 4 and 5-year old spawners predominate
- Fry emerge in the spring, depending on time of egg deposition and water temperature; fall Chinook fingerlings emigrate from the Wind River in spring and early summer

Diversity

- Considered a late spawning upriver bright stock (URB), likely developed as a result of straying from URB fall Chinook produced at nearby hatcheries

- The Wind River URB late fall Chinook stock was designated based on spawning distribution, spawning timing, river entry timing, appearance, and age composition



Abundance

- Historically, URB late fall Chinook were not found in the Wind River basin; presence in the basin is likely a result of straying from nearby hatcheries (Little White Salmon NFH and Bonneville Hatchery in Oregon)
- Presence of URB fall Chinook in the Wind was discovered by WDFW in 1988 and was likely a result of displaced Bonneville Hatchery produced adults, which started with URB adults trapped at Bonneville Dam in 1977
- Wind River URB spawning escapements from 1988-2001 ranged from 25-1,101 (avg.397)

Productivity & Persistence

- Fall Chinook smolt capacity was estimated at 206,608 for the Wind River basin
- Although the URB stock fall Chinook likely originated from hatchery production, the run appears to be self-sustaining

Hatchery

- Hatchery production of URB fall Chinook has not occurred in the Wind River; nearby hatcheries that release this stock include Little White Salmon NFH and the Bonneville Hatchery

Harvest

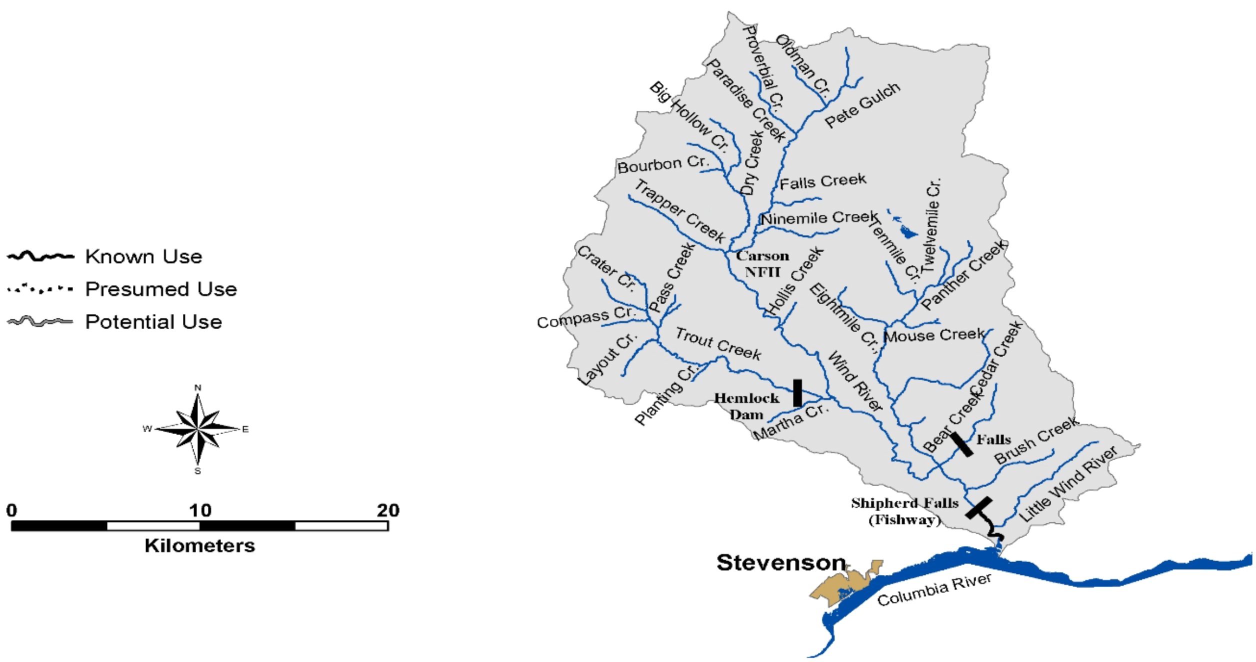
- Fall Chinook are harvested in ocean commercial and recreational fisheries from Oregon to Alaska, and in Columbia River commercial gill net and sport fisheries
- URB fall Chinook migrate farther north in the ocean than lower Columbia Chinook, with most ocean harvest occurring in Alaska and Canada
- URB fall Chinook are also an important sport fish in the mainstem Columbia from the mouth upstream to the Hanford Reach, and an important commercial fish from August into October
- Fall Chinook destined for above Bonneville Dam are and extremely important fish for Treaty Indian commercial and subsistence fisheries during August and September
- CWT data analysis of the 1989-94 brood URB fall Chinook from Priest Rapids Hatchery indicates that the majority of the URB fall Chinook stock harvest occurred in Alaska (24%), British Columbia (23%), and Columbia River (42%) fisheries during the mid 1990s
- Current annual harvest dependent on management response to annual abundance in PSC (U.S./Canada), PFMC (U.S. ocean), and Columbia River Compact forums

- Columbia River harvest of URB fall Chinook is limited to 31.29% (23.04% Indian/ 8.25% non-Indian) based on Snake River wild fall Chinook ESA limits
- Fall Chinook originating upstream of Bonneville Dam are subject to Federal Court Agreements regarding Indian and non-Indian harvest sharing.

Chum—Wind River Subbasin

ESA: Threatened 1999	SASSI: Depressed 1992

The historical Wind River adult population is estimated at 25,000-30,000. Current natural spawning returns are assumed to be very low, since the chum count at Bonneville Dam is typically less than 100 fish. Spawning occurs in the lower reaches below Shipperd Falls, with the majority of historical spawning area now inundated by Bonneville Reservoir. Spawning occurs from late November through December. Natural spawning chum in the Wind are all naturally produced as no hatchery chum are released in the area. Juveniles rear in the lower reaches for a short period in the early spring and quickly migrate to the Columbia.



Distribution

- There appears to be potential chum spawning in the Wind River in the lower river below Shipherd Falls

Life History

- Adults enter the lower Columbia River from mid-October through November
- Peak spawning occurs in late November
- Dominant adult ages are 3 and 4
- Fry emerge in early spring; chum emigrate as age-0 smolts

Diversity

- No hatchery releases have occurred in the Wind River

Abundance

- Historical Wind River chum abundance data are not available
- Bonneville Dam count of chum ranged from 788-3,636 during 1938-1954
- Since 1971, chum counts at Bonneville Dam have ranged from 1-147

Productivity & Persistence

- Chum salmon natural production is low

Hatchery

- Chum salmon have not been produced/released in the Wind River

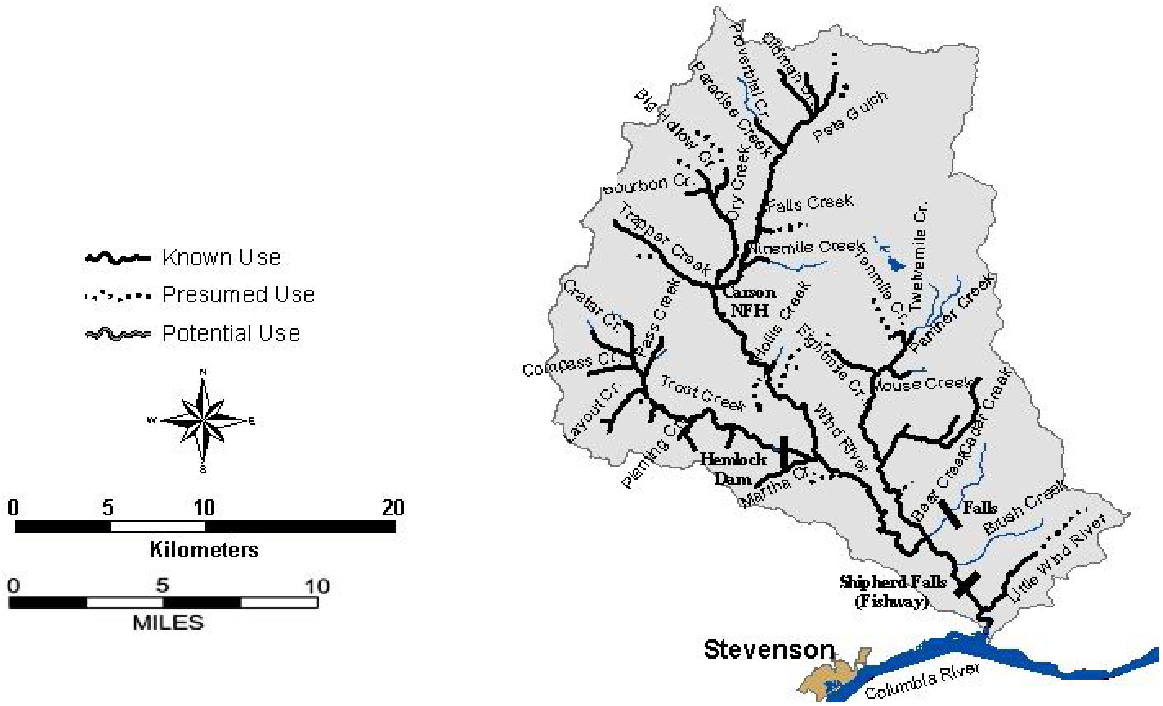
Harvest

- Currently very limited chum harvest occurs in the ocean and Columbia River and is incidental to fisheries directed at other species
- Columbia River commercial fishery historically harvested chum salmon in large numbers (80,000-650,000 in years prior to 1943); from 1965-1992 landings averaged less than 2,000 chum, and since 1993 less than 100 chum
- In the 1990s November commercial fisheries were curtailed and retention of chum was prohibited in Columbia River sport fisheries
- The ESA limits incidental harvest of Columbia River chum to less then 5% of the annual return

Summer Steelhead—Wind Subbasin

ESA: Threatened 1998 **SASSI: Depressed 2002**

The historical Wind River adult population is estimated at 2,000-5,000 fish. Current natural spawning returns range from 100-800 fish. Summer steelhead spawning occurs throughout the Wind Basin including the mainstem Wind, the Little Wind, and Panther, Bear, Trout, Trapper, Dry, and Paradise creeks. Spawning time is early March through May. Juvenile rearing occurs both downstream and upstream of the spawning areas. Juveniles rear for a full year or more before migrating from the Wind River basin.

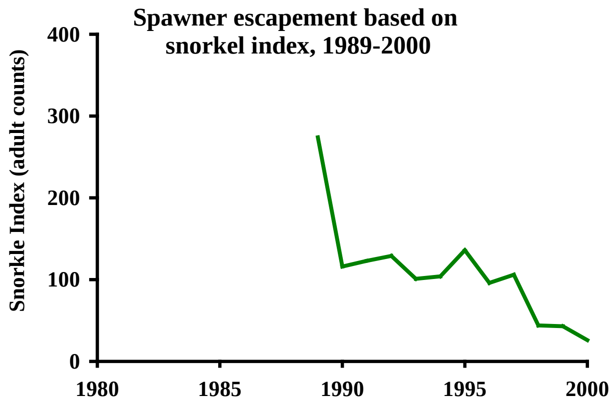


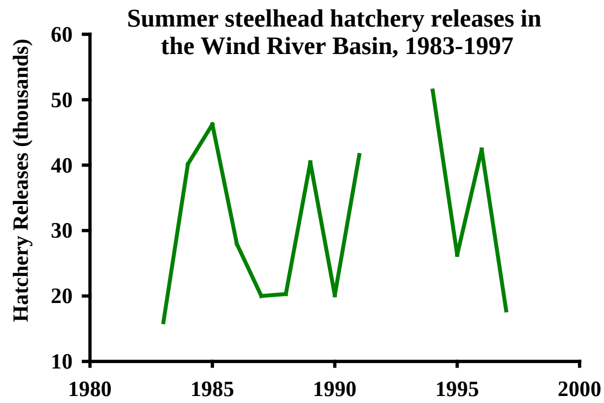
Distribution

- Summer steelhead are distributed throughout the Wind River basin, including the mainstem Wind River, the Little Wind River (RM 1.1), Panther Creek (RM 4.3), Bear Creek (RM 4.3), Trout Creek (RM 10.8), Trapper Creek (RM 18.9), Dry Creek (RM 19.1), and Paradise Creek (RM 25.1)
- High drop-offs and waterfalls exist throughout the basin; some have been modified to promote fish passage while others remain as impediments to upstream steelhead migration
- Shipperd Falls (40 ft cascade) located at RM 2.1 on the mainstem was laddered in 1956, allowing anadromous fish passage to the upper basin
- Construction of Bonneville Dam inundated the lower one mile of river, flooding spawning and rearing habitat

Life History

- Adult migration timing for Wind River summer steelhead is from May through November
- Spawning timing in the Wind River basin is generally from early March through May
- Limited age class data indicate that the dominant age class is 2.2 and 2.3 (58% and 26%, respectively)
- Wild steelhead fry emerge from April through July; juveniles generally rear in fresh water for two years; juvenile emigration occurs from April to May, with peak migration in early May





Diversity

- Wind River summer steelhead stock (including Panther and Trout Creek) was designated based on distinct spawning distribution and early run timing
- 1994 allozyme analyses clustered mainstem Wind River and Panther Creek summer steelhead with a number of lower Columbia summer and winter steelhead stocks, including Skamania Hatchery summer steelhead; Trout Creek summer steelhead were part of an outlier group that included SF Nooksack summer steelhead, Washougal steelhead, and Cowlitz native late winter steelhead

Abundance

- In 1936, steelhead were observed in the Wind River during escapement surveys
- Prior to 1950, wild summer steelhead run size was estimated to be between 2,500 and 5,000 fish
- Trout Creek escapement was estimated at over 100 wild summer steelhead in the 1980s but declined to less than 30 fish in the 1990s
- Snorkel index adult counts from 1989-2000 ranged from 26 to 274
- Escapement goal for the Wind River basin is 957 wild adult steelhead

Productivity & Persistence

- Baseline risk assessment determined a low risk of extinction for summer steelhead in the Wind River subbasin
- The smolt density model estimated potential summer steelhead smolt production for the Wind River basin was 62,273
- Wild steelhead smolt yield has been monitored in the Wind River basin since 1995; the trend indicates increasing smolt yield
- WDFW indicated that natural production in the watershed is primarily sustained by wild fish

Hatchery

- The Carson National Fish Hatchery operates in the basin but does not produce summer steelhead
- Skamania and Vancouver Hatchery stock were planted in the Wind River Basin; release data are displayed from 1983-1997
- Summer steelhead hatchery releases began in the basin in 1960; releases were suspended in the early 1980s for wild steelhead management then reinstated in the mid 1980s; releases of catchable rainbow trout were discontinued in 1994 and hatchery steelhead releases were discontinued in 1997
- Snorkel surveys from 1989-1998 indicated that hatchery summer steelhead comprised 41-60% of the spawning escapement

- Trout Creek trap counts conducted in 1992 indicate almost no migration of hatchery steelhead into this drainage; the hatchery fish that are captured are excluded from the drainage to preserve genetic diversity of the wild stock

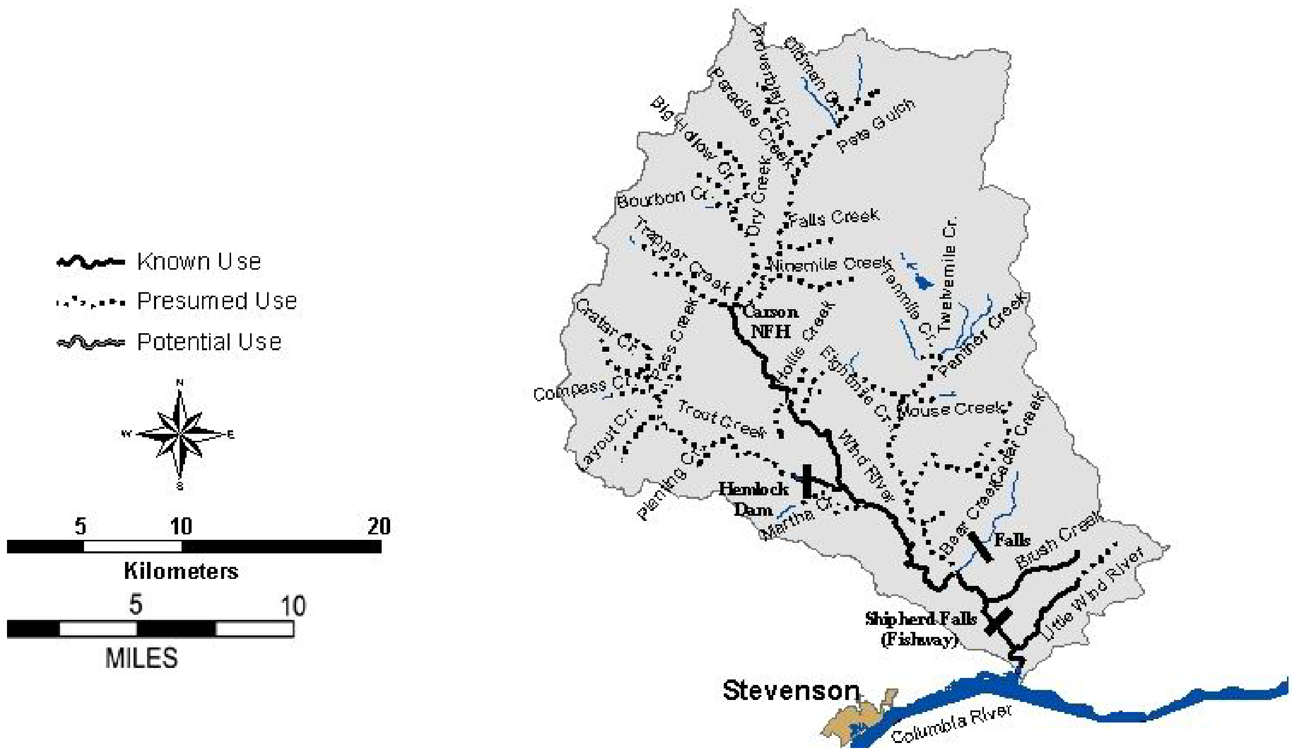
Harvest

- No directed non-Indian commercial fisheries target Wind River summer steelhead; incidental mortality currently occurs during the Columbia River fall gill net fisheries
- Summer steelhead are harvested in the Columbia River Treaty Indian fall commercial and recreational fisheries in Zone 6
- Current steelhead harvest is primarily in the lower Wind and Cowlitz of hatchery steelhead from other Columbia basins which temporarily enter the Wind River before continuing their Columbia River migration
- Summer steelhead sport harvest in the Wind River from 1977-1982 averaged 1,373 and declined to an average annual harvest of 421 fish from 1983-1991; since 1981, regulations limit harvest to hatchery fish only
- ESA limits Wind wild summer steelhead fishery impact (Indian and non-Indian combined) to 17% per year

Winter Steelhead—Wind Subbasin

ESA: Threatened 1998 **SASSI: Unknown 2002**

The historical Wind River adult population is estimated at 300-2,500 fish. Current natural spawning returns are about 100 fish. Shipperd Falls was a historical block to winter steelhead until 1956 when a fish ladder was constructed. Spawning occurs in the mainstem to RM 11 and in Trout Creek. Spawning time is early March to early June. Juvenile rearing occurs both downstream and upstream of the spawning areas. Juveniles rear for a full year or more before migrating from the Wind River basin.



Distribution

- Winter steelhead are distributed throughout the lower mainstem Wind River (~11 mi) and Trout Creek (RM 10.8)
- High drop-offs and waterfalls exist throughout the basin; some have been modified to promote fish passage while others remain as impediments to upstream steelhead migration
- Shipherd Falls (40 ft cascade) located at RM 2.1 on the mainstem was laddered in 1956, allowing anadromous fish passage to the upper basin
- Construction of Bonneville Dam inundated the lower one mile of river, flooding spawning and rearing habitat

Life History

- Adult migration timing for Wind River winter steelhead is from December through April
- Spawning timing on the Wind is generally from early March to early June
- Age composition data for Wind River winter steelhead are not available
- Wild steelhead fry emerge from March through May; juveniles generally rear in fresh water for two years; juvenile emigration occurs from April to May, with peak migration in early May

Diversity

- Wind River winter steelhead stock is designated based on distinct spawning distribution and run timing
- Wild stock interbreeding with Chambers Creek Hatchery brood stock may have occurred but is assumed to be minimal

Abundance

- In 1936, steelhead were observed in the Wind River during escapement surveys
- Trout Creek escapement was estimated at over 100 wild steelhead in the 1980s but has declined to less than 30 fish in the 1990s
- Wild winter steelhead escapement estimates for the Wind River are not available

Productivity & Persistence

- Wild steelhead smolt yield has been monitored in the Wind River basin since 1995; the trend indicates increasing smolt yield in recent years
- WDFW indicated that natural production in the watershed is primarily sustained by wild fish

Hatchery

- The Carson NFH operates in the basin but does not produce winter steelhead
- Hatchery releases of Chambers Creek and Skamania stock occurred in the Wind River Basin in the 1951, 1956, 1959, and 1963; releases ranged from 2,500 to 10,000 smolts
- Because of concern with wild steelhead interactions, releases of catchable-size rainbow trout were discontinued in 1994 and hatchery steelhead releases were discontinued in 1997
- No anadromous fish except unmarked (wild) steelhead are allowed past Hemlock Dam on Trout Creek

Harvest

- No directed commercial fisheries target Wind River winter steelhead; incidental mortality currently occurs during the lower Columbia River spring Chinook tangle net fisheries
- Harvest occurs in the Columbia River Zone 6 winter commercial tangle net fishery and in tribal ceremonial and subsistence fisheries
- Winter steelhead sport harvest data in the Wind River are not available but approximately 25-50 wild winter steelhead are estimated to be harvested annually; since 1991, regulations limit harvest to hatchery fish only
- ESA limits fishery impact (Indian and non-Indian) of Wind River wild winter steelhead to 17% per year

Other Species

Pacific lamprey – Information on lamprey abundance is limited and does not exist for the Wind River population. However, based on declining trends measured at Bonneville Dam and Willamette Falls it is assumed that Pacific lamprey have declined in the Wind River also. Adult lamprey return from the ocean to spawn in the spring and summer. Juveniles rear in freshwater up to seven years before migrating to the ocean.

P.3.3. Focal Wildlife Species

A complete list of wildlife species potentially occurring within the Wind River subbasin has been compiled by the Northwest Habitat Institute (NHI) and is available on their Interactive Biodiversity

Information System (IBIS) website (www.nwhi.org/ibis/home/ibis.asp). Of those species potentially occurring within the Wind River subbasin, many are considered species of concern by the State of Washington (Table P-2).

Table P-2. Federal and state legal status of Washington species of concern that are potentially found in the Wind River subbasin.

Common Name	Scientific Name	Federal Status	State Status
	MAMMALS		
Fisher	*Martes pennanti*	FCo	SE
Townsend's Big-Eared Bat	*Coryhorhinus townsendii*	FCo	SC
Western Gray Squirrel	*Sciurus griseus*	FCo	ST
Wolverine	*Gulo gulo*	FCo	SC
Yuma Myotis	*Myotis yumanensis*	FCo	none
	BIRDS		
Bald Eagle	*Haliaeetus leucocephalus*	FT	ST
Black-Backed Woodpecker	*Picoides arcticus*	none	SC
Flammulated Owl	*Otus flammeolus*	none	SC
Golden Eagle	*Aquila chrysaetos*	none	SC
Harlequin Duck	*Histrionicus histrionicus*	FCo	None
Northern Goshawk	*Accipiter gentilis*	FCo	SC
Olive-Sided Flycatcher	*Contopus borealis*	FCo	None
Pileated Woodpecker	*Dryocopus pileatus*	none	SC
Purple Martin	*Progne subis*	none	SC
Spotted Owl	*Strix occidentalis*	FT	SE
Vaux's Swift	*Chaetura vauxi*	none	SC
Willow Flycatcher	*Empidonax traillii*	FCo	None
	AMPHIBIANS		
Cascade Torrent Salamander	*Rhyacotriton cascadae*	none	SC
Larch Mountain Salamander	*Plethodon larselli*	FCo	SS
Oregon Spotted Frog	*Rana pretiosa*	FC	SE
Red-Legged Frog	*Rana aurora*	FCo	None
Van Dyke's Salamander	*Plethodon vandykei*	FCo	SC
Western Toad	*Bufo boreas*	FCo	SC
	REPTILES		
California Mountain Kingsnake	*Lampropeltis zonata*	none	SC
Western Pond Turtle	*Clemmys marmorata*	FCo	SE

Status codes are defined as follows: FT=Federal threatened, FC=Federal candidate, FCo=Federal Species of Concern, SE=State endangered, ST=State threatened, SC=State candidate, SS=State sensitive.

A subset of these species of concern are considered focal species because of their special ecological, cultural, or legal status. Management of the focal species and their habitats are an integral part of future subbasin planning efforts. A total of one mammal, three bird, two amphibian, and one reptile species were chosen as focal or indicator species that represent the various wildlife habitats in the Wind River subbasin (Table P-3).

Table P-3. Focal or indicator wildlife species in the Wind River subbasin.

Common Name	Habitat Association	Priority Habitat Species	Status Federal	Status State
Western Gray Squirrel	Mixed Conifer Forests (near Oak Woodlands)	Yes	FCo	ST
Yellow Warbler	Riparian areas with deciduous shrubs	No	-	-
Pileated Woodpecker	Mature stands of hardwood, conifer, or mixed forests	Yes	-	SC
Band-tailed Pigeon	Mixed Conifer Forests with mineral springs	Yes	-	-
Western Pond Turtle	Open Water associated with Mixed Conifer-Hardwood Forests	Yes	FCo	SE
Larch Mountain Salamander	Mixed Conifer-Hardwood Forests with talus slopes	Yes	FCo	SS

Status codes are defined as follows: FCo=Federal Species of Concern, SE=State endangered, ST=State threatened, SS=State sensitive, SC=State candidate.

Additionally, some wildife species in the Wind River subbasin are of interest because of their ecological, cultural, or legal status (Table P-4). Wildlife species of interest differ from focal species in that management of these species and their habitats may not be a significant part of future subbasin planning efforts. In the case of the fisher and the Oregon spotted frog, there is uncertainty regarding their current statewide distribution; presence in the Wind River has not been confirmed. Considering the unknown presence and habitat association of fishers and Oregon spotted frogs in the Wind River, it is difficult to develop management actions to benefit either species. Either of these species may become an important part of future subbasin management if presence and habitat association in the Wind River subbasin are confirmed. In the case of bald eagle, the statewide population has increased in abundance and productivity; WDFW supports downgrading the eagle's legal status. Thus, management of eagles and their associated habitat will not likely be part of future subbasin planning.

Table P-4. Wildlife species of interest in the Wind River subbasin.

Common Name	Habitat Association	Priority Habitat Species	Status Federal	Status State
Fisher	Mixed Conifer-Hardwood Forests	Yes	FCo	SE
Bald Eagle	Mature Forests in proximity to Open Water	Yes	FT	ST
Oregon Spotted Frog	Open Water associated with Mixed Conifer-Hardwood Forests	Yes	FC	SE

Status codes are defined as follows: FT=Federal threatened, FC=Federal candidate, FCo=Federal Species of Concern, SE=State endangered, ST=State threatened.

Western Gray Squirrel

The western gray squirrel (*Sciurus griseus*) is a Washington state threatened species and a Federal species of concern (Table P-2). Although the western gray squirrel was once abundant and widespread throughout oak-conifer forests (Figure P-4), its range in Washington State has contracted to three disjunct populations. In the Wind River subbasin, little is known about historical populations of western gray squirrels. Population loss and fragmentation most likely occurred in the lower drainage because of habitat loss and degradation. Competition from the introduced eastern grey squirrel may also be an issue in the Wind River subbasin. The western gray squirrel is heavily associated with both ponderosa pine and Oregon white oak forests in the remainder of its range in Columbia River Gorge. These forests follow stream drainages northward toward Goldendale and into Yakima County (Franklin and Dyrness 1973). A 1993 unpublished status review by the Washington Department of Wildlife (currently WDFW) found that the species was "in danger of extirpation from most of its range in Washington" (WDW 1993).

Figure P-4. Historical distribution of western gray squirrels in Washington (adapted from Booth 1947, Ingles 1947, Source: WDFW 2004).

Western gray squirrels prefer habitat with the following characteristics (Foster 1992): contiguous canopy cover (mean = 60%); nest tree age (69-275 yr, mean = 108 yr); diameter at breast height (21-58 cm, mean = 40 cm); within 180 m (600 ft) of water; adequate food sources (acorns important in winter and early spring while pine cones and seeds in late summer and fall); and adequate habitat within home range (in Klickitat County 95% home ranges from 10-187 ha (mean 73 ha) for males and 3-44 ha (mean 21 ha) for females (Linders 2000)).

Western gray squirrels need a variety of mast-producing trees for food, cover and nesting sites (WDW 1993). The quality of the habitat is influenced by the number of mast-bearing tree species in and near the nest tree sites, the age and size of the trees, and proximity to permanent water (Cross 1969, Gilman 1986, Foster 1992). The western gray squirrel is usually associated with mature forests (Table P-5), which provide the above-mentioned characteristics (WDW 1993).

Generally, the squirrels require trees of sufficient size to produce an interconnected canopy for arboreal travel (Foster 1992). Barnum (1975) observed no use of a lone pine tree that was full of green cones, conceivably because there was no travel cover available.

Since extinction or extirpation rates are partly area-dependent, the size of reserves, spacing of reserves, and location of dispersal corridors are important. Individual reserves must be large enough to ensure stability of the ecosystem and to provide a buffer from disturbance (Frankel and Soulé 1981). The western gray squirrel was probably more widely distributed in prehistoric times and has diminished recently along with the oak woodlands (Rodrick 1986). Presently, both the oak and the squirrel are at the northern extent of their ranges and are subject to increased pressure from a variety of environmental factors.

Most squirrels build round stick nests, approximately 60 cm (2 ft) in diameter, in pole to sawtimber-sized conifers, about one third of distance from the top of the tree and next to the trunk. The nests are lined with lichen, moss, and bark shavings (WDW 1993).

In a 2003 Status Review and 12-month finding for a petition to list the Washington population of the western gray squirrel (68 FR 34682), the USFWS concluded that listing was not warranted because the Washington population of western gray squirrels is not a distinct population segment and, therefore, not a listable entity. The Washington populations are discrete from the Oregon and California populations and are declining, but they are not “significant to the remainder of the taxon”. The U.S. Forest Service considers the squirrel to be a sensitive species, and uses it as an oak-pine community management indicator species in the Columbia River Gorge National Scenic Area.

Persistence of this species in the state of Washington will likely depend on state-level protections of oak-conifer habitats and voluntary efforts by landowners federal entities. The WDFW completed a recovery plan in November 2007. Anecdotal evidence suggests there was essentially no acorn crop in the Columbia Gorge in 1991, and an insignificant crop in 1992 (from WDW 1993), indicating that weather cycles associated with mast failures also may cause cyclical declines in squirrel populations.

Table P-5. Western gray squirrel association with wildlife habitats in the Wind River subbasin (IBIS 2004).

Wildlife-Habitat Type	Association	Habitat Requisite	Data Confidence	Comments
Mesic Lowlands Conifer-Hardwood Forest	Present	Feeds and Breeds	High	Uses this habitat where adjacent to Westside Oak and Dry Douglas-fir habitat.

Yellow Warbler

The yellow warbler (*Dendroica petechi*a) is a long-distance neotropical migrant; spring migrants begin to arrive in the Pacific Northwest region in April but the peak of spring migration in the region is in late May (Gilligan et al. 1994). Southward migration begins in late July, and peaks in late August to early September; very few migrants remain in the region in October (Lowther et al. 1999). Western populations overwinter primarily in Mexico and northern Central America. The yellow warbler is strongly associated with riparian and wet, deciduous habitats throughout its North American range. It is positively associated with sub-canopy/shrub habitats in riparian areas, making it a good species index of this habitat (Altman 2001; Sauer *et al*. 2003).

The habitat requirements of neotropical migrants are extremely diverse. Within a single species, the habitat and food preferences on breeding grounds, is often different than wintering areas (Petit et al. 1990). The yellow warbler is a common breeder in riparian habitats with hardwood trees throughout the state, generally found at lower elevations. Associated with riparian habitats, they prefer the presence of nearby water (Table P-6). Their habitat suitability index strongly associates them with a dense deciduous shrub layer 1.5-4 m. (5-13.3 feet), with edge, and small patch size (heterogeneity). Other suitability index associations include % of deciduous shrub canopy comprised of hydrophytic shrubs (wetlands dominated by shrubs had the highest average of breeding densities of 2males/ha) and deciduous tree basal area (abundance is positively associated). Negative associations are closed canopy and cottonwood proximity. Some nests have been found in cottonwood, but more often in shrubs with an average nest height of 0.9-2.4 m., maximum being 9-12 m. (Schroeder 1982).

Partners in Flight have established biological objectives for this species in the lowlands of western Oregon and western Washington. These include providing habitats that meet the following definition: >70% cover in shrub layer (<3 m) and subcanopy layer (>3 m and below the canopy foliage) with subcanopy layer contributing >40% of the total; shrub layer cover 30-60% (includes shrubs and small saplings); and a shrub layer height >2 m. At the landscape level, the biological objectives for habitat included high degree of deciduous riparian heterogeneity within or among wetland, shrub, and woodland patches; and a low percentage of agricultural land use (Altman 2001).

Little is known about yellow warbler breeding behavior in Washington, although substantial information is available from other parts of its range. Yellow warblers have developed effective responses to nest parasitism by the brown-headed cowbird (*Molothrus ater*). The brown-headed cowbird is an obligate nest brood parasite that does not build a nest and instead lays eggs in the nests of other species. When cowbird eggs are recognized in the nest the yellow warbler female will often build a new nest directly on top of the original. In some cases, particularly early in the incubation phase, the female yellow warbler will bury the cowbird egg within the nest. Some nests are completely abandoned after a cowbird egg is laid (Lowther *et al.* 1999). Up to 40% of yellow warbler nests in some studies have been parasitized (Lowther *et al.* 1999).

Pair formation and nest construction may begin within a few days of arrival at the breeding site (Loather et al. 1999). Egg dates have been reported from British Columbia, and range between 10 May and 16 August; the peak period of activity there was between 7 and 23 June (Campbell et al. 2001). The incubation period is about 11 days and young fledge 8-10 days after hatching. The young often associate with their parents for up to 3 weeks following fledging (Loather et al. 1999). Yellow warblers typically lay only one clutch with 4 or 5 eggs. Re-nesting may occur, however, following nest failure or nest parasitism by Brown-headed Cowbirds (Sibley 2001; Lowther et al. 1999).

Yellow warblers capture and consume a variety of insect species and occasionally wild berries, especially when migrating. Food is generally obtained by gleaning from sub-canopy vegetation, although the species also sallies and hovers to a much lesser extent (Lowther *et al*. 1999; Sibley 2001).

They are primarily insectivores on their breeding grounds, and this enables them to take advantage of the high insect productivity that occurs in riparian areas. Generally, there is a positive relationship in, the greater the structural layering and complexity of the habitat, the greater the insect productivity, and the greater the diversity of bird species. Many studies have reported higher species richness, abundance, or diversity in riparian zones than adjacent habitats, particularly at lower elevations (Stauffer and Best 1980; Sibley 2001).

Washington breeders represent the western subspecies *D. p. morcomi* (AOU 1998). Little is known about population size, although it is locally common where habitat exists. It is one of two widespread species in the Wood-warbler family exhibiting vast geographic variation, each species containing 10 or more sub-species occurring north of Mexico. Browning (1994) recognized 43 subspecies of the yellow warbler; two of these are known to occur in Washington. One of them, *Dendroica petechia brewsteri*, is found in western Washington (Sibley 2000).

Little is known about the size of the breeding population in Washington State. Locally common where riparian and wet, deciduous habitat exists, the yellow warbler can be found in the riparian areas along the Columbia River, and most riverine systems. See Figure P-5 for Washington breeding distribution of yellow warbler from 1987-1995.

Loss of riparian and riparian-marsh habitat for these birds resulted from the inundation and alteration of habitats in the Wind River Subbasin and in the mainstem of the Columbia River.

Table P-6. Yellow warbler association with wildlife habitats in the Wind River subbasin (IBIS 2004).

Wildlife-Habitat Type	Association	Habitat Requisite	Data Confidence	Comments
Westside Riparian-Wetlands	Closely Associated	Feeds and Breeds	High	none

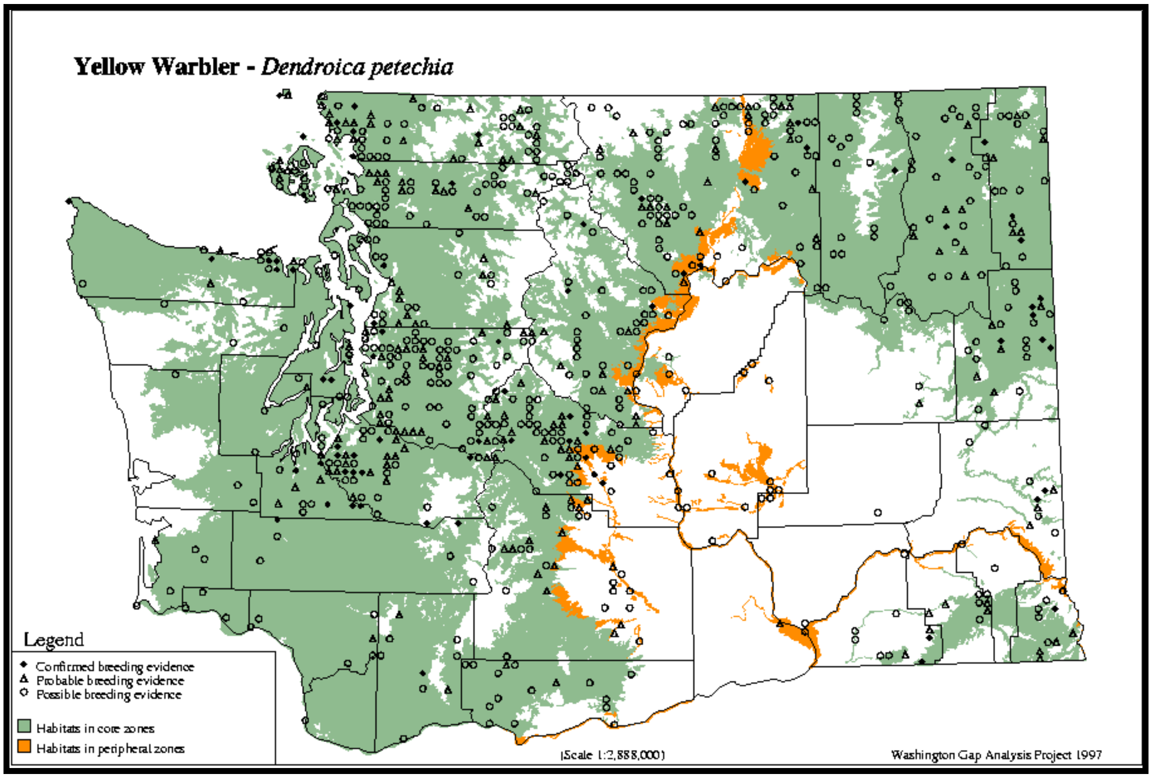


Figure P-5. Breeding bird atlas data (1987–95) and species distribution for yellow warbler in Washington.

Pileated Woodpecker

Pileated woodpeckers are the largest woodpeckers in North America (i.e. crow-sized). Any forest type (broadleaved, coniferous, or mixed) can sustain pileated woodpeckers as long as there are trees large enough for roosting and nesting (Table P-7). Pileated woodpeckers are often associated with mature and old-growth forests but can breed in younger forests if they contain some large trees. In western Washington, they typically roost in western hemlock and western red cedar. Although generally resident, pileated woodpeckers sometimes wander from their breeding areas and many move down-slope or into streamside forests or suburban areas in winter (Figure P-6).

These powerful woodpeckers chip out characteristic oval or rectangular excavations in the trees in which they forage. Their drumming can be heard for long distances, as can their loud “laughing” call. They roost in hollow trees with multiple entrance holes.

Long-term monogamous pairs stay together on territories year round. Both members of the pair excavate a new nest cavity in a dead tree or branch every year. The excavation can take the pair up to six weeks to complete. The nest is lined only with woodchips from the excavation. Both sexes typically incubate the 3 to 5 eggs for about 18 days and brood the young for the first 7 to 10 days after they hatch. Both regurgitate food for the young, which leave the nest after 24 to 28 days but may stay with the parents for another 2 to 3 months while they learn to forage. Pileated woodpeckers eat wood-boring insects and insects that nest in trees, including long-horned beetles and especially carpenter ants. They eat some fruits and nuts as well.

Pileated woodpeckers play an important role within their ecosystems by excavating nesting and roosting cavities that are subsequently used by many other birds and by many small mammals, reptiles, amphibians, and invertebrates. Shooting for sport and food was formerly a significant source of mortality. Although shooting pileated woodpeckers is now illegal, the practice may continue in some places but probably not enough to significantly affect the population. Clear-cutting of old-growth and other forests currently has the most significant impact on pileated woodpecker habitat, but pileated woodpeckers are fairly adaptable, which offsets some of the impact from habitat loss. They are, however, currently candidates for endangered species listing by the Washington Department of Fish and Wildlife.

Table P-7. Pileated woodpecker association with wildlife habitats in the Wind River subbasin (IBIS 2004).

Wildlife-Habitat Type	Association	Habitat Requisite	Data Confidence	Comments
Mesic Lowlands Conifer-Hardwood Forest	Generally Associated	Feeds and Breeds	High	none
Montane Mixed Conifer Forest	Generally Associated	Feeds and Breeds	Moderate	none
Interior Mixed Conifer Forest	Generally Associated	Feeds and Breeds	High	none
Lodgepole Pine Forest and Woodlands	Present	Feeds	Low	none
Montane Coniferous Wetlands	Generally Associated	Feeds and Breeds	Moderate	none

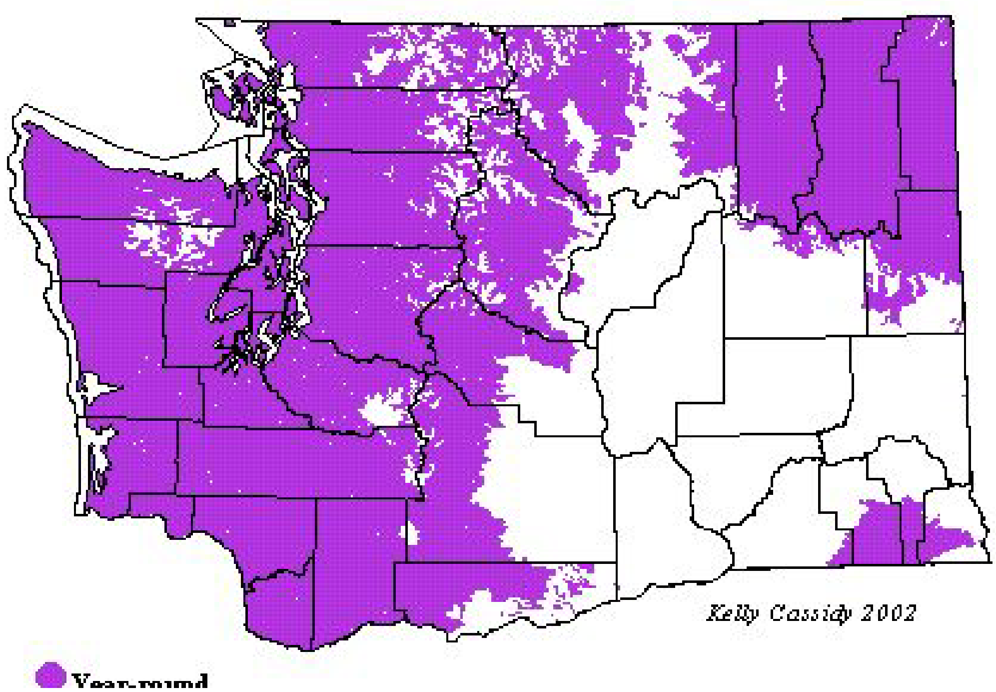


Figure P-6. Distribution of pileated woodpeckers in Washington.

Band-tailed Pigeon

Band-tailed pigeons (*Columba fasciata*) are primarily restricted to coniferous forest zones in mountainous areas of western North America (Jarvis and Passmore 1992); the Pacific Coast race (*Columba fasciata monilis*) breeds west of the Cascade and Sierra Nevada crests up to 4,200 m (13,800 ft) elevation (Pacific Flyway Council 1983). The band-tailed pigeon breeds throughout much of Western Washington (Figure P-7).

During the breeding season (April - September), most of the population is found below 305 m (1,000 ft) elevation (Jeffrey 1989). In late summer, band-tailed pigeons may move to higher elevations. By late September, most band-tailed pigeons leave Washington and migrate to their wintering grounds.

In Washington, band-tailed pigeons are associated with Douglas-fir (*Pseudotsuga menziesii*), red alder (*Alnus rubra*), western hemlock (*Tsuga heterophylla*), red cedar (*Thuja plicata*), bigleaf maple (*Acer macrophyllum*), sitka spruce (*Picea sitchensis*), willow (*Salix* spp.), pine (*Pinus* spp.), cottonwood (*Populus* spp.), and Garry oak (*Quercus garryana*) (Jeffrey 1989, Braun 1994) (Table P-8). Berry- and nut-producing trees and shrubs are also common in their range (Keppie and Braun 2000). Nests are placed in conifers or broad-leafed trees, typically 4.5-12.0 m (15-40 ft) above the ground. Nests may be distributed in small groups or well-dispersed (Jeffrey 1977, Curtis and Braun 1983).

Band-tailed pigeons have specific habitat requirements for reproduction. The band-tailed pigeon requires mineral springs as a source of calcium for egg-laying and the production of crop-milk for its young (March and Sadleir 1975, Jarvis and Passmore 1992, Braun 1994). The proximity of these mineral springs to suitable foraging habitats is an important factor for band-tailed pigeons (Jarvis and Passmore 1992). Pigeons have been documented returning to mineral springs in subsequent years (Jarvis and Passmore 1977, 1992). A mineral spring located in the lower reach of the Wind River has one of the highest concentrations of pigeon use in the state. Current threats to this resource include timber harvest and increased disturbance from recreational development near these mineral springs.

Band-tailed pigeons are listed as a State and Federal Game species. The hunting season in Washington underwent an emergency closure in 1991 due to a rapid decline in the population as determined from pigeon surveys (Braun 1994). Breeding Bird Survey data indicated the population of band-tailed pigeons in Washington declined significantly from 1968 to 1993 (Braun 1994, Keppie and Braun 2000). However, more recent data showed increases in population that allowed the reinstatement of a limited hunting season in 2002, after a 10-year restriction on hunting (WDFW 2001, 2002).

A scarcity of mineral sites combined with the alteration of available nesting habitat jeopardizes band-tailed pigeon populations (Braun 1994). Intensive hunting pressure in the past has also been held responsible for declines in the population (Jarvis and Passmore 1992). Land development and forest practices that degrade or destroy mineral springs and nesting habitat limit band-tailed pigeon populations (Pacific Flyway Council 1983). Although undocumented mineral sites likely occur, only a limited number of mineral sites actively used by pigeons are known to exist in western Washington (Gillum 1993). Outbreaks of the protozoan disease Trichomoniasis are suspected in periodic large-scale mortalities of band-tailed pigeons (Keppie and Braun 2000). Trichomoniasis is transmitted through contaminated feed at urban bird feeders.

Table P-8. Band-tailed pigeon association with wildlife habitats in the Wind River subbasin (IBIS 2004).

Wildlife-Habitat Type	Association	Habitat Requisite	Data Confidence	Comments
Mesic Lowlands Conifer-Hardwood Forest	Closely Associated	Feeds and Breeds	Moderate	none
Montane Mixed Conifer Forest	Generally Associated	Feeds and Breeds	High	none
Interior Mixed Conifer Forest	Present	Feeds	High	none

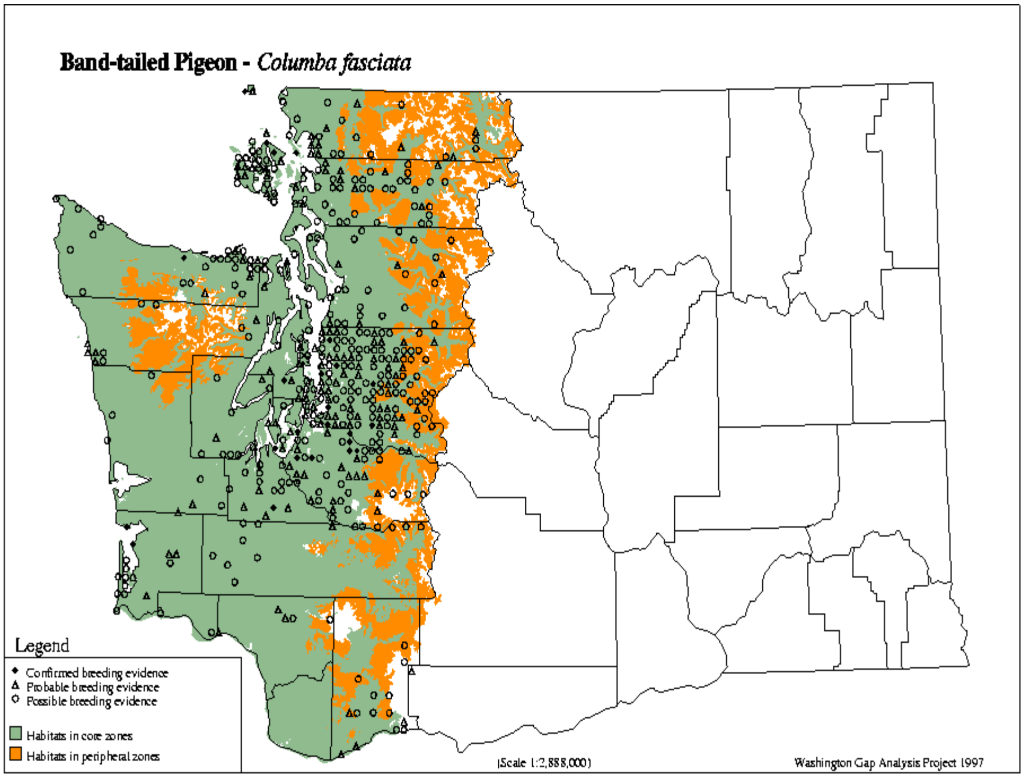


Figure P-7. Distribution of band-tailed pigeon in Washington.

Western Pond Turtle

The western pond turtle (*Clemmys marmorata*) is listed by Washington State as an endangered species and has been extirpated from most of its range in Washington. Their present range in Washington is thought to be composed of two small populations in Skamania and Klickitat counties, and a small pond complex in Pierce County where they were recently reintroduced from captive bred stock (Figure P-8). The species is not listed under the federal Endangered Species Act. It was petitioned in 1992 for federal listing, but the Fish and Wildlife Service found that listing was not warranted in 1993. The species requires a continued recovery program (Hays et al. 1999) to ensure its survival in the state until sources of excessive mortality can be reduced or eliminated.

This highly aquatic turtle occurs in streams, ponds, lakes, and permanent and ephemeral wetlands. Although pond turtles spend much of their lives in water, they require terrestrial habitats for nesting (Table P-9). They also often overwinter on land, disperse via overland routes, and may spend part of the warmest months in aestivation on land. Pond turtles are generally wary, but they may be seen basking on emergent or floating vegetation, logs, rocks, and occasionally mud or sand banks. In Washington, the species overwinters in mud bottoms of lakes or ponds or in upland habitats adjacent to water bodies. Nesting occurs from May to mid-July in soils with scant vegetative cover. They usually nest within 100 meters of water, but occasionally up to 400 m. Western pond turtles are long-lived, with some reaching an estimated maximum life-span of 50 to 70 years, though most individuals may not live that long. They require more than 10 years to attain sexual maturity.

The initial cause of the decline in western pond turtle numbers in Washington may have been commercial exploitation for food. Western pond turtle populations cannot be sustained under exploitation, due to their low rate of recruitment and lower densities at the northern portion of the range. Pond turtles never recovered from this decline, in part, due to concurrent or subsequent alteration and loss of habitat. Wetlands were filled for residential and industrial development, particularly in the Puget Sound region. Dam construction and water diversion projects reduced available habitat and isolated populations. Introduced predators such as bullfrogs and warm-water fish, which were introduced to lakes and ponds, probably took a toll on hatchlings and young turtles. Human disturbance may have kept females from crossing over land to lay eggs, or may have reduced the amount of time spent basking, which in turn, may be important for egg maturation. Loss of lakeside emergent wetland vegetation to grazing and trampling may have made habitat less suitable for hatchlings and juveniles. Successional changes through fire suppression on native grasslands may have resulted in excessive shade on nesting grounds.

Two native populations of the species remain in the Columbia River Gorge (Figure P-8). The total number of western pond turtles in known Washington populations is estimated at greater than 500 individuals, approximately half of which went through the head-start program at the Woodland Park Zoo. Additional turtles may still occur in wetlands that have not been surveyed in western Washington and the Columbia Gorge. Currently, WDFW is working on Western Pond Turtle recovery in habitat near the mouth of the Klickitat River. The goal of the recovery program is to re-establish self-sustaining populations of western pond turtles in the Columbia Gorge region (Hays et al. 1999). The recovery objectives are to establish at least 5 populations of >200 pond turtles, composed of no more than 70% adults, which occupy habitat that is secure from development or major disturbance. It is also necessary that the populations show evidence of being sustained by natural recruitment of juveniles. The core pond turtle sites should be wetland complexes that may be less susceptible to catastrophes than sites of a single water body. The recovery objectives need to be met before the western pond turtle would be considered for downlisting to threatened. Objectives for downlisting to sensitive are similar, except those 7 populations of >200 pond turtles will be needed.

Table P-9. Western pond turtle association with wildlifec habitats in the Wind River subbasin (IBIS 2004).

Wildlife-Habitat Type	Association	Habitat Requisite	Data Confidence	Comments
Mesic Lowlands Conifer-Hardwood Forest	Present	Feeds and Breeds	High	Uses this habitat where it is near marshes, streams, rivers, ponds or lakes. Nests are placed in dry, well-drained soils in open areas with grass and herbaceous vegetation, with trees and shrubs in close proximity. Overwintering sites are characterized as having deep leaf or needle litter and logs and shrubs.
Open Water - Lakes, Rivers, and Streams	Closely Associated	Feeds	High	none

Table P-10. Potential relationships between western pond turtle and salmonids (IBIS 2004).

Common Name	Relationship Type	Salmonid Stage	Comments
Western Pond Turtle	Rare	Freshwater rearing - fry, fingerling, and parr	none
Western Pond Turtle	Rare	Carcasses	none

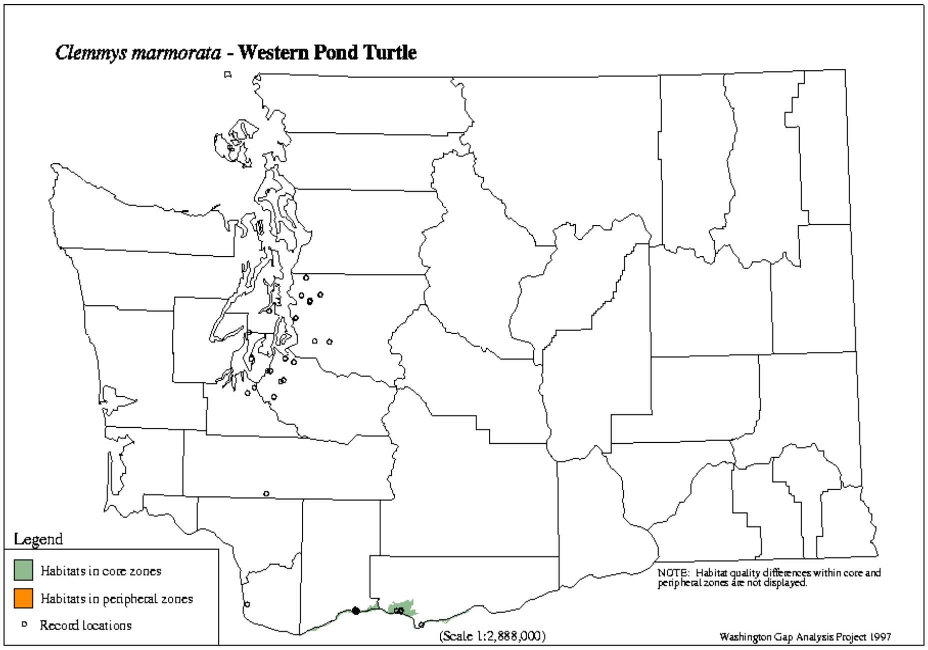


Figure P-8. Distribution of western pond turtles in Washington.

Larch Mountain Salamander

The Larch Mountain salamander (*Plethodon larselli*) occurs only in Washington and Oregon. Its known distribution includes west-side habitats of the southern Cascades region in Washington and the Columbia Gorge area of Oregon and Washington, including the Wind River subbasin (Figure P-9). The southern edge of its range is roughly defined by the towns of Hood River and Troutdale, Oregon. The northern edge of its range extends into the central Cascade Range of Washington. Isolated populations have been found near Snoqualmie Pass, Washington, and in a lava tube cave in Mount St. Helens National Volcanic Monument ([Nussbaum et al. 1983, Aubry et al. 1987, Leonard et al. 1993, McAllister 1995, Corkran and Thoms 1996] as cited in Larsen 1997).

Larch Mountain salamanders depend on cool, moist environments; they require a suitable combination of slope, rock size, shade, and organic debris. Larch Mountain salamanders are most often associated with steep talus slopes in forested areas but have also been found on steep slopes in old growth forests, under woody debris on the forest floor or in piles of detritus beneath snags (Corkran and Thoms 1996 as cited in Larsen 1997; Table P-11). They have been described as the most terrestrial of the western *Plethodon* salamanders and are usually found some distance from streams (Brodie 1970 as cited in Larsen 1997). Most talus slopes occupied by Larch Mountain salamanders have an overstory of bigleaf maple (*Acer macrophyllum*), Douglas-fir (*Pseudotsuga menziesii*), and sometimes Oregon ash (*Fraxinus oregona*) ([Larsen and Schaub 1982, Herrington and Larsen 1985] as cited in Larsen 1997). Organic matter has been identified as one of the more important habitat features for sustaining Larch Mountain salamander populations because it supports an invertebrate prey base and maintains moisture within the talus (Larsen 1997). Herrington and Larsen (1985 as cited in Larsen 1997) found that sites with all habitat requirements except organic debris lacked salamanders and over half the Larch Mountain salamander sites they found had substrates that contained less than 10% soil.

Larch Mountain salamanders are generally found within the top 30 cm of moss or detritus covered talus, where rock size is 1-6 cm in diameter, substrate temperatures range between 5°C and 14.5°C (41-58°F), moisture values average between 35 and 64%, and slopes are greater than 30° (Larsen 1997). Increased temperatures and reduced moisture during the summer months may cause the salamanders to nestle deeper into the talus (Herrington and Larsen 1985 as cited in Larsen 1997).

Populations of Larch Mountain salamanders are small, isolated, and occur in a limited geographic area. This salamander is sedentary and its very specific habitat requirements may hinder dispersal (Larsen 1997). Colonization of suitable, unoccupied habitat may be difficult if the habitat is far from existing Larch Mountain salamander populations (Dumas 1956 as cited in Larsen 1997). Because the habitats preferred by these salamanders are naturally discontinuous, they are vulnerable to disturbance from human activity (Larsen 1997). They are vulnerable to disturbances such as logging, rock extraction, and inundation that can alter these habitats and make them unsuitable. As the species is patchily distributed in the landscape, disturbances at the local level may negatively impact the population as a whole. For these reasons, the Larch Mountain salamander is a Federally-listed species of concern as well as a sensitive species in the states of Washington and Oregon.

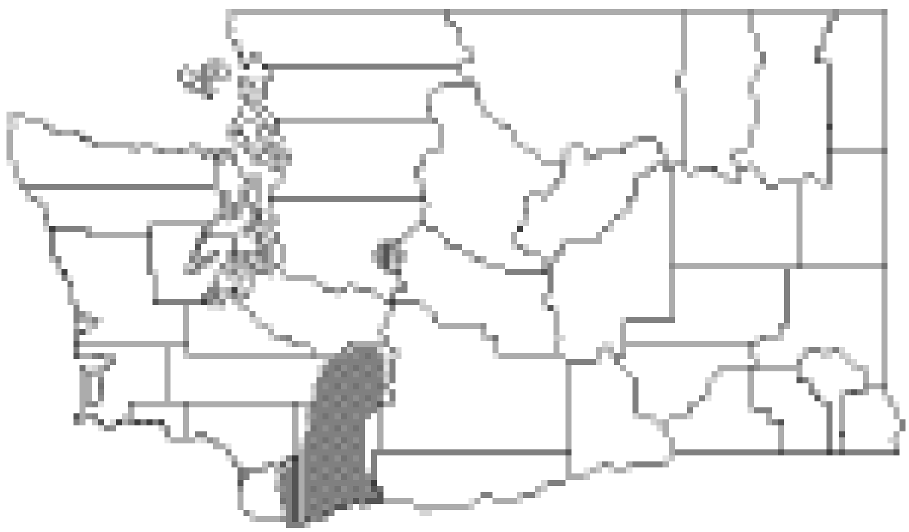


Figure P-9. Range of the Larch Mountain salamander in Washington, based on literature cited above.

Table P-11. Larch Mountain salamander association with wildlife habitats in the Wind River subbasin (IBIS 2004).

Wildlife-Habitat Type	Association	Habitat Requisite	Data Confidence	Comments
Mesic Lowlands Conifer-Hardwood Forest	Generally Associated	Feeds and Breeds	High	Requires mossy talus, logs, or woody debris.
Montane Mixed Conifer Forest	Generally Associated	Feeds and Breeds	Moderate	Requires mossy talus, logs, or woody debris.
Interior Mixed Conifer Forest	Unsure	Unsure	Low	Requires mossy talus, logs, or woody debris.

Fisher

The fisher (*Martes pennanti*) is a Washington state endangered species and a federal species of concern (Table P-2). The Wind River subbasin is part of the historical range of the fisher (Figure P-10). Overtrapping, and loss and alteration of habitats are considered the most significant reasons for the decline of fishers in Washington. Although extensive surveys for fishers have been conducted throughout their historical range, no known population of fishers exists in Washington. The apparent absence of fishers in Washington represents a significant gap (i.e., lack of population continuity) in the species range from Canada to Oregon and California. Riparian habitats, especially those with large diameter snags, live trees and downed logs, are considered high quality habitats for fishers, especially for resting and reproduction. Loss and fragmentation of these habitats can limit the suitability of a landscape for fishers. Oregon now has a resident population of fishers in the Cascades that could serve as a source population for Washington. However, the Bonneville Dam makes the Columbia River a more formidable barrier for fisher dispersal from Oregon to Washington.

Fishers historically occurred throughout much of the forested areas of Washington, though they were not particularly abundant. The fisher was over-trapped in the 19th and early 20th centuries. Trapping, predator and pest control programs, and loss and alteration of habitat combined to push the fisher to near extirpation. Despite protection from legal harvest for 64 years, the fisher has not recovered. The fisher population may have been kept from recovering by a combination of factors. These factors likely include: a reduction in quality and quantity of habitat due to development and logging; past predator and pest control programs; low inherent reproductive capacity of the species; and demographic and genetic effects of small population size.

Fisher biology is characterized by low population density and a low reproductive rate. They have large home ranges and generally avoid large openings, which suggests that viable populations would require large areas of relatively contiguous habitat. Throughout their range, fishers are generally associated with late-successional coniferous and mixed coniferous-deciduous forest (Table P-12). In western Washington, fishers may have been restricted by frequent soft snows or deep snow packs to elevations below 1800 m. Forests with high canopy closure, multiple canopies, shrubs, and that support a diverse prey base are most used. Large diameter trees, large snags, tree cavities, and logs are most often used for den and rest sites, and are an important component of suitable habitat.

Currently, the fisher is very rare in Washington. Infrequent sighting reports and incidental captures indicate that a small number may still be present. However, despite extensive surveys, no one has been able to confirm the existence of a population in the state. The lack of detections of fishers given the extensive carnivore surveys conducted since 1990, an average of less than four fisher sightings per year since 1980, and few incidental captures by trappers, all indicate that fishers are very rare in Washington and could become completely extirpated. We believe that any remaining fishers in Washington are unlikely to represent a viable population, and without a recovery program that includes reintroductions, the species is likely to be extirpated from the state.

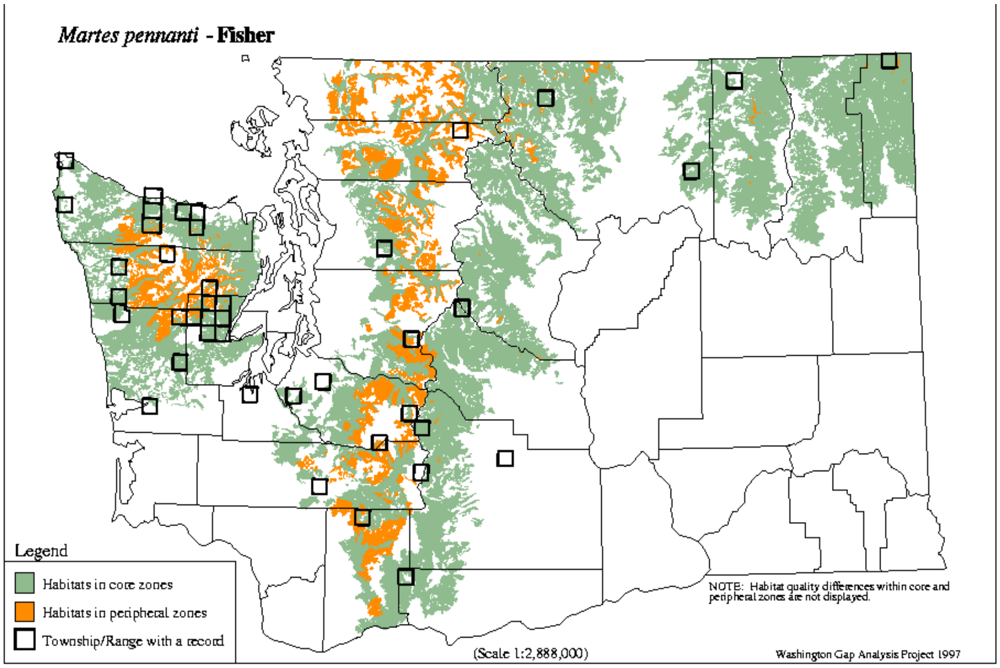


Figure P-10. Distribution of fisher in Washington.

Table P-12. Fisher association with wildlife habitats in the Wind River subbasin (IBIS 2004).

Wildlife-Habitat Type	Association	Habitat Requisite	Data Confidence	Comments
Mesic Lowlands Conifer-Hardwood Forest	Closely Associated	Feeds and Breeds	Moderate	none
Montane Mixed Conifer Forest	Closely Associated	Feeds and Breeds	Moderate	none
Interior Mixed Conifer Forest	Closely Associated	Feeds and Breeds	Moderate	none
Lodgepole Pine Forest and Woodlands	Unsure	Unsure	Low	none
Montane Coniferous Wetlands	Generally Associated	Feeds and Breeds	Low	none

Table P-13. Potential relationship between fishers and salmonids (IBIS 2004).

Common Name	Relationship Type	Salmonid Stage	Comments
Fisher	Rare	Carcasses	May feed on salmon carcasses.

Bald Eagle

The bald eagle (*Haliaeetus leucocephalus*) is a Federal and Washington state threatened species; the historical eagle population in Washington may have been around 6,500. Persecution, the cutting of forests, commercial exploitation of salmon runs, and finally the use of DDT reduced the state's population to only 105 known breeding pairs by 1980. Loss of wetlands, contamination of estuaries, and declines in water quality also probably have reduced the carrying capacity for eagles. The erection of >1,000 dams and the introduction of warm water fishes, however, has likely added nesting and wintering sites and produced changes in local distribution and abundance of eagles. The population has recovered dramatically with the ban on DDT use after 1972 and increased protection for eagles and eagle habitat. In the past 20 years, the population of nesting bald eagles grew about 10% per year as eagles reoccupied habitat. Based on a model, the population is predicted to reach carrying capacity at about 733 nesting pairs. In 1998, there were 664 occupied nests, and there are some indications that the population has reached carrying capacity in parts of western Washington. The population may still be increasing in northeastern Washington and along some western Washington rivers. Though the nesting habitat may be saturated around Puget Sound and other marine coasts, the total late spring/early summer population may continue to grow with an increase in the pool of non-breeding adults until all available food resources are exploited. If there is no decline in the number of nest sites, productivity, or survival, the population may stabilize around 4,400.

Comprehensive, statewide surveys of wintering eagles in Washington from 1982-89 counted 1,000-3,000 eagles in the state. The increasing trends in those surveys and in resident breeding birds predict a population of 3,200 winter visitors and a total winter population of about 4,500 bald eagles in Washington in the year 2000; this assumes that winter carrying capacity limits have not been reached. Statewide winter counts have not been conducted in recent years, and the carrying capacity is unknown. The number of resident breeders, and trends in localized winter counts suggest that Washington hosts perhaps 3,500 – 4,000 bald eagles each winter. Up to 80% of the eagles seen in mid-winter in Washington consists of migrants, largely from the Canadian provinces and Alaska. Wintering eagles will most benefit from protection of salmon runs and communal roosts, and managing human disturbance at eagle concentration areas.

Almost no late seral forest remains in the lowlands around Puget Sound, and eagles nest in small patches of residual large trees and second growth (Table P-14). The large trees along shorelines used by eagles are a diminishing resource, as more and more shoreline is dedicated to residential development. Only 1% of the Puget Sound Douglas-fir Zone is found on lands dedicated to the conservation of biodiversity. Conservation of bald eagle nesting habitat is difficult because 80% of the land within ½ mile of shores is privately owned, and contains desirable view property. Two thirds of the aggregate land within eagle territories and two thirds of eagle nests are on private lands. The state bald eagle protection rule (WAC 232-12-292) requires a management plan for development, forest practices, or potentially disturbing activities on state and private lands near eagle nests and roosts. Over 1,200 management plans have been signed by Washington landowners since 1986. There are indications that some eagles in Washington, and other states, have become fairly tolerant of human activity near nests. Most eagles, particularly those in rural areas, remain rather sensitive to disturbance during nesting.

The U.S. Fish and Wildlife Service is expected to remove the bald eagle from the federal list of threatened and endangered species in 2001. Bald eagles will still be protected by the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. The Bald and Golden Eagle Protection Act also prohibits disturbance or molesting of eagles. Despite state and federal protection, a large percentage of fatalities of adult bald eagles have human related causes, including shooting, poisoning, vehicle collisions, and electrocution, and a black market trade in eagle feathers and parts still exists.

Although the breeding population of bald eagles in Washington has increased dramatically in the past 20 years, two thirds of nests are on private lands. Only about 10% of eagle nests are on lands where their habitat values could be considered secure in the absence of habitat protection rules. Land near shores is highly desirable for residential development and the human population of Washington is expected to increase by 2 million to 7.7 million in the next 20 years, and double to 11 million by 2050. Forest near shores is rapidly being cleared, and the needs of eagles and desires of humans are increasingly in conflict. Without protections of nesting and roosting habitat, the bald eagle could again decline dramatically and require re-listing as threatened or endangered in the state. For these reasons we recommend that the bald eagle be down-listed to sensitive, but not de-listed, in the State of Washington, and that the bald eagle protection rule be amended to apply to a Sensitive species.

Table P-14. Bald eagle association with wildlife habitats in the Wind River subbasin (IBIS 2004).

Wildlife-Habitat Type	Association	Habitat Requisite	Data Confidence	Comments
Mesic Lowlands Conifer-Hardwood Forest	Generally Associated	Reproduces	High	Could breed in this habitat where near open water habitats.
Montane Mixed Conifer Forest	Generally Associated	Reproduces	High	Could breed in this habitat where near open water habitats.
Interior Mixed Conifer Forest	Generally Associated	Reproduces	High	Could breed in this habitat where near open water habitats.
Lodgepole Pine Forest and Woodlands	Generally Associated	Reproduces	High	Could breed in this habitat where near open water habitats.
Alpine Grasslands and Shrublands	Present	Feeds	Low	Known to occur in sub-alpine and alpine areas on Vancouver Island, B.C.
Open Water - Lakes, Rivers, and Streams	Closely Associated	Feeds	High	none

Table P-15. Relationship between bald eagle and salmonids (IBIS 2004).

Common Name	Relationship Type	Salmonid Stage	Comments
Bald Eagle	Indirect	Incubation - eggs and alevin	Feed on birds that feed on salmon.
Bald Eagle	Indirect	Freshwater rearing - fry, fingerling, and parr	Feed on birds that feed on salmon.
Bald Eagle	Strong, consistent	Saltwater - smolts, immature adults, and adults	none
Bald Eagle	Indirect	Saltwater - smolts, immature adults, and adults	Feed on birds that feed on salmon.
Bald Eagle	Strong, consistent	Spawning - freshwater	none
Bald Eagle	Strong, consistent	Carcasses	none
Bald Eagle	Indirect	Carcasses	Feed on birds that feed on salmon.

Oregon Spotted Frog

The Oregon spotted frog (*Rana pretiosa*) is a Pacific Northwest endemic recently differentiated from a close relative, the Columbia spotted frog (*Rana luteiventris*). Historically, the Oregon spotted frog occurred from southwestern British Columbia south to the northeast corner of California (Figure P-11). In Washington, the Oregon spotted frog was historically found in the Puget Trough from the Canadian border to the Columbia River and east into the southern Washington Cascades. McAllister and Leonard (1997) developed a status report for the Oregon spotted frog in Washington state. The Oregon spotted frog is listed as endangered in the State of Washington and is a federal candidate for protection under the Endangered Species Act.

Oregon spotted frogs breed during late winter or early spring. The low-volume calls of the males resemble the sound of the distant tapping of a woodpecker. Females lay their eggs in traditional communal oviposition sites; areas of shallow, still or slow-moving water and sparse, emergent wetland vegetation. Eggs hatch in 18 to 30 days and the tadpoles grow and develop for 13 to 16 weeks prior to metamorphosis in mid-summer. Oregon spotted frogs mature and begin breeding at two or three years of age.

Oregon spotted frogs are preyed upon during all life stages by a wide variety of predators ranging from invertebrates that prey on eggs, to garter snakes (*Thamnophis spp*.) and herons (family Ardeidae) that feed on adults. Among the most significant of predators are various introduced species. Numerous warmwater fish species (primarily of the families Centrarchidae, Percidae, and Ictaluridae) and the bullfrog (*Rana catesbeiana*) have been introduced to waters within the historic range of the Oregon spotted frog. Because of their life histories and habitat affinities, these introduced species pose serious threats to Oregon spotted frog populations.

Oregon spotted frogs are almost entirely aquatic in habit, leaving the wetlands only occasionally and for short duration. Wetlands associated with lakes, ponds, and slow-moving streams can provide suitable habitat (Table P-16). However, these aquatic environments must include a shallow emergent wetland component to be capable of supporting an Oregon spotted frog population. Historically, this critical element was found in the floodplains of many larger water bodies. Various emergent-wetland and floating aquatic plants are found in abundance in Oregon spotted frog habitat. Adult female and juvenile frogs, in particular, spend summers in relatively warm water of this shallow emergent wetland environment.

Historically, the shallow floodplain pools that Oregon spotted frogs inhabited were drained, diked and filled to accommodate human needs. In the Puget Sound lowlands, existing wetlands represent a small proportion of what was present in pre-settlement times. In addition, exotic plants like reed canarygrass (*Phalaris arundinacea*) have changed the character of many wetlands and reduced their value as habitat for Oregon spotted frogs.

The locations for 11 historical populations in Washington have been verified using museum specimen and published records (Figure P-12). Only one historically known population and two recently discovered populations are known to remain in Washington. An additional 20 extant populations are known in Oregon and one in British Columbia. Based on an assessment of presence at historical localities, the species is estimated to have been lost from 78% of its former range. However, considering the broad former range suggested by the historical data, it is likely the species has actually been lost from over 90% of its former range.

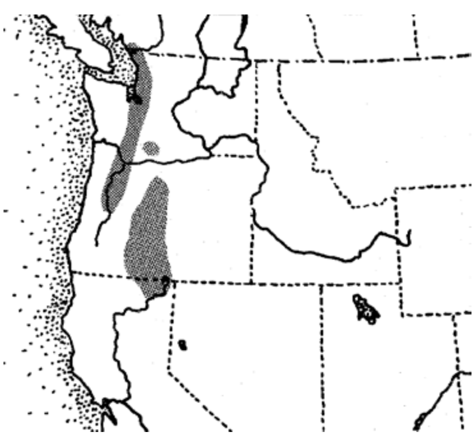


Figure P-11. Range of the Oregon spotted frog (McAllister and Leonard 1997).

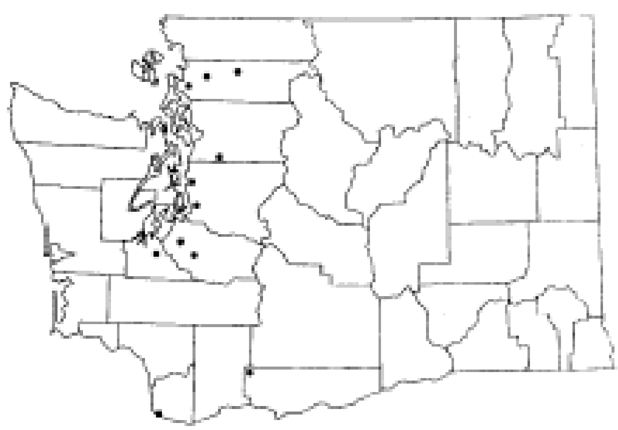


Figure P-12. Location of Oregon spotted frog populations in Washington known prior to 1990.

Table P-16. Oregon spotted frog association with wildlife habitats in the Wind River subbasin (IBIS 2004).

Wildlife-Habitat Type	Association	Habitat Requisite	Data Confidence	Comments
Mesic Lowlands Conifer-Hardwood Forest	Present	Feeds	Moderate	Requires shallow water in wet meadows or stream/pond edges with abundant aquatic vegetation for breeding.
Montane Mixed Conifer Forest	Present	Feeds	High	Requires shallow water in wet meadows or stream/pond edges with abundant aquatic vegetation for breeding.
Interior Mixed Conifer Forest	Generally Associated	Feeds	High	Requires shallow water in wet meadows or stream/pond edges with abundant aquatic vegetation for breeding.
Lodgepole Pine Forest and Woodlands	Present	Feeds	High	Requires shallow water in wet meadows or stream/pond edges with abundant aquatic vegetation for breeding.
Open Water - Lakes, Rivers, and Streams	Closely Associated	Feeds and Breeds	High	Rare or absent where predatory fish or bullfrogs occur. Requires shallow water in wet meadows or stream/pond edges with abundant aquatic vegetation for breeding.
Montane Coniferous Wetlands	Present	Feeds and Breeds	High	Rare or absent where predatory fish or bullfrogs occur. Requires shallow water in wet meadows or stream/pond edges with abundant aquatic vegetation for breeding.

P.3.4.Stream Habitat Conditions

This section describes the current condition of aquatic and terrestrial habitats within the subbasin. Descriptions are included for habitat features of particular significance to focal salmonid species including watershed hydrology, passage obstructions, water quality, key habitat availability, substrate and sediment, woody debris, channel stability, riparian function, and floodplain function. These descriptions will form the basis for subsequent assessments of the effects of habitat conditions on focal salmonids and opportunities for improvement.

Watershed Hydrology

Wind River flows are unregulated and thus driven primarily by watershed conditions and weather patterns. Flows in the Wind River mainstem range from an average monthly flow of 250 cubic feet per second (cfs) in the summer to over 2,000 cfs in winter months. Peak flows occur between November and March in response to rainfall or rain-on-snow events (Figure P-13). The highest recorded flow was 45,700 cfs in January 1974, though the estimate of the February 1996 flood (gage was not operating) was 54,000 cfs (USFS 1996). Summer flows are maintained by snowmelt and groundwater recharge.

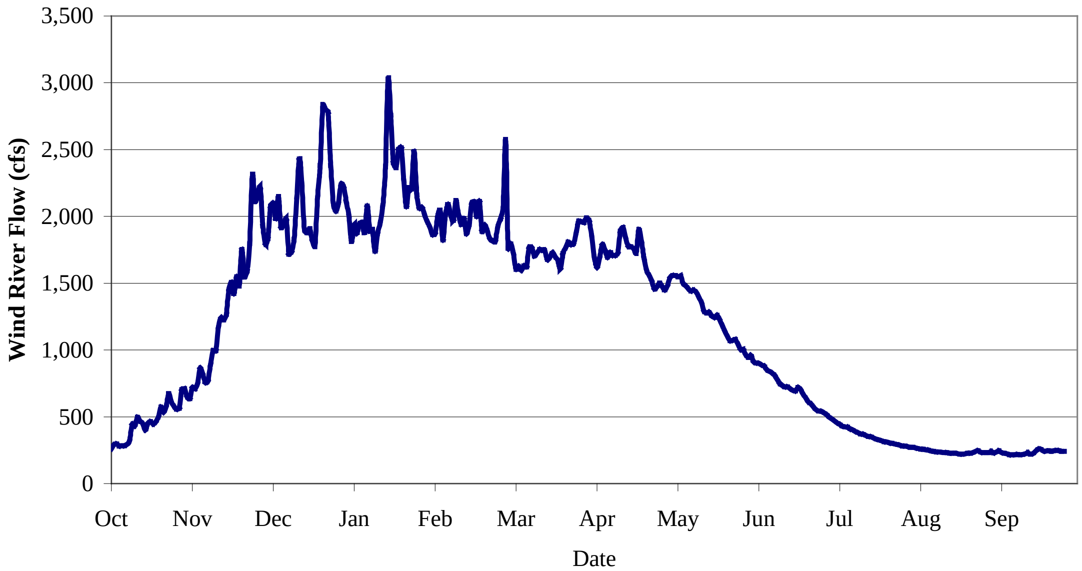


Figure P-13. Wind River hydrograph (1934-1980). Peak flows are primarily related to winter and spring rain, with some high peaks occuring due to winter rain-on-snow. Flows fall below 300 cfs in late summer. USGS Gage #14128500; Wind River near Carson, WA.

Forest cover characteristics are believed to impact runoff conditions in the subbasin. Approximately 20% of the subbasin is in early-seral vegetation due to past fires and timber harvest. This condition, combined with moderately high road densities in a few watersheds (Lower Wind, Middle Wind, Trout Creek), has likely increased the potential for altered peak flow timing and magnitude. The 1996 and 2001 (second iteration) watershed analyses estimated risk of increased peak flows by calculating aggregate recovery percentage (ARP), which looks at the age of forest stands as a representation of hydrologic maturity. Watersheds with 100% ARP are fully hydrologically mature. Watersheds with low ARP levels would be at greater risk of increased peak flows associated with rain-on-snow events.

ARPs in 1995 ranged from 72% in Lower Falls Creek to 97% in Trapper Creek. 2001 levels ranged from 74% in Lower Falls and Eightmile Creek to 99% in Trapper Creek. Most sub-watersheds increased in ARP since 1995 due to tree growth, however, 5 out of 26 sub-watersheds decreased in ARP due to vegetation removal. In 2001, 5 of the 26 sub-watersheds had an ARP of less than 80%. A “relative risk” of increased peak flows was calculated for the 26 subwatersheds as part of the 1996 watershed analysis (USFS 1996). The analysis used road density, ARP, and percent of area in rain-on-snow zone to evaluate “relative risk”. The Headwaters Wind, Ninemile, Compass/Crater, Upper Trout, Upper Panther, and Layout Creek subwatersheds ranked the highest for risk of increased peak flows. The remainder of the subbasin has a relatively low risk of increased peak flows.

Summer low flows may also be a problem in some stream reaches. Dry Creek, Martha Creek, and portions of the Trout Creek basin regularly go subsurface in late summer, possibly stranding fish. Water withdrawals from the subbasin are not believed to have a substantial impact on summer flow levels in the mainstem, though withdrawals do occur at the Carson Hatchery and at a few irrigation diversions. Withdrawal conditions in tributary streams warrant further investigation, especially in Trout Creek, where irrigation water rights may have an impact on the already very low summer flows. In the subbasin as a whole, the net streamflow depletion in the summer due to water withdrawals is approximately 3.9 cfs, representing up to 2.4% of the 90% exceedance flow in late summer (Greenberg and Callahan 2003).

Passage Obstructions

All anadromous fish except for steelhead were blocked by Shipherd Falls at RM 2 until a fish ladder was constructed there in the 1950s to allow spring Chinook to return to the Carson National Fish Hatchery (RM 18). Upstream migration is regulated by a trap at the fish ladder. A significant portion of the riverine habitat downstream of Shipherd Falls was inundated by Bonneville Dam impoundment in 1938.

Hemlock Dam, at RM 2.1 on Trout Creek, is the other major migration barrier. This concrete dam replaced temporary splash dams in 1935 and was used to generate electricity for the USFS Ranger Station that is located nearby. The dam was eventually used only to provide irrigation water to the Wind River Tree Nursery. Since the nursery's 1997 closure, the dam provides a reservoir (Hemlock Lake) for recreation. A fish ladder built in 1936 at the dam has efficiency problems and the lake, which is rapidly filling with sediment, has problems with high temperatures. The dam is ranked as the highest priority for restoration in the Wind River Watershed Analysis—second iteration (2001), and dam removal options and benefits are currently being evaluated.

There are various culverts that restrict passage in Youngman and Oldman Creeks, although the impact on steelhead is believed to be minimal. Subsurface flow may be a problem in Martha Creek, Dry Creek, and portions of the Trout Creek Flats area. Passage in Tyee Creek is blocked by the water intake for the Carson Hatchery.

Water Quality

The major water quality concerns in the subbasin are temperature and sediment. Bear Creek, Eight-mile Creek, and Trout Creek were listed on the State's 1996 303(d) list of impaired water bodies for exceedance of the 60.8ºF (16ºC) temperature standard (WDOE 1996). Only Bear Creek and Eight-mile Creek were included on the 1998 list (WDOE 1998). Water temperature monitoring has been conducted in the basin for many years. The USGS measured temperatures over 64.4ºF (18ºC) in the summer of 1977 in the Lower Wind River. In more recent years the USFS, USGS Columbia River Research Lab (CRRL), and UCD have conducted water quality monitoring using continuously recording thermographs. USFS and USGS monitoring has focused on the federally owned lands while the UCD monitoring has focused primarily on privately owned lands in the lower subbasin. USFS monitoring goes as far back as 1977 for some sites, whereas CRRL and UCD monitoring is limited to the past several years. A total of approximately 46 different locations have been monitored since 1977, all with various periods of record. At 32 of the sites, the temperature has exceeded 60.8ºF (16ºC) on at least one day during the sampling period. Fifteen of the sites have exceeded 64.4ºF (18ºC). Sites exceeding 68ºC (20ºC) include the mouth of Eight-mile Creek, the Wind River at the 3065 Road Bridge, and Trout Creek below Crater Creek, below Compass Creek, above Hemlock Lake, below Hemlock Dam, and at the mouth. The Trout Creek above Hemlock Lake station has been under the 60.8ºF (16ºC) standard for only one year since 1977 (USFS, CRRL, UCD published and unpublished data).

A Total Maximum Daily Load (TMDL) analysis was performed in the subbasin to identify problems and potential solutions related to high stream temperatures. High summer temperatures were attributed to loss of riparian cover, channel widening, and reduced summer base flows. Modeling indicated that an increase in stream shade would potentially be adequate to lower temperatures in the mainstem Wind River and Panther Creek. In Trout Creek, it was determined that a reduction in channel widening, combined with increased shading, would be the most effective strategy for lowering temperatures (WDOE 2002 Draft, as cited in Michaud 2002). The USFS developed a Water Quality Restoration Plan (WQRP) for the Wind River as part of requirements by the WDOE and EPA due to stream temperature problems. The analysis focused on stream shading, stream widening, and water withdrawals as sources for stream heating. GIS modeling of riparian shade revealed that the Middle Wind, Trout Creek, and the lower Wind had shade levels greater than 10% less than potential levels. The Lower Wind had shade levels approximately 50% less than the potential. Air photo analysis revealed that channel widening occurred on most of the surveyed stream reaches in the period dating from 1959 to 1979 and the period dating from 1989 to 1999. Most channels narrowed during the interim period. Channel widening was attributed to periods of large flood events. The analysis of the impact of water withdrawals indicated that Trout Creek and Bear Creek were the most susceptible to temperature increases due to water withdrawals (USFS 2001). Water withdrawals in Trout Creek are primarily for irrigation while withdrawals from Bear Creek are for the City of Carson's domestic water supply.

Turbidity is also regarded as a concern in the subbasin. Sampling of 16 sites at 4 different flow levels by the USFS in 1995 revealed that Lower Panther Creek, Trout Creek, and the Lower Wind River have the highest turbidity levels at high flow volumes. The Lower Wind River had the highest turbidity levels at all flow volumes. It should be noted that investigators caution the use of such a limited data set (USFS 2001).

USGS and UCD have measured pH levels that are below standards, but low pH conditions are believed to be from natural sources (Michaud 2002).

Key Habitat Availability

The USFS has conducted habitat surveys on many of the streams within public ownership. Pool quantity and quality are low in many of the surveyed streams. The 1996 watershed analysis reported that 93% of surveyed reaches did not meet desired condition for pool frequency. It should be noted, however, that investigators caution the use of pool frequency due to problems associated with observer bias. The use of a pool quality index that relates pool area to depth is recommended over pool frequency measures, and such an analysis was conducted. USFS stream surveys reveal that pool depths are low (surface area / volume > 68) in the Panther Creek tributaries Eight-mile, Cedar, and Mouse Creeks, as well as in the Headwaters Wind River and Upper Falls Creek. Width-to-depth ratios are high (>9) in the middle Wind River, Eight-mile Creek, and Cedar Creek, with only one stream segment, Upper Panther Creek, having "excellent" width-to-depth ratios (<6). Restoration efforts by the USFS have improved pool quality and quantity in several locations. In particular, reconnection of side channel / floodplain habitats restored 600 feet to Layout Creek and increased the channel length in the Mining Reach (middle Wind River) by 48%. In addition, bankfull pool volume in the Mining Reach was increased by 520% (USFS 2001).

Substrate & Sediment

There is not a lot of direct information on stream substrate conditions; however, as part of the USFS Watershed Analysis – second iteration (2001), McNeil Core Sediment samples were taken on 9 streams. Dry Creek the Upper Wind River had the highest percentages of fines and small sediment size classes. Both streams had greater then 34% of sediments less than 6.3 mm, with a high percentage (15% for Dry Creek and 16% for Upper Wind) of fines (<1.6 mm).

Observations indicate that Youngman and Dry Creeks have excessive in-stream sediment levels. Landslide activity appears to be contributing to instream sediment levels in Paradise Creek and Pete's Gulch. The Trout Creek basin has fine sediment aggradations due to basin morphology that includes steep headwater streams emptying into the broad alluvial valley known as Trout Creek Flats (WCC 1999). Sedimentation of channels is a problem in the lower and Little Wind Rivers due to landslide activity related to roads, utility corridors, timber harvest, a golf course, and naturally unstable soil conditions. Accumulation of sediment at the mouth of the Wind has long been a concern to local fishermen and to the Port of Skamania County who wish to preserve adequate water depths for commercial shipping traffic.

A number of watershed-scale sediment supply assessments have been conducted in the subbasin. Sediment supply conditions were evaluated as part of the IWA watershed process modeling, which is presented later in this chapter. Ten of the 25 IWA subwatersheds were rated as “moderately impaired” with respect to landscape conditions that influence sediment supply; the remaining subwatersheds were rated as “functional”. High road densities, steep topography, and naturally unstable soils are the primary drivers of these sediment supply impairment ratings. The moderately impaired subwatersheds are scattered throughout the basin and include the Little Wind, lower Trout Creek, headwaters Trout Creek, Trapper Creek, Paradise Creek, Falls Creek, and lower Panther Creek subwatersheds.

A similar investigation conducted as part of the USFS Watershed Analysis used road crossings per square mile, peak flow turbidity, mass wasting, surface erosion, and channel stability information to identify subwatersheds with the greatest threat of erosion and sedimentation. Twelve of the 26 USFS subwatersheds were identified as having a high risk of fine sediment impact on aquatic habitats. The percentage of land area with landslides, debris flows, and potentially unstable soils was calculated for the same 26 sub-watersheds. The sub-watersheds over 20% were Paradise Creek, Ninemile Creek, Layout Creek, Mouse Creek, Cedar Creek, North Fork Bear Creek, and East Fork Bear Creek (USFS 1996).

Approximately 20% of the forest cover in the subbasin is in early-seral stages, suggesting that portions of the basin may not have adequate vegetation to prevent excessive soil erosion, however, the presence of an extensive road network may be the factor contributing most to sediment production and delivery. The entire subbasin has an average road density of 2.2 mi/mi^2. This level has been reduced from 2.6 mi/mi^2 in 1995 due to road decommissioning efforts by the USFS (USFS 2001). Road densities greater than 3 mi/mi^2 are generally considered high, while those between 2 and 3 mi/mi^2 are considered moderate. Although the subbasin as a whole has only moderate road densities, several portions of the subbasin have high road densities. The 6^{th} field basins with the greatest road densities are the Lower Wind, Middle Wind, and Trout Creek basins. All of the 6^{th} field basins have seen an increase in the length of the drainage network due to roads. The increase has been greatest (up to 40%) in the Lower Wind, Middle Wind, and Trout Creek basins. The amount of stream crossings per mile is greatest in the Upper Wind, Middle Wind, Trout Creek, and Panther Creek basins (USFS 2001).

Several restoration projects by the USFS and Underwood Conservation District have attempted to restore bank stability and reduce sediment delivery rates to streams. Monitoring of a USFS restoration project in Layout Creek reveals a decrease of 73% of eroding banks in the reach (USFS 2001).

Sediment production from private forest roads is expected to decline over the next 15 years as roads are updated to meet the new forest practices standards, which include ditchline disconnect from streams and culvert upgrades. The frequency of mass wasting events should also decline due to the new regulations, which require geotechnical review and mitigation measures to minimize the impact of forest practices activities on unstable slopes.

Woody Debris

Pieces of LWD per mile have been collected as part of USFS stream surveys. In general, LWD conditions are very poor throughout the basin. This can be attributed to loss of recruitment due to past harvest of riparian areas and past stream clean-outs. Currently, 12 out of 20 regularly surveyed reaches contain less than 75 pieces of LWD per mile.

Restoration efforts conducted by the USFS and UCD have placed wood into streams in order to increase aquatic habitat complexity and to restore natural levels of bank stabilization. Monitoring of USFS restoration projects reveals that the number of LWD pieces has increased by 333% in Layout Creek and by 497% in the middle Wind River (Mining Reach) (USFS 2001).

Channel Stability

USFS surveys have revealed bank stability concerns in the Compass Creek, upper Trout Creek, middle Wind, Layout Creek, and upper Wind basins. High width-to-depth ratios can be an indicator of low channel stability causing excessive lateral bank erosion. High ratios (>9) have been measured in the middle Wind, Eight-mile Creek, and Cedar Creek. The middle Wind from RM 12-19 is a highly dynamic alluvial section that experiences rapid channel migration and avulsions during high flow events. Avulsions are often associated with the accumulation of large log jams that serve to re-direct the stream course through overflow / floodplain channels. The instability of this reach is believed to be partly due to excess sedimentation from upstream sources, loss of bank stability due to degradation of riparian forests, and the loss of stable in-stream large wood pieces. USFS and UCD restoration projects have increased bank stability through re-introduction of large wood assemblages and re-planting efforts. USFS efforts on the Mining Reach have increased bank stability by 58% (USFS 2001). Bank stability is also a concern in the Trout Creek basin. Accumulation of sediments from past logging operations resulted in lateral bank cutting as well as dramatic downcutting through aggraded substrates. Restoration efforts have alleviated some of these problems through large wood re-introduction and re-routing of the stream into stable channels with intact riparian forests.

The lower Wind River suffers from bank stability problems related to mass wasting. The most prominent feature is an eroded gully created by excessive runoff from the golf course in Carson. The gully, which is several hundred feet long, has contributed large amounts of sediment to the lower mile of the Wind River. There are other landslides along the lower Wind and the Little Wind River that are related to roads, timber harvest, utility corridors, and commercial development.

Riparian Function

The sub-watersheds with greater than 25% early-seral vegetation in riparian areas are the upper Wind, Eightmile Creek, Lower Trout, and the Little Wind River. Non-forest, seedling / sapling / pole, and small tree assemblages make up over 67% of riparian areas. The percent in the large tree category is under 33%, compared to the desired future condition of 75% (USFS 2001).

The mainstem Wind River between RM 12 and RM 19 contains rural residential development and past agricultural development that has resulted in cleared riparian forests. As a result, canopy cover and bank stability have been substantially reduced. The reduction of bank stability and LWD recruitment is partially responsible for dramatic channel shifts and rapid channel migration that has occurred in this reach.

Riparian function is expected to improve over time on private forestlands. This is due to the requirements under the Washington State Forest Practices Rules (Washington Administrative Code Chapter 222). Riparian protection has increased dramatically today compared to past regulations and practices.

Floodplain Function

Alluvial reaches with developed floodplains are located on the middle Wind River, upper Wind River, Dry Creek, Panther Creek, and Trout Creek. There is a lack of quantitative information on channel connectivity and function of these floodplains. Observations gathered as part of the 1999 Limiting Factors Analysis (WCC 1999) reveal a few areas of concern. On the middle Wind River, floodplain connectivity is reduced by the 30 Road, which closely abuts the river in several places. Diking associated with residential development, the Beaver Campground, and the Carson Fish Hatchery also limit floodplain function in this segment. In the Mining Reach, Forest Road 30 intercepts the floodplain from RM 21 to RM 25. On Trapper Creek, cabins are located within the historical floodplain on the lower mile of stream. Some filling of flood channels has occurred in order to protect property. Portions of Trout Creek within Trout Creek Flats have downcut to the point where the stream can no longer access its floodplain. Similar problems exist on Layout Creek, where stream restoration efforts recently reconnected 600 feet of side-channel habitat (USFS 2001).

P.3.5.Stream Habitat Limitations

A systematic link between habitat conditions and salmonid population performance is needed to identify the net effect of habitat changes, specific stream sections where problems occur, and specific habitat conditions that account for the problems in each stream reach. In order to help identify the links between fish and habitat conditions, the Ecosystem Diagnosis and Treatment (EDT) model was applied to Wind River subbasin fall Chinook, chum, coho, winter steelhead, and summer steelhead. A thorough description of the EDT model, and its application to lower Columbia salmonid populations, can be found in Appendix E.

Three general categories of EDT output are discussed in this section: population analysis, reach analysis, and habitat factor analysis. Population analysis has the broadest scope of all model outputs. It is useful for evaluating the reasonableness of results, assessing broad trends in population performance, comparing among populations, and for comparing past, present, and desired conditions against recovery planning objectives. Reach analysis provides a greater level of detail. Reach analysis rates specific reaches according to how degradation or restoration within the reach affects overall population performance. This level of output is useful for identifying general categories of management (i.e. preservation and/or restoration), and for focusing recovery strategies in appropriate portions of a subbasin. The habitat factor analysis section provides the greatest level of detail. Reach specific habitat attributes are rated according to their relative degree of impact on population performance. This level of output is most useful for practitioners who will be developing and implementing specific recovery actions.

Population Analysis

Population assessments that compare historical and current habitat conditions are useful for evaluating trends and establishing recovery goals. Fish population levels under current and historical habitat conditions were inferred using the EDT model based on habitat characteristics of each stream reach and a synthesis of habitat effects on fish life cycle processes.

Habitat-based assessments were completed in the Wind River subbasin for fall Chinook, chum, coho, winter steelhead, and summer steelhead. Model results indicate declines in adult productivity from historical levels for all species (Table P-17). Current productivity is only 17% and 19% of historical levels for winter steelhead and chum, respectively. Similarly, summer steelhead have experienced a decline in productivity to 25% of historical levels. The two species with the smallest decline in adult productivity are fall Chinook and coho. Fall Chinook productivity has declined by 55% and coho productivity has declined by 49%.

As with productivity, adult abundance levels have also declined from historical levels for all five species (Figure P-14). The decline in abundance has been most severe for chum and winter steelhead. Current chum abundance is estimated at only 3% of historical levels, while winter steelhead abundance is estimated at only 24% of historical levels. For fall Chinook, coho and summer steelhead declines in adult abundance have been less severe, with current levels ranging from 32-51% of historical levels. Diversity (as measured by the diversity index) appears to have remained relatively steady for summer steelhead, with greater declines estimated for fall Chinook, chum, coho, and winter steelhead (Table P-17).

Modeled historical-to-current changes in smolt productivity and abundance show declines for all species (Table P-17). The decrease in subbasin smolt productivity is greatest for winter steelhead and coho, with a decrease from historical levels of 87% for coho and 74% for winter steelhead. Smolt productivity appears to have declined the least for chum. However, this relatively higher productivity is an artifact of the way the EDT model calculates productivity. That is, the higher productivity of chum smolts is because Wind chum now have many less trajectories (life history pathways) that are viable (those that result in return spawners); but the few trajectories that remain have higher productivities than historical trajectories (many of which were only marginally viable).

Current smolt abundance is substantially less than the historical level for all species (Table P-17), reflecting the significant loss of habitat (which is also reflected in the life history diversity index). Historical-to-current change in fall Chinook, coho, and chum smolt abundance shows an 81%, 90%, and a 94% decrease, respectively. Summer and winter steelhead smolt abundance appears to have declined somewhat less dramatically, with a modeled 40% and 56% decrease from past levels, respectively.

Table P-17. Population productivity, abundance, and diversity (of both smolts and adults) based on EDT analysis of current (P or patient) and historical (T or template) habitat conditions.

	Adult Abundance		Adult Productivity		Diversity Index		Smolt Abundance		Smolt Productivity	
Species	**P**	**T**	**P**	**T**	**P**	**T**	**P**	**T**	**P**	**T**
Fall Chinook	954	2,584	4.85	10.78	0.62	0.99	158,081	835,275	568	1,316
Chum	361	10,886	1.67	9.02	0.45	1.00	227,457	3,829,348	720	1,083
Coho	95	186	3.20	5.87	0.05	0.11	308	3,126	39	298
Winter Steelhead	70	280	3.46	20.81	0.56	0.79	1,403	3,198	71	272
Summer Steelhead	1,230	3,814	4.37	17.73	0.88	1.00	24,673	41,020	84	185

[1] Estimate represents historical conditions in the subbasin and current conditions in the mainstem and estuary.

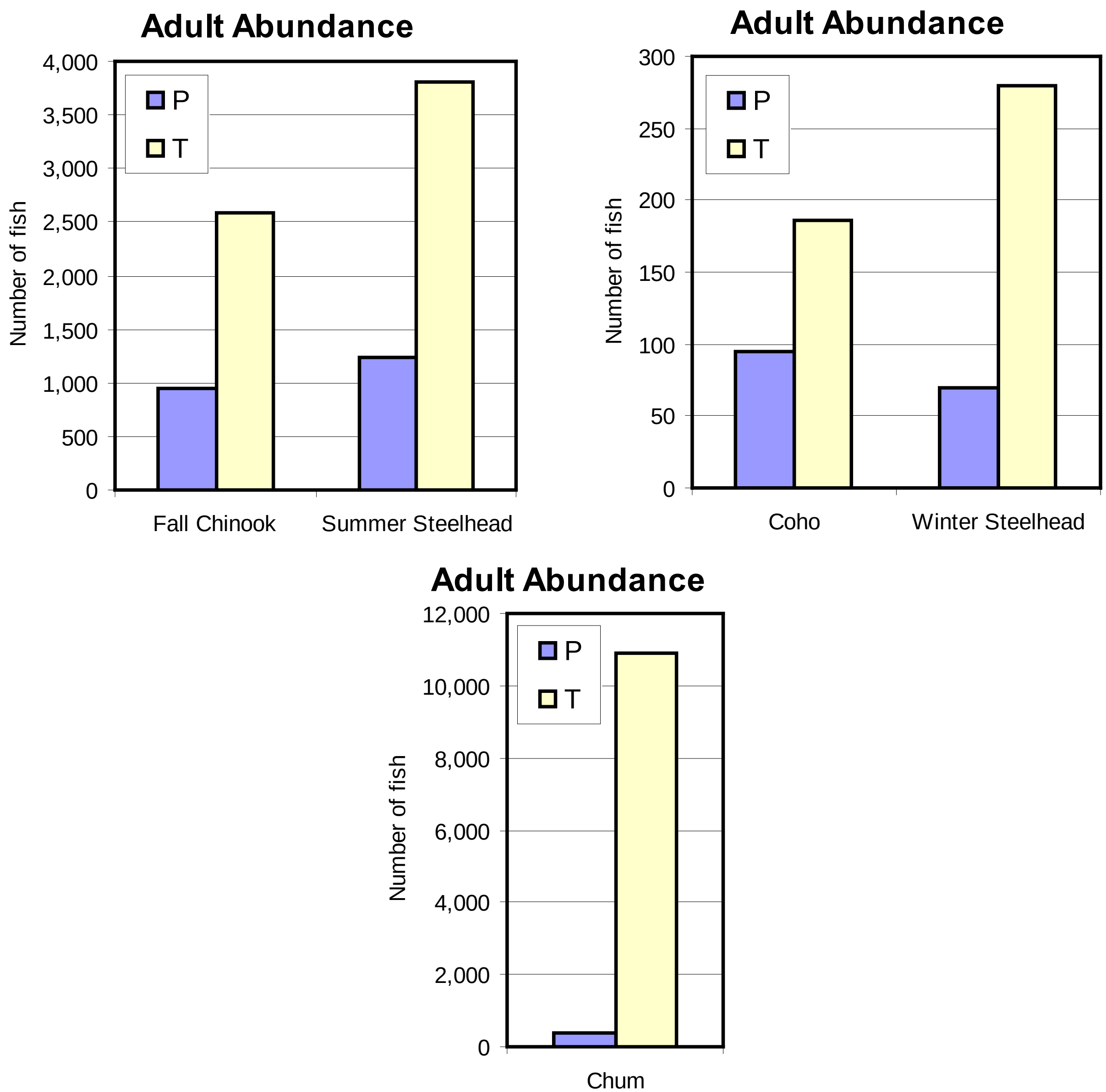


Figure P-14. Adult abundance of Wind river fall Chinook, spring Chinook, chum, coho and winter and summer steelhead based on EDT analysis of current (P or patient) and historical (T or template) habitat conditions.

Stream Reach Analysis

Habitat conditions and suitability for fish are better in some portions of a subbasin than in others. The reach analysis of the EDT model uses estimates of the difference in projected population performance between current/patient and historical/template habitat conditions to identify core and degraded fish production areas. Core production areas, where habitat degradation would have a large negative impact on the population, are assigned a high value for preservation. Likewise, currently degraded areas that provide significant potential for restoration are assigned a high value for restoration. Collectively, these values are used to prioritize the reaches within a given subbasin.

The Wind River subbasin includes approximately 60 reaches and has significant production potential for salmon and steelhead. Historically, Shipherd Falls could be passed by summer steelhead but the falls limited chum and fall Chinook to the lower 3 miles of the river. Winter steelhead used the Lower Wind and the Little Wind River. The location of EDT reaches is displayed in Figure P-15.

For Wind River fall Chinook, chum, coho, and winter steelhead, the high priority reaches (Wind 1, Wind 2, and Little Wind 1) are located in the lower river (Figure P-16 - Figure P-19). In this lower section of the river, reach Wind 1 shows high restoration potential. However, restoring this reach would require substantial changes to the operation or configuration of Bonneville Dam, which is unlikely in the foreseeable future. Significant improvements in fall Chinook, chum, and coho habitat could be gained by restoration activities in reach Wind 2. Restoration activities in Little Wind 1 would benefit winter steelhead and coho. Reach Wind 3 generally has both restoration and preservation value (see ladder diagrams below).

High priority reaches for summer steelhead are most concentrated in the mid to lower sections of the subbasin (Figure P-20). The high priority reaches in the mainstem include Wind 4a, 4b, and 6b, each with a preservation emphasis. Tributaries flowing into the mainstem Wind River also contain high priority reaches for summer steelhead. Reach Trout 1a and Panther 1a and 1b are all high priority for summer steelhead, again each with a preservation emphasis. Juvenile trapping has indicated that up to 70% of the Wind River steelhead smolt production is believed to originate in mainstem canyon reaches (Wind 4a-4b) (Rawding and Cochran 2000). Many age-1 parr move into these areas in May and rear for one year before out-migration. These canyon reaches, which are in relatively good condition, have high preservation value. Some potential for restoration exists in the mainstem Wind between Trout Creek and Tyee Springs (Wind 5a and 5c), often referred to as the Wind Flats reach; the mainstem between Falls and Paradise Creeks (Wind 6d), often referred to as the mining reach; Panther Creek from the mouth to Eight-mile Creek (Panther 1a, 1b, and 1c); and Trout Creek between Hemlock Dam and Layout Creek (Trout 1c and 1d), referred to as Trout Flats.

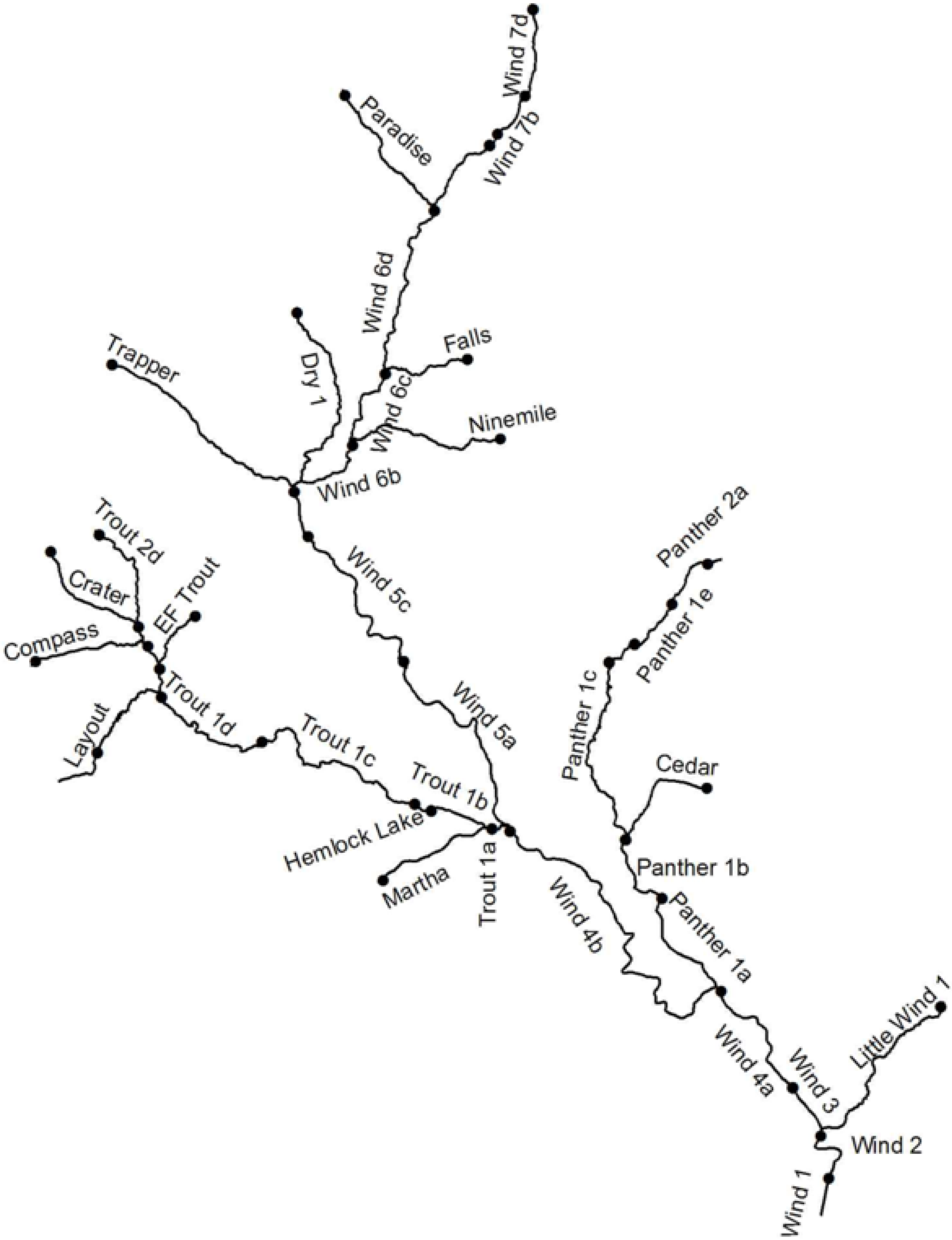


Figure P-15. Wind River basin with EDT reaches identified. For readability, not all reaches are labeled.

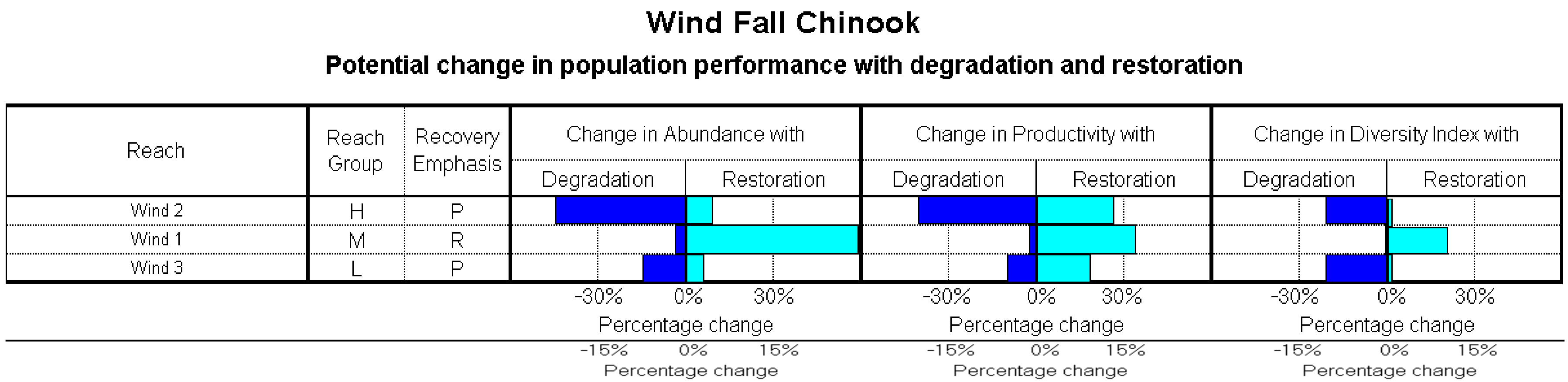


Figure P-16. Wind River fall Chinook ladder diagram. The rungs on the ladder represent the reaches and the three ladders contain a preservation value and restoration potential based on abundance, productivity, and diversity. The units in each rung are the percent change from the current population. For each reach, a reach group designation and recovery emphazsis designation is given. Percentage change values are expressed as the change per 1000 meters of stream length within the reach. See Appendix E Chapter 6 for more information on EDT ladder diagrams.

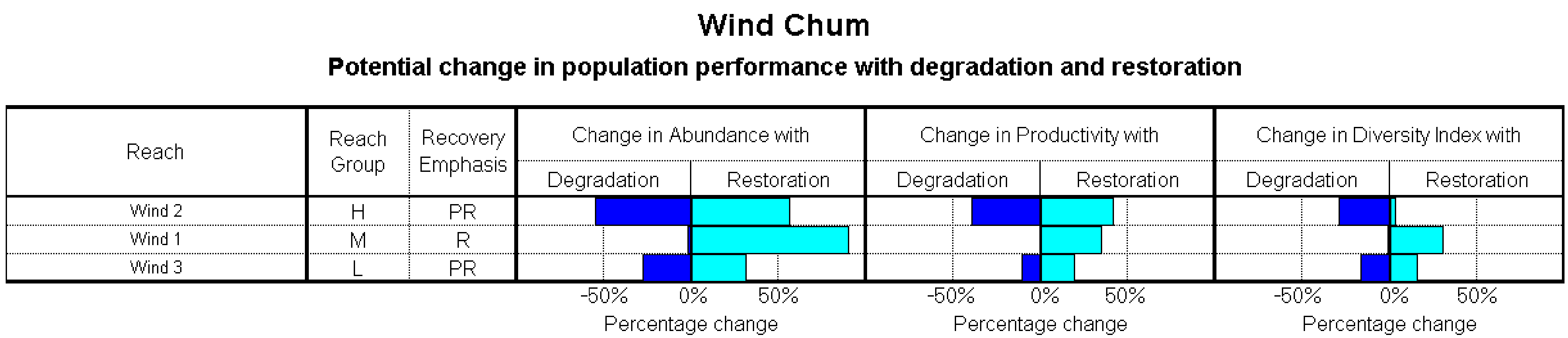


Figure P-17. Wind River chum ladder diagram. The rungs on the ladder represent the reaches and the three ladders contain a preservation value and restoration potential based on abundance, productivity, and diversity. The units in each rung are the percent change from the current population. For each reach, a reach group designation and recovery emphazsis designation is given. Percentage change values are expressed as the change per 1000 meters of stream length within the reach. See Appendix E Chapter 6 for more information on EDT ladder diagrams.

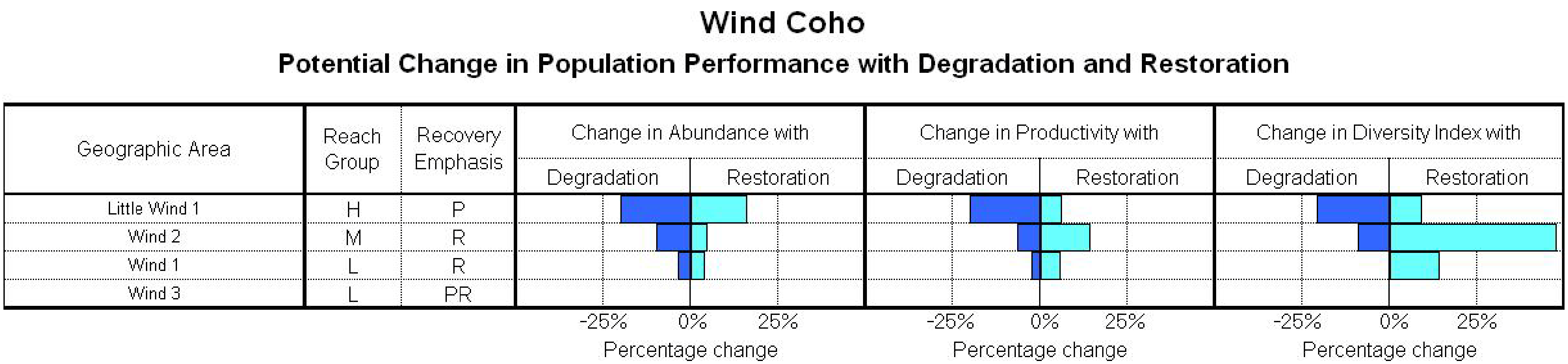


Figure P-18. **Wind River coho ladder diagram. The rungs on the ladder represent the reaches and the three ladders contain a preservation value and restoration potential based on abundance, productivity, and diversity. The units in each rung are the percent change from the current population. For each reach, a reach group designation and recovery emphazsis designation is given. Percentage change values are expressed as the change per 1000 meters of stream length within the reach. See Appendix E Chapter 6 for more information on EDT ladder diagrams.**

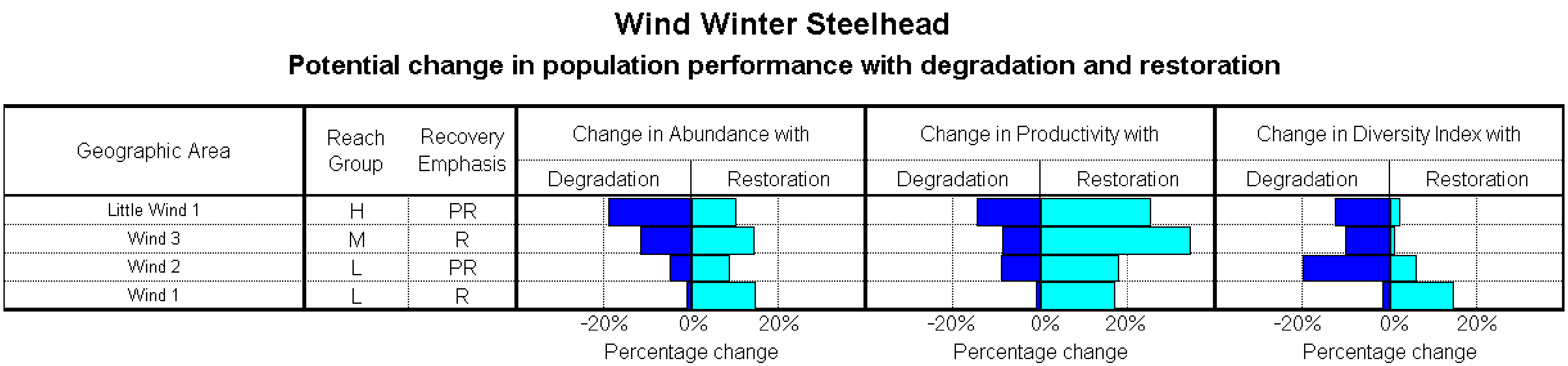


Figure P-19. **Wind River winter steelhead ladder diagram. The rungs on the ladder represent the reaches and the three ladders contain a preservation value and restoration potential based on abundance, productivity, and diversity. The units in each rung are the percent change from the current population. For each reach, a reach group designation and recovery emphazsis designation is given. Percentage change values are expressed as the change per 1000 meters of stream length within the reach. See Appendix E Chapter 6 for more information on EDT ladder diagrams.**

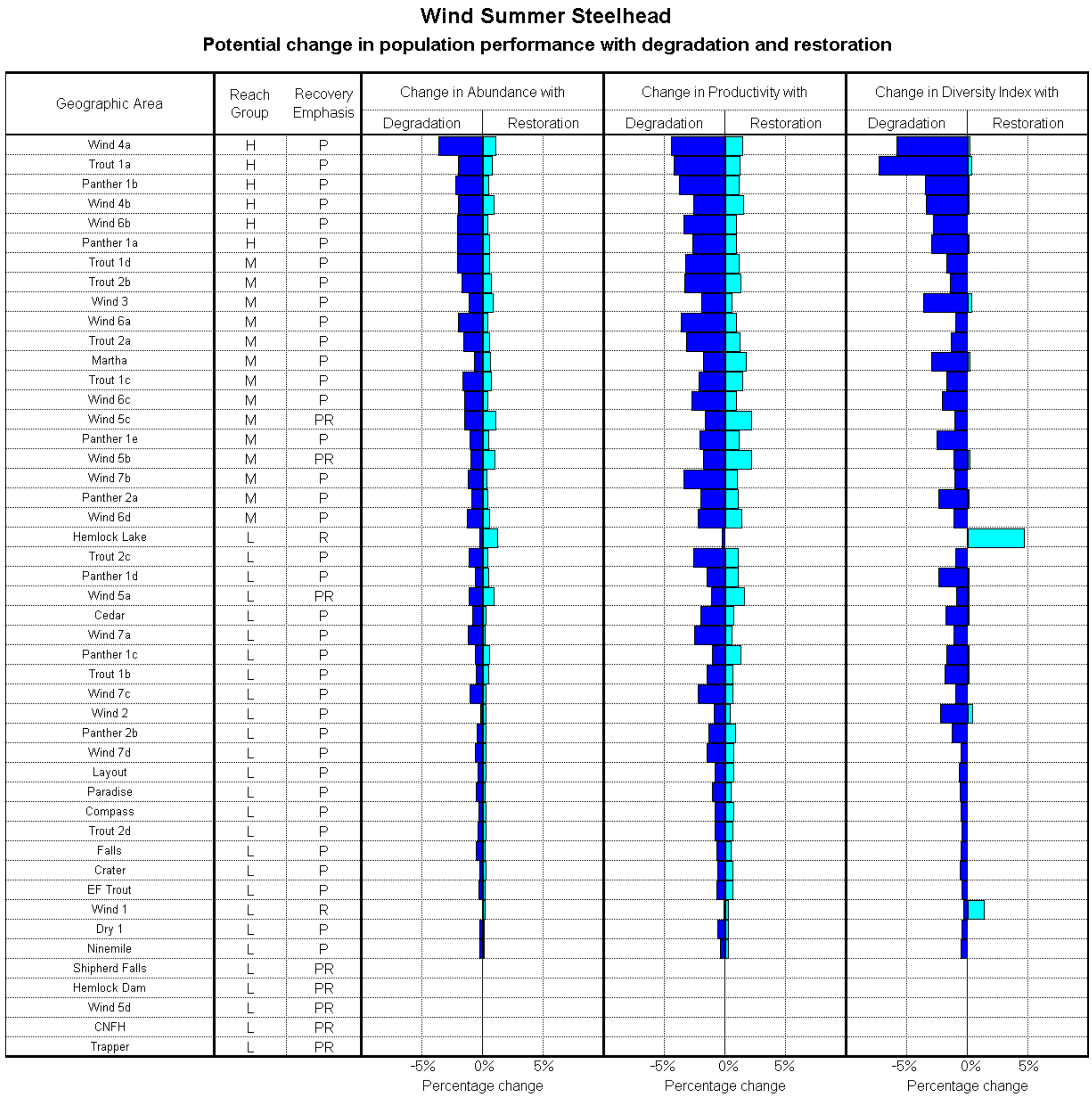


Figure P-20. Wind River summer steelhead ladder diagram. The rungs on the ladder represent the reaches and the three ladders contain a preservation value and restoration potential based on abundance, productivity, and diversity. The units in each rung are the percent change from the current population. For each reach, a reach group designation and recovery emphazsis designation is given. Percentage change values are expressed as the change per 1000 meters of stream length within the reach. See Appendix E Chapter 6 for more information on EDT ladder diagrams.

Habitat Factor Analysis

The Habitat Factor Analysis of EDT identifies the most important habitat factors affecting fish in each reach. Whereas the EDT reach analysis identifies reaches where changes are likely to significantly affect the fish, the Habitat Factor Analysis identifies specific stream reach conditions that may be modified to produce an effect. Like all EDT analyses, the habitat factor analysis compares current/patient and historical/template habitat conditions. For each reach, EDT generates what is referred to as a “consumer reports diagram”, which identifies the degree to which individual habitat factors are acting to suppress population performance. The effect of each habitat factor is identified for each life stage that occurs in the reach and the relative importance of each life stage is indicated. For additional information and examples of this analysis, see Appendix E. Inclusion of the consumer report diagram for each reach is beyond the scope of this document. A summary of the most critical life stages and the habitat factors affecting them are displayed for each species in Table P-18.

Table P-18. Summary of the primary limiting factors affecting life stages of focal salmonid species. Results are summarized from EDT Analysis.

Species and Lifestage		Primary factors	Secondary factors	Tertiary factors
Wind Fall Chinook				
most critical	Egg incubation	sediment	channel stability, key habitat	harassment, pathogens, temperature
second	Fry colonization	habitat diversity, predation	channel stability, food	flow, competition (other spp.), pathogens
third	Spawning	habitat diversity, harassment	key habitat, pathogens	flow, sediment, predation
Wind Chum				
most critical	Prespawning holding	habitat diversity, harassment	pathogens	flow, temperature
second	Egg incubation	sediment	channel stability, key habitat harassment	pathogens
third	Spawning	habitat diversity, harassment	flow, pathogens, temperature	
Wind Coho				
most critical	Egg incubation	key habitat	sediment	channel stability
second	0-age summer rearing	key habitat	habitat diversity, temperature	competition (hatchery), food, predation
third	Fry colonization	key habitat	flow, food, habitat diversity	channel stability, predation
Wind Summer Steelhead				
most critical	Egg incubation	sediment	temperature	key habitat
second	0-age summer rearing	habitat diversity, pathogens	flow, temperature, competition (hatchery), predation	
third	1-age summer rearing	competition (hatchery)	flow, habitat diversity	pathogens, predation, temperature
Wind Winter Steelhead				
most critical	0-age summer rearing	competition (hatchery), habitat diversity, pathogens, temperature	predation	flow, food
second	Egg incubation	sediment, temperature	key habitat	channel stability, harassment, pathogens
third	0,1-age summer rearing	flow	channel stability, food, habitat diversity	

The consumer reports diagrams have also been summarized to show the relative importance of habitat factors by reach. The summary figures are referred to as habitat factor analysis diagrams and are displayed for each species below. The reaches are ordered according to their combined restoration and preservation rank. The reach with the greatest potential benefit is listed at the top. The dots represent the relative impact of habitat attributes on reach-level performance.

The Habitat Factor Analysis of the Wind is most easily discussed in two areas within the subbasin. The first is the lower river, below Shipherd Falls, which provides habitat for winter steelhead, fall Chinook, and historically, chum. The second area constitutes the remainder of the basin, which is accessed by wild summer steelhead. Spring Chinook hatchery fish also access the upper basin, but this population is not covered in this analysis.

For the lower river, Wind 1 affects fall Chinook and chum due to loss of key habitat, habitat diversity, increased sediment, and increased temperature (Figure P-21 and Figure P-22). All of these are related to Bonneville Pool inundation. For chum, reach Wind 2 has similar impacts. For winter steelhead, habitat diversity, temperature, and sediment are a problem in all of the Lower Wind and Little Wind reaches accessed (Figure P-23). Sediment from upstream sources collects in reaches Wind 1 and Wind 2 as the velocity slows in these low gradient reaches. Fine sediment originates from upper basin hillslope sources, upstream channel erosion, and local mass wasting. Upper basin hillslope sources contribute fine sediment due to high road densities and early-seral stage forests. This is especially a problem in the Trout Creek and Middle Wind basins (USFS 2001). Sediment is also contributed during storm flows from upstream channel sources, mainly from the Wind Flats and Trout Creek alluvial channels. There is also considerable contribution of fine sediment from bank erosion in the Lower Wind itself. This area is underlain by Bretz Flood deposits that continue to deliver sediment through mass wasting events. Mass wasting from landslides and debris flows is exacerbated by roadways, denuded riparian vegetation, and concentrated runoff from the greater Carson urban area, in particular the Carson Golf Course.

Loss of key habitat is another major concern in the lower river. Riffle habitat has been lost by Bonneville Pool inundation and much of reach Wind 2 is in glide habitat. The prevalence of glides may be due in part to natural conditions but is also likely exacerbated by hydro-confinement from a rip-raped roadway along the east bank of reach Wind 2. Temperature is also a concern in the Lower Wind reaches. Wind 1 has elevated temperature due to the influx of Columbia River water, a condition that is unlikely to change. Temperature problems also exist in Wind 3 and on the Little Wind River, related primarily to loss of adequate riparian tree canopy cover. Habitat diversity is a concern in all of the Lower Wind reaches. This is related to confinement, denuded riparian vegetation, and lack of LWD.

For the remainder of the basin, summer steelhead habitat degradation is a concern in a number of areas. The main areas of concern include the reaches Wind 4a and 4b (canyon), Wind 5a–5c (wind flats), reach Wind 6d (mining reach), reaches Trout 1c and 1d (Lower Trout), and Panther 1a, 1b, and 1c (Lower Panther) (Figure P-25). These areas represent major steelhead spawning and rearing sites. The impacts result from a suite of conditions, including loss of key habitat, fine sediment contribution, altered flow regimes, loss of habitat diversity, elevated temperatures, and channel instability. Key habitat in the form of pools and riffles has decreased due to filling of pools with sediment, channel confinement, and lack of LWD. Elevated fine sediment is contributed from hillslope and in-channel sources and is related to high road densities and young riparian forests. In some areas, the rate of channel migration has increased due to a loss of old-growth valley bottom forests, loss of large log jams, and elevated coarse sediment from forest harvest activities (i.e. landslides, debris flows).

Impaired flow conditions are likely related to the low hydrologic maturity of forests (early seral-stages) in the rain-on-snow zones in Upper Wind, Falls Creek, Trout, and Panther Creek basins (USFS 2001). High road densities in Upper Wind, Trout, and Falls Creek basins are also likely contributors. Habitat diversity is affected by hydro-confinement, degraded riparian conditions, lack of LWD, and past practices including wood removals and splash dam logging. Channel straightening/confinement and floodplain isolation occur in the wind flats and mining reaches, where Hwy 30 parallels the river. Riparian manipulations have contributed to stream temperature impairments. Stream temperature is especially high in portions of Trout Creek and the middle Wind (wind flats and mining reach). Temperature problems in the Wind basin are also related to an increase in channel width-to-depth ratios (USFS 2001), which result from bank erosion and sedimentation.

Impacts from changes in biological community are of lesser magnitude than changes in hydrologic and stream corridor characteristics. There are however, minor concerns of competition with hatchery spring Chinook and brook trout in the middle wind and Trout Creek, respectively. There are also concerns regarding the impact of potential pathogens originating from the Carson Hatchery. The food resource has been increased in reach Wind 5c due to an increase in spring Chinook salmon carcasses since historical times.

Wind Fall Chinook

Reach Name	Channel stability	Habitat diversity	Temperature	Predation	Competition (other spp)	Competition (hatchery fish)	Withdrawals	Oxygen	Flow	Sediment	Food	Chemicals	Obstructions	Pathogens	Harassment / poaching	Key habitat quantity
Wind 2	•	•	•						•	•					•	•
Wind 1	•	●	⬤	●	•				•	●	•			•	●	⬤
Wind 3	●	•								•					•	+

High Impact ⬤ Moderate Impact ● Low Impact • None Low Positive Impact + Moderate Positve Impact ✚ High Positve Impact ✚

Figure P-21. Wind River fall Chinook habitat factor analysis diagram. Diagram displays the relative impact of habitat factors in specific reaches. The reaches are ordered according to their restoration and preservation rank, which factors in their potential benefit to overall population abundance, productivity, and diversity. The reach with the greatest potential benefit is listed at the top. The dots represent the relative degree to which overall population abundance would be affected if the habitat attributes were restored to template conditions. See Appendix E Chapter 6 for more information on habitat factor analysis diagrams.

Wind Chum

Reach Name	Channel stability	Habitat diversity	Temperature	Predation	Competition (other spp)	Competition (hatchery fish)	Withdrawals	Oxygen	Flow	Sediment	Food	Chemicals	Obstructions	Pathogens	Harassment / poaching	Key habitat quantity
Wind 2	•	●		•					•	•	•				●	●
Wind 1	•	●	•	•	•				•	•	•			•	●	⬤
Wind 3	•	●		•					•	•					•	•

High Impact ⬤ Moderate Impact ● Low Impact • None Low Positive Impact + Moderate Positve Impact ✚ High Positve Impact ✚

Figure P-22. Wind River chum habitat factor analysis diagram. Diagram displays the relative impact of habitat factors in specific reaches. The reaches are ordered according to their restoration and preservation rank, which factors in their potential benefit to overall population abundance, productivity, and diversity. The reach with the greatest potential benefit is listed at the top. The dots represent the relative degree to which overall population abundance would be affected if the habitat attributes were restored to template conditions. See Appendix E Chapter 6 for more information on habitat factor analysis diagrams.

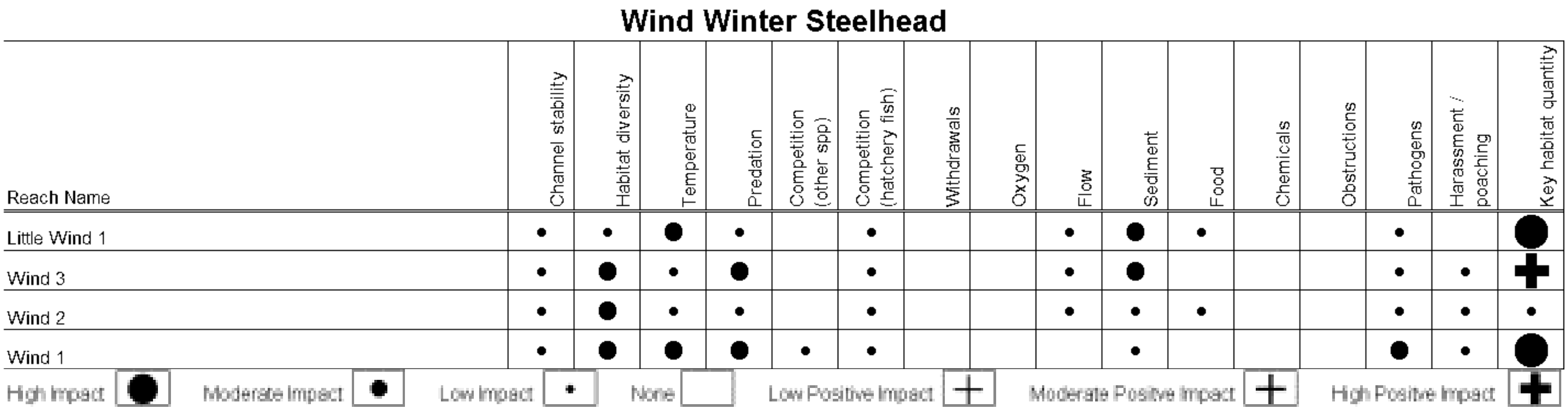


Figure P-23. Wind River winter steelhead habitat factor analysis diagram. Diagram displays the relative impact of habitat factors in specific reaches. The reaches are ordered according to their restoration and preservation rank, which factors in their potential benefit to overall population abundance, productivity, and diversity. The reach with the greatest potential benefit is listed at the top. The dots represent the relative degree to which overall population abundance would be affected if the habitat attributes were restored to template conditions. See Appendix E Chapter 6 for more information on habitat factor analysis diagrams.

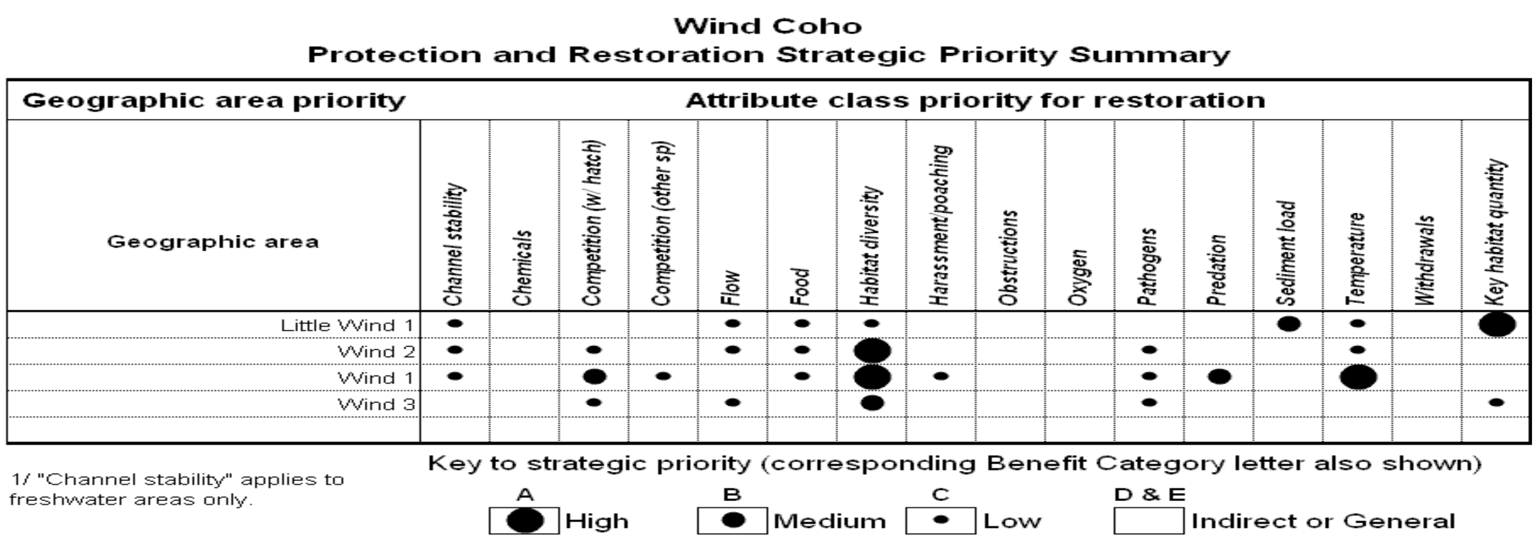


Figure P-24. Wind River coho habitat factor analysis diagram. This diagram differs slighlty from the diagrams for other Wind River populations in that the size of the dot only reflects the within-reach importance of habitat factors and does not reflect the importance of factors between reaches.

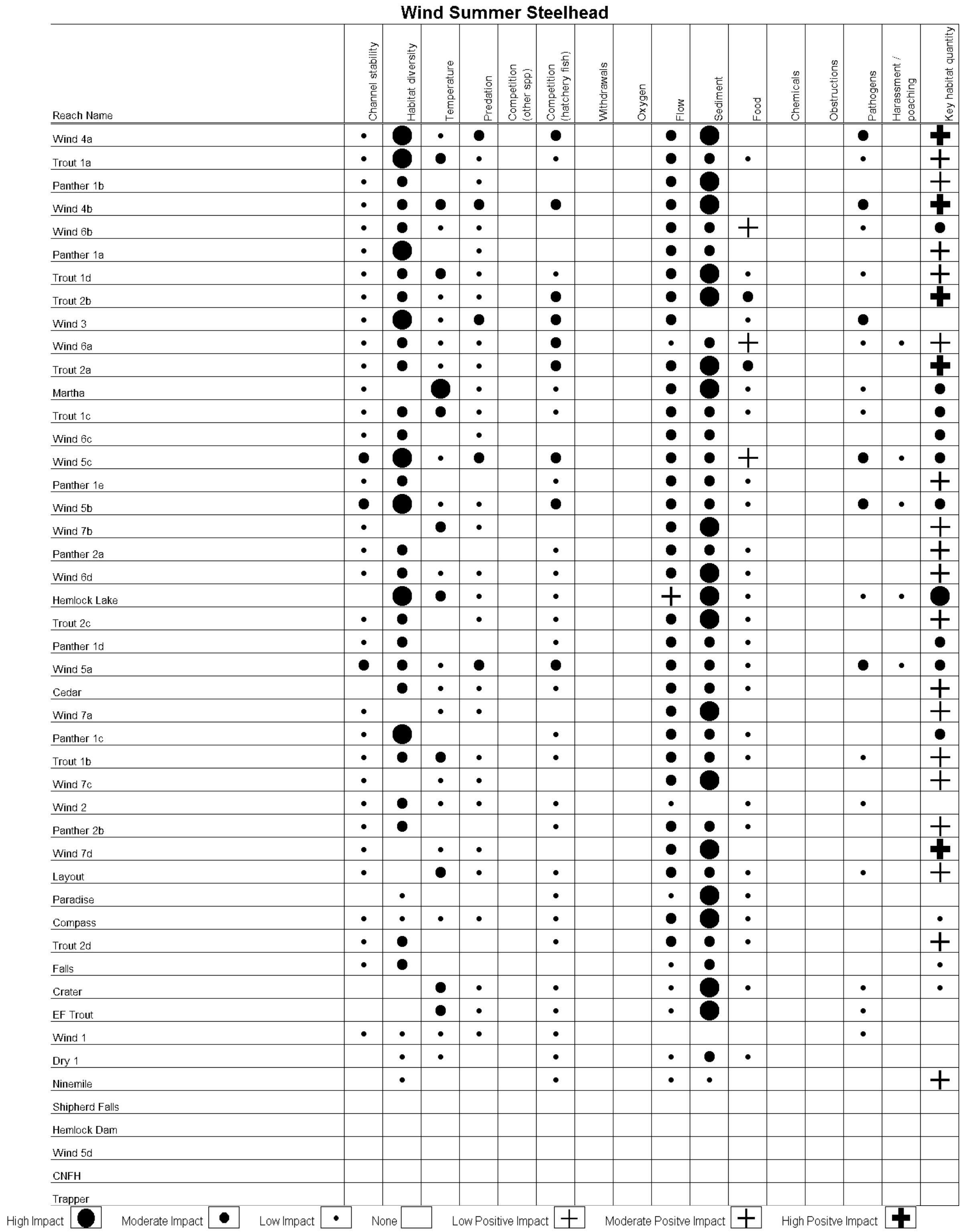


Figure P-25. Wind River summer steelhead habitat factor analysis diagram. Diagram displays the relative impact of habitat factors in specific reaches. The reaches are ordered according to their restoration and preservation rank, which factors in their potential benefit to overall population abundance, productivity, and diversity. The reach with the greatest potential benefit is listed at the top. The dots represent the relative degree to which overall population abundance would be affected if the habitat attributes were restored to template conditions. See Appendix E Chapter 6 for more information on habitat factor analysis diagrams.

P.3.6.Watershed Habitat Conditions

The historical and current watershed habitat acreage in the Wind River subbasin are displayed in Figure P-26 and summarized in Table P-19. The Northwest Habitat Institute (NHI) has compiled descriptions of each of these habitat types; these detailed descriptions are available on their Interactive Biodiversity Information System (IBIS) website (www.nwhi.org/ibis/home/ibis.asp) and are also included below; additional habitat data are available in Johnson and O'Neil (2001). IBIS (2004) mapping suggests an almost complete loss of the Interior Mixed Conifer Forest from historical to current conditions; concurrently, acreage of other forest types has increased substantially (Table P-19). It is unlikely that an actual shift in forest habitat types has occurred in the Wind River subbasin, rather the habitat changes noted from historical to current conditions appear to be an artifact of habitat mapping. For example, fire suppression and management have reduced the frequency, intensity, and size of fires throughout the region that historically maintained an open canopy, early seral stage Interior Mixed Conifer Forest. As a result, Interior Mixed Conifer Forests have transitioned to a late seral stage with a closed canopy and structure elements that are more characteristic of forests on the west side of the Cascades. Thus, it is likely that a substantial amount of Interior Mixed Conifer Forest acreage is still present in the Wind River subbasin, but this habitat type was incorrectly mapped because of its current forest structure.

Another factor that may contribute to possible mis-classified habitats during mapping is that the Wind River subbasin is located within the transition zone between the dry forest types typical of areas east of the Cascades and moist forest types typical of areas west of the Cascades. As a result, the eastside forest types in the Wind River subbasin are at the extreme end of the moisture gradient for these habitat types, while the westside forest types in the subbasin characterize drier conditions within the range possible for these habitat types. At each end of the moisture regime for the different habitat types (i.e. moist eastside forests and dry westside forests), there is considerable overlap in species composition and forest structure, which leads to possible mis-classification of habitat types.

Table P-19. Historical (1850) and current (1999) wildlife habitat acreage in the Wind River subbasin (IBIS 2004).

	Acreage			
Habitat Type	**Historical**	**Current**	**Change**	**% Change[a]**
Mesic Lowlands Conifer-Hardwood Forest	124,899	137,587	+12,688	+10
Montane Mixed Conifer Forest	31,803	46,468	+14,665	+46
Interior Mixed Conifer Forest	35,421	1,935	-33,486	-95
Lodgepole Pine Forest and Woodlands	741	8,241	+7,500	+1,000
Subalpine Parkland	1,523	-	-1,523	-100
Alpine Grasslands and Shrublands	118	406	+288	+244
Westside Riparian-Wetlands	1,228	-	-1,228	-100
Montane Coniferous Wetlands	-	890	+890	-
Open Water-Lakes, Rivers, and Streams	-	205	+205	-

[a] Old growth forests may be present in late seral stages of any of the forest habitat types.
[b] Riparian habitat may comprise microhabitat components within the forested or grassland habitat types or macro or microhabitat components within the wetland or open water habitat types.
[a] Represents the acreage change in relation to the historical acreage.

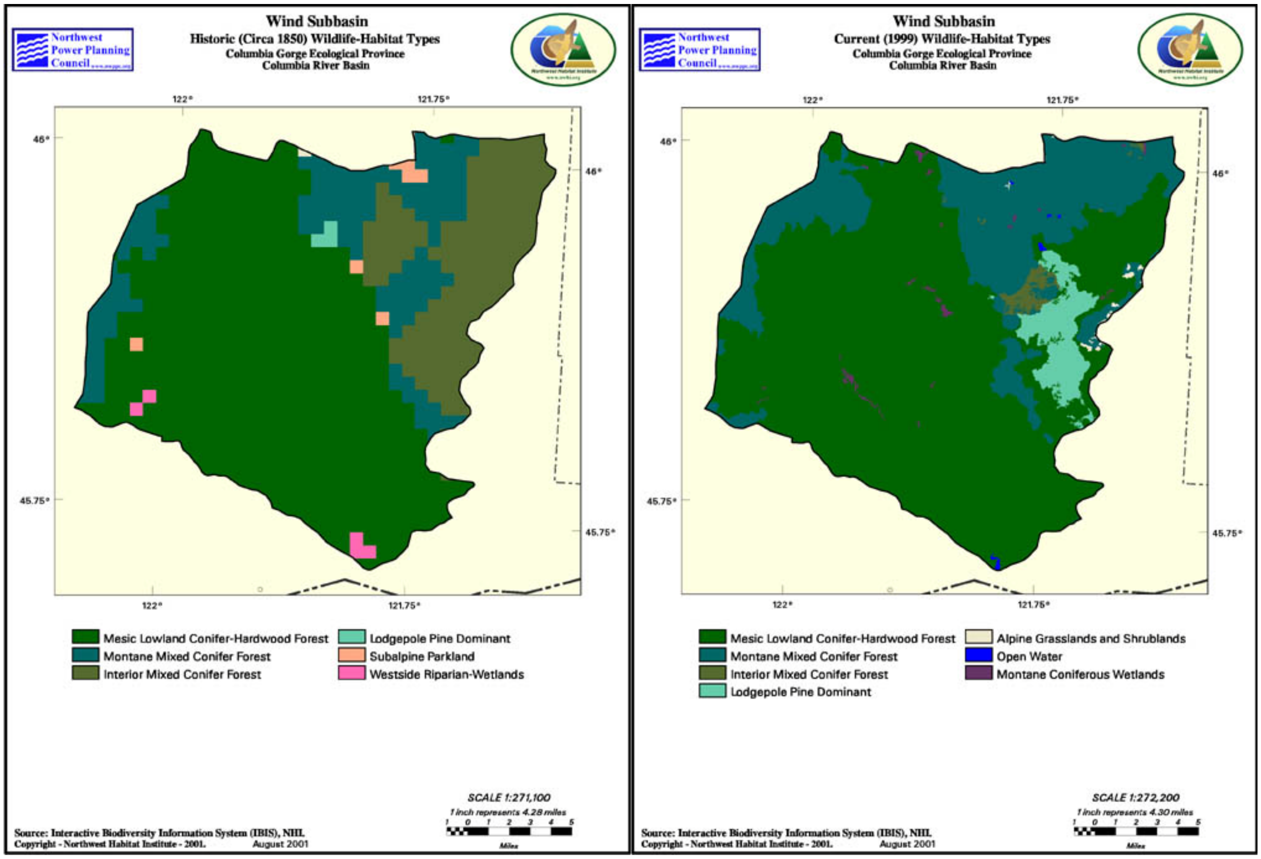


Figure P-26. Historical (1850) and current (1999) wildlife habitat in the Wind River subbasin (IBIS 2004).

Mesic Lowlands Conifer-Hardwood Forest

This forest habitat occurs throughout low-elevation western Washington, except on extremely dry or wet sites. Within the Wind River subbasin, there has been an increase in acreage of this habitat type from historical to current conditions (Table P-19), however, this appears to be an artifact of mapping instead of an actual habitat change. Climate that produces this habitat type is relatively mild and moist to wet. Mean annual precipitation is mostly 35-100 inches (90-254 cm), but can vary locally. Snowfall ranges from rare to regular, but is transitory. Summers are relatively dry. Elevation ranges from sea level to a maximum of about 2,000 ft (610 m) in much of northern Washington. Soils and geology are very diverse. Topography ranges from relatively flat glacial till plains to steep mountainous terrain.

This is the most extensive habitat in the lowlands on the westside of the Cascades and forms the matrix within which other habitats occur as patches, especially Westside Riparian-Wetlands and less commonly Herbaceous Wetlands or Open Water. Bordering this habitat at upper elevations is generally Montane Mixed Conifer Forest. The primary land use for this habitat is forestry.

Structure of this habitat type is forest, or rarely woodland, dominated by evergreen conifers, deciduous broadleaf trees, or both. Late seral stands typically have an abundance of large (>164 ft [50 m] tall) coniferous trees, a multi-layered canopy structure, large snags, and many large logs on the ground. Early seral stands typically have smaller trees, single-storied canopies, and may be dominated by conifers, broadleaf trees, or both. Coarse woody debris is abundant in early seral stands after natural disturbances but much less so after clearcutting. Forest understories are structurally diverse: evergreen shrubs tend to dominate on nutrient-poor or drier sites; deciduous shrubs, ferns, and/or forbs tend to dominate on relatively nutrient-rich or moist sites. Shrubs may be low (1.6 ft [0.5 m] tall), medium-tall (3.3-6.6 ft [1-2 m]), or tall (6.6-13.1 ft [2-4 m]). Almost all structural stages are represented in the successional sequence within this habitat. Mosses are often a major ground cover. Lichens are abundant in the canopy of old stands.

Western hemlock (*Tsuga heterophylla*) and Douglas-fir (*Pseudotsuga menziesii*) are the most characteristic species and 1 or both are typically present. Most stands are dominated by 1 or more of the following: Douglas-fir, western hemlock, western redcedar (*Thuja plicata*), Sitka spruce (*Picea sitchensis*), red alder (*Alnus rubra*), or bigleaf maple (*Acer macrophyllum*). Western white pine (*Pinus monticola*) is frequent but subordinate in importance through much of this habitat. Common small subcanopy trees are cascara buckthorn (*Rhamnus purshiana*) in more moist climates and Pacific yew (*Taxus brevifolia*) in somewhat drier climates or sites.

Dominant or co-dominant understory shrub species of more than local importance include salal (*Gaultheria shallon*), dwarf Oregongrape (*Mahonia nervosa*), vine maple (*Acer circinatum*), Pacific rhododendron (*Rhododendron macrophyllum*), salmonberry (*Rubus spectabilis*), trailing blackberry (*R. ursinus*), red elderberry (*Sambucus racemosa*), fools huckleberry (*Menziesia ferruginea*), beargrass (*Xerophyllum tenax*), oval-leaf huckleberry (*Vaccinium ovalifolium*), evergreen huckleberry (*V. ovatum*), and red huckleberry (*V. parvifolium*). Salal and rhododendron are particularly associated with low nutrient or relatively dry sites.

Swordfern (*Polystichum munitum*) is the most common herbaceous species and is often dominant on nitrogen-rich or moist sites. Other forbs and ferns that frequently dominate the understory are Oregon oxalis (*Oxalis oregana*), deerfern (*Blechnum spicant*), bracken fern (*Pteridium aquilinum*), vanillaleaf (*Achlys triphylla*), twinflower (*Linnaea borealis*), false lily-of-the-valley (*Maianthemum dilatatum*), western springbeauty (*Claytonia siberica*), foamflower (*Tiarella trifoliata*), inside-out flower (*Vancouveria hexandra*), and common whipplea (*Whipplea modesta*).

Fire is the major natural disturbance in all but the wettest climatic area, where wind becomes the major source of natural disturbance. Natural fire-return intervals generally range from about 100 years or less in the driest areas to several hundred years (Henderson et al. 1989, Morrison and Swanson 1990, Agee 1993). Major natural fires are associated with occasional extreme weather conditions (Agee 1993). Fires are typically high-severity, with few trees surviving. However, low- and moderate-severity fires that leave partial to complete live canopies are not uncommon, especially in drier climatic areas. Bark beetles and fungi are significant causes of mortality that typically operate on a small scale. Landslides are another natural disturbance that occur in some areas.

After a severe fire or blowdown, a typical stand will be briefly occupied by annual and perennial ruderal forbs and grasses as well as predisturbance understory shrubs and herbs that resprout (Halpern 1989). Herbaceous species generally give way to dominance by shrubs or a mixture of shrubs and young trees within a few years. If shrubs are dense and trees did not establish early, the site may remain as a shrubland for an indeterminate period. Early seral tree species can be any of the potential dominants for the habitat, depending on environment, type of disturbance, and seed source. All of these species except the short-lived red alder are capable of persisting for at least a few hundred years. Douglas-fir is the most common dominant after fire, but is uncommon in the wettest zones. It is also the most fire resistant of the trees in this habitat and survives moderate-severity fires well. After the tree canopy closes, the understory may become sparse, corresponding with the stem-exclusion stage (Oliver 1981). Eventually tree density will decrease and the understory will begin to flourish again, typically at stand age 60-100 years. As trees grow larger and a new generation of shade-tolerant understory trees (usually western hemlock, less commonly western redcedar) grows up, a multi-layered canopy will gradually develop and be well expressed by stand age 200-400 years (Franklin et al. 1981). Another fire is likely to return before the loss of shade-intolerant Douglas-fir from the canopy at stand age 800-1,000 years, unless the stand is located in the wet maritime zone. Throughout this habitat, western hemlock tends to increase in importance as stand development proceeds. Coarse woody debris peaks in abundance in the first 50 years after a fire and is least abundant at about stand age 100-200 years (Spies et al. 1988).

Red alder is more successful after typical logging disturbance than after fire alone on moist, nutrient-rich sites, perhaps because of the species' ability to establish abundantly on scarified soils (Haeussler and Coates 1986). Alder is much more common now because of large-scale logging activities (Franklin 1988). Alder grows more quickly in height early in succession than the conifers, thereby prompting many forest managers to apply herbicides for alder control. If alder is allowed to grow and dominate early successional stands, it will decline in importance after about 70 years and die out completely by age 100. Often there are suppressed conifers in the subcanopy that potentially can respond to the death of the alder canopy. However, salmonberry sometimes forms a dense shrub layer under the alder, which can exclude conifer regeneration (Franklin and Dyrness 1973). Salmonberry responds positively to soil disturbance, such as that associated with logging (Barber 1976). Bigleaf maple sprouts readily after logging and is therefore well adapted to increase after disturbance as well. Clearcut logging and plantation forestry have resulted in less diverse tree canopies, and have focused mainly on Douglas-fir, with reductions in coarse woody debris over natural levels, a shortened stand initiation phase, and succession truncated well before late-seral characteristics are expressed. Douglas-fir has been almost universally planted, even in wet coastal areas of Washington, where it is rare in natural stands.

This habitat type remains fairly common throughout the region; some loss has occurred, primarily to development in the Puget Lowland. Condition of what remains has been degraded by industrial forest practices at both the stand and landscape scale. Most of the habitat is probably now in Douglas-fir plantations. Only a fraction of the original old-growth forest remains, mostly in national forests in the Cascade and Olympic mountains. An increase in alternative silviculture practices may be improving structural and species diversity in some areas. However, intensive logging of natural-origin mature and young stands and even small areas of old growth continues.

Montane Mixed Conifer Forest

These forests occur in mountains throughout Washington and Oregon, excepting the Basin and Range of southeastern Oregon. Within the Wind River subbasin, there has been a sizable increase in acreage of this habitat type from historical to current conditions (Table P-19), however, this appears to be an artifact of mapping instead of an actual habitat change. The habitat is typified by a moderate to deep winter snow pack that persists for 3 to 9 months. The climate is moderately cool and wet to moderately dry and very cold. Mean annual precipitation ranges from about 40 inches (102 cm) to >200 inches (508 cm). Elevation is mid- to upper montane, as low as 2,000 ft (610 m) in northern Washington, to as high as 7,500 ft (2,287 m) in southern Oregon. On the westside, it occupies an elevational zone of about 2,500 to 3,000 vertical feet (762 to 914 m), and on the eastside it occupies a narrower zone of about 1,500 vertical feet (457 m). Topography is generally mountainous. Soils are typically not well developed, but varied in their parent material: glacial till, volcanic ash, residuum, or colluvium. Spodosols are common.

This habitat is found adjacent to Mesic Lowlands Conifer-Hardwood Forest at its lower elevation limits and to Subalpine Parkland at its upper elevation limits. Inclusions of Montane Forested Wetlands, Westside Riparian Wetlands, and less commonly Open Water or Herbaceous Wetlands occur within the matrix of montane forest habitat. The typical land use is forestry or recreation. Most of this type is found on public lands managed for timber values and much of it has been harvested in a dispersed-patch pattern.

Habitat structure is a forest, or rarely woodland, dominated by evergreen conifers. Canopy structure varies from single- to multi-storied. Tree size also varies from small to very large. Large snags and logs vary from abundant to uncommon. Understories vary in structure: shrubs, forbs, ferns, graminoids or some combination of these usually dominate, but they can be depauperate as well. Deciduous broadleaf shrubs are most typical as understory dominants. Early successional structure after logging or fire varies depending on understory species present. Mosses are a major ground cover and epiphytie lichens are typically abundant in the canopy.

Forest composition is recognized by the dominance or prominence of 1 of the following species: Pacific silver fir (*Abies amabilis*), mountain hemlock (*Tsuga mertensiana*), subalpine fir (*A. lasiocarpa*), Shasta red fir (*A. magnific var. shastensi*), Engelmann spruce (*Picea engelmannii*), noble fir (*A. procera*), or Alaska yellow-cedar (*Chamaecyparis nootkatensis*). Several other trees may co-dominate: Douglas-fir (*Pseudotsuga menziesii*), lodgepole pine (*Pinus contorta*), western hemlock (*Tsuga heterophylla*), western redcedar (*Thuja plicata*), or white fir (*A. concolor*). Tree regeneration is typically dominated by Pacific silver fir in moist westside middle-elevation zones and by mountain hemlock, sometimes with silver fir, in cool, very snowy zones on the westside and along the Cascade Crest.

Subalpine fir and Engelmann spruce are major species only east of the Cascade Crest in Washington. Douglas-fir is important east of the Cascade Crest and at lower elevations on the westside. Pacific silver fir is a major species on the westside as far south as central Oregon. Noble fir, as a native species, is found primarily in the western Cascades from central Washington to central Oregon. Mountain hemlock is a common dominant at higher elevations along the Cascade Crest and to the west. Western hemlock, and to a lesser degree western redcedar, occur as dominants primarily with silver fir at lower elevations on the westside. Alaska yellow-cedar occurs as a co-dominant west of the Cascade Crest in Washington, rarely in northern Oregon.

Deciduous shrubs that commonly dominate or co-dominate the understory are oval-leaf huckleberry (*Vaccinium ovalifolium*), big huckleberry (*V. membranaceum*), grouseberry (*V. scoparium*), dwarf huckleberry (*V. cespitosum*), fools huckleberry (*Menziesia ferruginea*), Cascade azalea (*Rhododendron albiflorum*), copperbush (*Elliottia pyroliflorus*), and devil's-club (*Oplopanax horridus*). Important evergreen shrubs include salal (*Gaultheria shallon*), dwarf Oregongrape (*Mahonia nervosa*), Pacific rhododendron (*Rhododendron macrophyllum*), deer oak (*Quercus sadleriana*), pinemat manzanita (*Arctostaphylos nevadensis*), beargrass (*Xerophyllum tenax*), and Oregon boxwood (*Paxistima myrsinites*).

Graminoid dominants are found primarily just along the Cascade Crest and to the east and include pinegrass (*Calamagrostis rubescens*), Geyer's sedge (*Carex geyeri*), smooth woodrush (*Luzula glabrata var. hitchcockii*), and long-stolon sedge (*Carex inops*). Deerfern (*Blechnum spicant*) and western oakfern (*Gymnocarpium dryopteris*) are commonly co-dominant. The most abundant forbs include Oregon oxalis (*Oxalis oregana*), single-leaf foamflower (*Tiarella trifoliata var. unifoliata*), rosy twisted-stalk (*Streptopus roseus*), queen's cup (*Clintonia uniflora*), western bunchberry (*Cornus unalaschkensis*), twinflower (*Linnaea borealis*), prince's pine (*Chimaphila umbellata*), five-leaved bramble (*Rubus pedatus*), and dwarf bramble (*R. lasiococcus*), sidebells (*Orthilia secunda*), avalanche lily (*Erythronium montanum*), Sitka valerian (*Valeriana sitchensis*), false lily-of-the-valley (*Maianthemum dilatatum*), and Idaho goldthread (*Coptis occidentalis*).

Fire is the major natural disturbance in this habitat. Fire regimes are primarily of the high-severity type (Agee 1993), but also include the moderate-severity regime (moderately frequent and highly variable) for Shasta red fir forests (Chappell and Agee 1996). Mean fire-return intervals vary greatly, from 800 years for some mountain hemlock-silver fir forests (Agee and Smith 1984) to about 40 years for red fir forests. Windstorms are a common small-scale disturbance and occasionally result in stand replacement. Insects and fungi are often important small-scale disturbances. However, they may affect larger areas also, for example, laminated root rot (*Phellinus weirii*) is a major natural disturbance, affecting large areas of mountain hemlock forests in the Oregon Cascades (Dickman and Cook 1989).

After fire, a typical stand will briefly be occupied by annual and perennial ruderal forbs and grasses, as well as predisturbance understory shrubs and herbs that resprout. Stand initiation can take a long time, especially at higher elevations, resulting in shrub/herb dominance (with or without a scattered tree layer) for extended periods (Hemstrom and Franklin 1982, Agee and Smith 1984). Early seral tree species can be any of the potential dominants for the habitat, or lodgepole pine, depending on the environment, type of disturbance, and seed source. Fires tend to favor early seral dominance of lodgepole pine, Douglas-fir, noble fir, or Shasta red fir, if their seeds are present (Agee 1993). In some areas, large stand-replacement fires will result in conversion of this habitat to the Lodgepole Pine Forest and Woodland habitat, distinguished by dominance of lodgepole. After the tree canopy closes, the understory typically becomes sparse for a time. Eventually tree density will decrease and the understory will begin to flourish again, but this process takes longer than in lower elevation forests, generally at least 100 years after the disturbance, sometimes much longer (Agee 1993). As stand development proceeds, relatively shade-intolerant trees (lodgepole pine, Douglas-fir, western hemlock, noble fir, Engelmann spruce) typically decrease in importance and more shade-tolerant species (Pacific silver fir, subalpine fir, Shasta red fir, mountain hemlock) increase. Complex multi-layered canopies with large trees will typically take at least 300 years to develop, often much longer, and on some sites may never develop. Tree growth rates, and therefore the potential to develop these structural features, tend to decrease with increasing elevation.

Forest management practices, such as clearcutting and plantations, have in many cases resulted in less diverse tree canopies with an emphasis on Douglas-fir. They also reduce coarse woody debris compared to natural levels, and truncate succession well before late-seral characteristics are expressed. Post-harvest regeneration of trees has been a perpetual problem for forest managers in much of this habitat (Gordon 1970, Atzet et al. 1984). Planting of Douglas-fir has often failed at higher elevations, even where old Douglas-fir were present in the unmanaged stand (Henderson et al. 1989). Slash burning often has negative impacts on productivity and regeneration (Ruth 1974). Management has since shifted away from burning and toward planting noble fir or native species, natural regeneration, and advance regeneration (Halverson and Emmingham 1982, Atzet et al. 1984). Noble fir plantations are now fairly common in managed landscapes, even outside the natural range of the species. Advance regeneration management tends to simulate wind disturbance but without the abundant downed wood component. Shelterwood cuts are a common management strategy in Engelmann spruce or subalpine fir stands (Williams et al. 1995).

This habitat type occupies large areas of the region. There has probably been little or no decline in the extent of this type over time. Large areas of this habitat are relatively undisturbed by human impacts and include significant old-growth stands. Other areas have been extensively affected by logging, especially dispersed patch clearcuts. The habitat is stable in area, but is probably still declining in condition because of continued logging. This habitat is one of the best protected, with large areas represented in national parks and wilderness areas. The only threat is continued road building and clearcutting in unprotected areas.

Interior Mixed Conifer Forest

The Interior Mixed Conifer Forest habitat appears primarily in the Blue Mountains, East Cascades, and Okanogan Highland Ecoregions of Oregon, Washington, adjacent Idaho, and western Montana. It also extends north into British Columbia. Within the Wind River subbasin, there has been a substantial loss of Interior Mixed Conifer Forest habitat from historical to current conditions (Table P-19), however, this appears to be an artifact of mapping instead of an actual habitat change.

Douglas-fir-ponderosa pine forests occur along the eastern slope of the Oregon and Washington Cascades, the Blue Mountains, and the Okanogan Highlands of Washington. Grand fir-Douglas-fir forests and western larch forests are widely distributed throughout the Blue Mountains and, lesser so, along the east slope of the Cascades south of Lake Chelan and in the eastern Okanogan Highlands. Western hemlock-western redcedar-Douglas-fir forests are found in the Selkirk Mountains of eastern Washington, and on the east slope of the Cascades south of Lake Chelan to the Columbia River Gorge.

The Interior Mixed Conifer Forest habitat is primarily mid-montane with an elevation range of between 1,000 and 7,000 ft (305-2,137 m), mostly between 3,000 and 5,500 ft (914-1,676 m). Parent materials for soil development vary. This habitat receives some of the greatest amounts of precipitation in the inland northwest, 30-80 inches (76-203 cm)/year. Elevation of this habitat varies geographically, with generally higher elevations to the east.

This habitat makes up most of the continuous montane forests of the inland Pacific Northwest. It is located between the subalpine portions of the Montane Mixed Conifer Forest habitat in eastern Oregon and Washington and lower tree line Ponderosa Pine and Forest and Woodlands.

Structure of the Interior Mixed Conifer habitat is montane forests and woodlands. Stand canopy structure is generally diverse, although single-layer forest canopies are currently more common than multilayered forests with snags and large woody debris. The tree layer varies from closed forests to more open-canopy forests or woodlands. This habitat may include very open stands. The undergrowth is complex and diverse. Tall shrubs, low shrubs, forbs or any combination may dominate stands. Deciduous shrubs typify shrub layers. Prolonged canopy closure may lead to development of sparsely vegetated undergrowth.

This habitat contains a wide array of tree species and stand dominance patterns. Douglas-fir (*Pseudotsuga menziesii*) is the most common tree species in this habitat. It is almost always present and dominates or co-dominates most overstories. Lower elevations or drier sites may have ponderosa pine (*Pinus ponderosa*) as a co-dominant with Douglas-fir in the overstory and often have other shade-tolerant tree species growing in the undergrowth. On moist sites, grand fir (*Abies grandis*), western redcedar (*Thuja plicata*) and/or western hemlock (*Tsuga heterophylla*) are dominant or co-dominant with Douglas-fir. Other conifers include western larch (*Larix occidentalis*) and western white pine (*Pinus monticola*) on mesic sites, Engelmann spruce (*Picea engelmannii*), lodgepole pine (*Pinus contorta*), and subalpine fir (*Abies lasiocarpa*) on colder sites. Rarely, Pacific yew (*Taxus brevifolia*) may be an abundant undergrowth tree or tall shrub.

Undergrowth vegetation varies from open to nearly closed shrub thickets with 1 to many layers. Throughout the eastside conifer habitat, tall deciduous shrubs include vine maple (*Acer circinatum*) in the Cascades, Rocky Mountain maple (*A. glabrum*), serviceberry (*Amelanchier alnifolia*), oceanspray (*Holodiscus discolor*), mallowleaf ninebark (*Physocarpus malvaceus*), and Scouler's willow (*Salix scouleriana*) at mid- to lower elevations. Medium-tall deciduous shrubs at higher elevations include fools huckleberry (*Menziesia ferruginea*), Cascade azalea (*Rhododendron albiflorum*), and big huckleberry (*Vaccinium membranaceum*). Widely distributed, generally drier site mid-height to short deciduous shrubs include baldhip rose (*Rosa gymnocarpa*), shiny-leaf spirea (*Spiraea betulifolia*), and snowberry (*Symphoricarpos albus, S. mollis,* and *S. oreophilus*). Low shrubs of higher elevations include low huckleberries (*Vaccinium cespitosum* and *V. scoparium*) and five-leaved bramble (*Rubus pedatus*). Evergreen shrubs represented in this habitat are chinquapin (*Castanopsis chrysophylla*), a tall shrub in southeastern Cascades, low to mid-height dwarf Oregongrape (*Mahonia nervosa* in the east Cascades and *M. repens* elsewhere), tobacco brush (*Ceanothus velutinus*), an increaser with fire, Oregon boxwood (*Paxistima myrsinites*) generally at mid- to lower elevations, beargrass (*Xerophyllum tenax*), pinemat manzanita (*Arctostaphylos nevadensis*) and kinnikinnick (*A. uva-ursi*).

Herbaceous broadleaf plants are important indicators of site productivity and disturbance. Species generally indicating productive sites include western oakfern (*Gymnocarpium dryopteris*), vanillaleaf (*Achlys triphylla*), wild sarsparilla (*Aralia nudicaulis*), wild ginger (*Asarum caudatum*), queen's cup

(*Clintonia uniflora*), goldthread (*Coptis occidentalis*), false bugbane (*Trautvetteria caroliniensis*), windflower (*Anemone oregana, A. piperi, A. lyallii*), fairybells (*Disporum hookeri*), Sitka valerian (*Valeriana sitchensis*), and pioneer violet (*Viola glabella*). Other indicator forbs are dogbane (*Apocynum androsaemifolium*), false solomonseal (*Maianthemum stellata*), heartleaf arnica (*Arnica cordifolia*), several lupines (*Lupinus caudatus, L. latifolius, L. argenteus ssp. argenteus var laxiflorus*), western meadowrue (*Thalictrum occidentale*), rattlesnake plantain (*Goodyera oblongifolia*), skunkleaf polemonium (*Polemonium pulcherrimum*), trailplant (*Adenocaulon bicolor*), twinflower (*Linnaea borealis*), western starflower (*Trientalis latifolia*), and several wintergreens (*Pyrola asarifolia, P. picta, Orthilia secunda*).

Graminoids are common in this forest habitat. Columbia brome (*Bromus vulgaris*), oniongrass (*Melica bulbosa*), northwestern sedge (*Carex concinnoides*) and western fescue (*Festuca occidentalis*) are found mostly in mesic forests with shrubs or mixed with forb species. Bluebunch wheatgrass (*Pseudoroegneria spicata*), Idaho fescue (*Festuca idahoensis*), and junegrass (*Koeleria macrantha*) are found in drier more open forests or woodlands. Pinegrass (*Calamagrostis rubescens*) and Geyer's sedge (*C. geyeri*) can form a dense layer under Douglas-fir or grand fir trees.

Fires were probably of moderate frequency (30-100 years) in presettlement times. Inland Pacific Northwest Douglas-fir and western larch forests have a mean fire interval of 52 years (Barrett et al. 1997). Typically, stand-replacement fire-return intervals are 150-500 years with moderate severity-fire intervals of 50-100 years. Specific fire influences vary with site characteristics. Generally, wetter sites burn less frequently and stands are older with more western hemlock and western redcedar than drier sites. Many sites dominated by Douglas-fir and ponderosa pine, which were formerly maintained by wildfire, may now be dominated by grand fir (a fire sensitive, shade-tolerant species).

Successional relationships of this type reflect complex interrelationships between site potential, plant species characteristics, and disturbance regime (Zack and Morgan 1994). Generally, early seral forests of shade-intolerant trees (western larch, western white pine, ponderosa pine, Douglas-fir) or tolerant trees (grand fir, western redcedar, western hemlock) develop some 50 years following disturbance. This stage is preceded by forb- or shrub- dominated communities. These early stage mosaics are maintained on ridges and drier topographic positions by frequent fires. Early seral forest develops into mid-seral habitat of large trees during the next 50-100 years. Stand replacing fires recycle this stage back to early seral stages over most of the landscape. Without high-severity fires, a late-seral condition develops either single-layer or multilayer structure during the next 100-200 years. These structures are typical of cool bottomlands that usually only experience low-intensity fires.

This habitat has been most affected by timber harvesting and fire suppression. Timber harvesting has focused on large shade-intolerant species in mid- and late-seral forests, leaving shade-tolerant species. Fire suppression reinforces those logging priorities by promoting less fire-resistant, shade-intolerant trees. The resultant stands at all seral stages tend to lack snags, have high tree density, and are composed of smaller and more shade-tolerant trees. Mid-seral forest structure is currently 70% more abundant than in historical, native systems (Quigley and Arbelbide 1997). Late-seral forests of shade-intolerant species are now essentially absent. Early-seral forest abundance is similar to that found historically but lacks snags and other legacy features.

Quigley and Arbelbide (1997) concluded that the Interior Douglas-fir, Grand fir, and Western redcedar/Western hemlock cover types are more abundant now than before 1900, whereas the Western larch and Western white pine types are significantly less abundant. Twenty percent of Pacific Northwest Douglas-fir, grand fir, western redcedar, western hemlock, and western white pine associations listed in the National Vegetation Classification are considered imperiled or critically imperiled (Anderson et al. 1998). Roads, timber harvest, periodic grazing, and altered fire regimes have compromised these forests. Even though this habitat is more extensive than pre-1900, natural processes and functions have been modified enough to alter its natural status as functional habitat for many species.

Lodgepole Pine Forest and Woodlands

This habitat is found along the eastside of the Cascade Range, in the Blue Mountains, the Okanogan Highlands and ranges north into British Columbia and south to Colorado and California. Within the Wind River subbasin, there has been a substantial acreage increase of Lodgepole Pine Forest habitat from historical to current conditions (Table P-19) however, this may be an artifact of mapping instead of an actual habitat change.

This habitat is located mostly at mid- to higher elevations (3,000-9,000 ft [914-2,743 m]). These environments can be cold and relatively dry, usually with persistent winter snowpack. A few of these forests occur in low-lying frost pockets, wet areas, or under edaphic control (usually pumice) and are relatively long-lasting features of the landscape. Lodgepole pine habitat appears within Montane Mixed Conifer Forest east of the Cascade crest and the cooler Eastside Mixed Conifer Forest habitats.

The lodgepole pine habitat is composed of open to closed evergreen conifer tree canopies. Vertical structure is typically a single tree layer. Reproduction of other more shade-tolerant conifers can be abundant in the undergrowth. Several distinct undergrowth types develop under the tree layer: evergreen or deciduous medium-tall shrubs, evergreen low shrub, or graminoids with few shrubs. On pumice soils, a sparsely developed shrub and graminoid undergrowth appears with open to closed tree canopies.

The tree layer of this habitat is dominated by lodgepole pine (*Pinus contorta var. latifolia* and *P. c. var. murrayana*), but it is usually associated with other montane conifers (*Abies concolor, A. grandis, A. magnifici var. shastensi, Larix occidentalis, Calocedrus decurrens, Pinus lambertiana, P. monticola, P. ponderosa, Pseudotsuga menziesii*). Subalpine fir (*Abies lasiocarpa*), mountain hemlock (*Tsuga mertensiana*), Engelmann spruce (*Picea engelmannii*), and whitebark pine (*Pinus albicaulis*), indicators of subalpine environments, are present in colder or higher sites. Quaking aspen (*Populus tremuloides*) sometimes occur in small numbers.

Shrubs can dominate the undergrowth. Tall deciduous shrubs include Rocky Mountain maple (*Acer glabrum*), serviceberry (*Amelanchier alnifolia*), oceanspray (*Holodiscus discolor*), or Scouler's willow (*Salix scouleriana*). These tall shrubs often occur over a layer of mid-height deciduous shrubs such as baldhip rose (*Rosa gymnocarpa*), russet buffaloberry (*Shepherdia canadensis*), shiny-leaf spirea (*Spiraea betulifolia*), and snowberry (*Symphoricarpos albus* and/or *S. mollis*). At higher elevations, big huckleberry (*Vaccinium membranaceum*) can be locally important, particularly following fire. Mid-tall evergreen shrubs can be abundant in some stands, for example, creeping Oregongrape (*Mahonia repens*), tobacco brush (*Ceanothus velutinus*), and Oregon boxwood (*Paxistima myrsinites*). Colder and drier sites support low- growing evergreen shrubs, such as kinnikinnick (*Arctostaphylos uva-ursi*) or pinemat manzanita (*A. nevadensis*). Grouseberry (*V. scoparium*) and beargrass (*Xerophyllum tenax*) are consistent evergreen low shrub dominants in the subalpine part of this habitat. Manzanita (*Arctostaphylos patula*), kinnikinnick, tobacco brush, antelope bitterbrush (*Purshia tridentata*), and wax current (*Ribes cereum*) are part of this habitat on pumice soil.

Some undergrowth is dominated by graminoids with few shrubs. Pinegrass (*Calamagrostis rubescens*) and/or Geyer's sedge (*Carex geyeri*) can appear with grouseberry in the subalpine zone. Pumice soils support grassy undergrowth of long-stolon sedge (*C. inops*), Idaho fescue (*Festuca idahoensis*) or western needlegrass (*Stipa occidentalis*). The latter 2 species may occur with bitterbrush or big sagebrush and other bunchgrass steppe species. Other nondominant indicator graminoids frequently encountered in this habitat are California oatgrass (*Danthonia californica*), blue wildrye (*Elymus* *glaucus*), Columbia brome (*Bromus vulgaris*) and oniongrass (*Melica bulbosa*). Kentucky bluegrass (*Poa pratensis*), and bottlebrush squirreltail (*Elymus elymoides*) can be locally abundant where livestock grazing has persisted.

The forb component of this habitat is diverse and varies with environmental conditions. A partial forb list includes goldthread (*Coptis occidentalis*), false solomonseal (*Maianthemum stellata*), heartleaf arnica (*Arnica cordifolia*), several lupines (*Lupinus caudatus, L. latifolius, L. argenteus ssp. argenteus var. laxiflorus*), meadowrue (*Thalictrum occidentale*), queen's cup (*Clintonia uniflora*), rattlesnake plantain (*Goodyera oblongifolia*), skunkleaf polemonium (*Polemonium pulcherrimum*), trailplant (*Adenocaulon bicolor*), twinflower (*Linnaea borealis*), Sitka valerian (*Valeriana sitchensis*), western starflower (*Trientalis latifolia*), and several wintergreens (*Pyrola asarifolia, P. picta, Orthilia secunda*).

This habitat typically reflects early successional forest vegetation that originated with fires. Inland Pacific Northwest lodgepole pine has a mean fire interval of 112 years (Barrett et al. 1997). Summer drought areas generally have low to medium-intensity ground fires occurring at intervals of 25-50 years, whereas areas with more moisture have a sparse undergrowth and slow fuel build-up that results in less frequent, more intense fire. With time, lodgepole pine stands increase in fuel loads. Woody fuels accumulate on the forest floor from insect (mountain pine beetle) and disease outbreaks and residual wood from past fires. Mountain pine beetle outbreaks thin stands that add fuel and create a drier environment for fire or open canopies and create gaps for other conifer regeneration. High-severity crown fires are likely in young stands, when the tree crowns are near deadwood on the ground. After the stand opens up, shade-tolerant trees increase in number.

Most Lodgepole Pine Forest and Woodlands are early- to mid seral stages initiated by fire. Typically, lodgepole pine establishes within 10-20 years after fire. This can be a gap phase process where seed sources are scarce. Lodgepole stands break up after 100-200 years. Without fires and insects, stands become more closed-canopy forest with sparse undergrowth. Because lodgepole pine cannot reproduce under its own canopy, old unburned stands are replaced by shade-tolerant conifers. Lodgepole pine on pumice soils is not seral to other tree species; these extensive stands, if not burned, thin naturally, with lodgepole pine regenerating in patches. On poorly drained pumice soils, quaking aspen sometimes plays a mid-seral role and is displaced by lodgepole when aspen clones die. Serotinous cones (cones releasing seeds after fire) are uncommon in eastern Oregon lodgepole pine (*P. c. var. murrayana*). On the Colville National Forest in Washington, only 10% of lodgepole pine (*P. c. var. latifolia*) trees in low-elevation Douglas-fir habitats had serotinous cones, whereas 82% of cones in high-elevation subalpine fir habitats were serotinous (Ahlenslager 1987).

Fire suppression has left many single- canopy lodgepole pine habitats unburned to develop into more multilayered stands. Thinning of serotinous lodgepole pine forests with fire intervals <20 years can reduce their importance over time. In pumice-soil lodgepole stands, lack of natural regeneration in harvest units has lead to creation of "pumice deserts" within otherwise forested habitats (Cochran 1985).

Quigley and Arbelbide (1997) concluded that the extent of the lodgepole pine cover type in Oregon and Washington is the same as before 1900 and in regions may exceed its historical extent. Five percent of Pacific Northwest lodgepole pine associations listed in the National Vegetation Classification are considered imperiled (Anderson et al. 1998). At a finer scale, these forests have been fragmented by roads, timber harvest, and influenced by periodic livestock grazing and altered fire regimes.

Subalpine Parkland

The Subalpine Parkland habitat occurs throughout the high mountain ranges of Washington and Oregon (e.g., Cascade crest, Olympic Mountains, Wallowa and Owyhee Mountains, and Okanogan Highlands), extends into mountains of Canada and Alaska, and to the Sierra Nevada and Rocky Mountains. Within the Wind River subbasin, this habitat type was present historically but was not present during recent mapping efforts (Table P-19).

Climate is characterized by cool summers and cold winters with deep snowpack, although much variation exists among specific vegetation types. Mountain hemlock sites receive an average precipitation of >50 inches (127 cm) in 6 months and several feet of snow typically accumulate. Whitebark pine sites receive 24-70 inches (61-178 cm) per year and some sites only rarely accumulate a significant snowpack. Summer soil drought is possible in eastside parklands but rare in westside areas. Elevation varies from 4,500 to 6,000 ft (1,371 to 1,829 m) in the western Cascades and Olympic Mountains and from 5,000 to 8,000 ft (1,524 to 2,438 m) in the eastern Cascades and Wallowa mountains.

The Subalpine Parkland habitat lies above the Mixed Montane Conifer Forest or Lodgepole Pine Forest habitat and below the Alpine Grassland and Shrubland habitat. Associated wetlands in subalpine parklands extend up a short distance into the alpine zone. Primary land use is recreation, watershed protection, and grazing.

Subalpine Parkland habitat has a tree layer typically between 10 and 30% canopy cover. Openings among trees are highly variable. The habitat appears either as parkland, that is, a mosaic of treeless openings and small patches of trees often with closed canopies, or as woodlands or savanna-like stands of scattered trees. The ground layer can be composed of (1) low to matted dwarf-shrubs (<1 ft [0.3 m] tall) that are evergreen or deciduous and often small-leaved; (2) sod grasses, bunchgrasses, or sedges; (3) forbs; or (4) moss- or lichen-covered soils. Herb or shrub-dominated wetlands appear within the parkland areas and are considered part of this habitat; wetlands can occur as deciduous shrub thickets up to 6.6 ft (2 m) tall, as scattered tall shrubs, as dwarf shrub thickets, or as short herbaceous plants <1.6 ft (0.5 m) tall. In general, western Cascades and Olympic areas are mostly parklands composed of a mosaic of patches of trees interspersed with heather shrublands or wetlands, whereas, eastern Cascades and Rocky mountain areas are parklands and woodlands typically dominated by grasses or sedges, with fewer heathers.

Species composition in this habitat varies with geography or local site conditions. The tree layer can be composed of 1 or several tree species. Subalpine fir (*Abies lasiocarpa*), Engelmann spruce (*Picea engelmannii*) and lodgepole pine (*Pinus contorta*) are found throughout the Pacific Northwest. Alaska yellowcedar (*Chamaecyparis nootkatensis*), Pacific silver fir (*A. amabilis*), and mountain hemlock (*Tsuga mertensiana*) are most common in the Olympics and Cascades. Whitebark pine (*P. albicaulis*) is found primarily in the eastern Cascade mountains Okanogan Highlands, and Blue Mountains.

West Cascades and Olympic areas generally are parklands. Tree islands often have big huckleberry (*Vaccinium membranaceum*) in the undergrowth interspersed with heather shrublands between. Openings are composed of pink mountain-heather (*Phyllodoce empetriformis*), and white mountain-heather (*Cassiope mertensiana*) and Cascade blueberry (*Vaccinium deliciosum*). Drier areas are more woodland or savanna like, often with low shrubs, such as common juniper (*Juniperus communis*), kinnikinnick (*Arctostaphylos uva-ursi*), low whortleberries or grouseberries (*Vaccinium myrtillus* or *V. scoparium*) or beargrass (*Xerophyllum tenax*) dominating the undergrowth. Wetland shrubs in the Subalpine Parkland habitat include bog-laurel (*Kalmia microphylla*), Booth's willow (*Salix boothii*), undergreen willow (*S. commutata*), Sierran willow (*S. eastwoodiae*), and blueberries (*Vaccinium uliginosum* or *V. deliciosum*)

Undergrowth in drier areas may be dominated by pinegrass (*Calamagrostis rubescens*), Geyer's sedge (*Carex geyeri*), Ross' sedge (*C. rossii*), smooth woodrush (*Luzula glabrata var. hitchcockii*), Drummond's rush (*Juncus drummondii*), or short fescues (*Festuca viridula, F. brachyphylla, F. saximontana*). Various sedges are characteristic of wetland graminoid-dominated habitats: black (*Carex nigricans*), Holm's

Rocky Mountain (*C. scopulorum*), Sitka (*C. aquatilis var. dives*) and Northwest Territory (*C. utriculatia*) sedges. Tufted hairgrass (*Deschampsia caespitosa*) is characteristic of subalpine wetlands.

The remaining flora of this habitat is diverse and complex. The following herbaceous broadleaf plants are important indicators of differences in the habitat: American bistort (*Polygonum bistortoides*), American false hellebore (*Veratrum viride*), fringe leaf cinquefoil (*Potentilla flabellifolia*), marsh marigolds (*Caltha leptosepala*), avalanche lily (*Erythronium montanum*), partridgefoot (*Luetkea pectinata*), Sitka valerian (*Valeriana sitchensis*), subalpine lupine (*Lupinus arcticus ssp. subalpinus*), and alpine aster (*Aster alpigenus*). Showy sedge (*Carex spectabilis*) is also locally abundant.

Although fire is rare to infrequent in this habitat, it plays an important role, particularly in drier environments. Whitebark pine woodland fire intervals varied from 50 to 300 years before 1900. Mountain hemlock parkland fire reoccurrence is 400-800 years. Wind blasting by ice and snow crystals is a critical factor in these woodlands and establishes the higher limits of the habitat. Periodic shifts in climatic factors, such as drought, snowpack depth, or snow duration either allow tree invasions into meadows and shrublands or eliminate or retard tree growth. Volcanic activity plays a long-term role in establishing this habitat. Wetlands are usually seasonally or perennially flooded by snowmelt and springs, or by subirrigation.

Succession in this habitat occurs through a complex set of relationships between vegetation response to climatic shifts and catastrophic disturbance, and plant species interactions and site modification that create microsites. A typical succession of subalpine trees into meadows or shrublands begins with the invasion of a single tree, subalpine fir and mountain hemlock in the wetter climates and whitebark pine and subalpine larch in drier climates. If the environment allows, tree density slowly increases (over decades to centuries) through seedlings or branch layering by subalpine fir. The tree patches or individual trees change the local environment and create microsites for shade-tolerant trees, Pacific silver fir in wetter areas, and subalpine fir and Engelmann spruce in drier areas. Whitebark pine, an early invading tree, is dispersed long distances by Clark's nutcrackers and shorter distances by mammals. Most other tree species are wind dispersed.

Fire suppression has contributed to change in habitat structure and functions. For example, the current "average" whitebark pine stand will burn every 3,000 years or longer because of fire suppression. Blister rust, an introduced pathogen, is increasing whitebark pine mortality in these woodlands (Ahlenslager 1987). Even limited logging can have prolonged effects because of slow invasion rates of trees. This is particularly important on drier sites and in subalpine larch stands. During wet cycles, fire suppression can lead to tree islands coalescing and the conversion of parklands into a more closed forest habitat. Parkland conditions can displace alpine conditions through tree invasions. Livestock use and heavy horse or foot traffic can lead to trampling and soil compaction. Slow growth in this habitat prevents rapid recovery.

This habitat is generally stable with local changes to particular tree variants. Whitebark pine maybe declining because of the effects of blister rust or fire suppression that leads to conversion of parklands to more closed forest. Global climate warming will likely have an amplified effect throughout this habitat. Less than 10% of Pacific Northwest subalpine parkland community types listed in the National Vegetation Classification are considered imperiled (Anderson et al. 1998).

Alpine Grasslands and Shrublands

This habitat occurs in high mountains throughout the region, including the Cascades, Olympic Mountains, Okanogan Highlands, Wallowa Mountains, Blue Mountains, Steens Mountain in southeastern Oregon, and, rarely, the Siskiyous. It is most extensive in the Cascades from Mount Rainier north and in the Wallowa Mountains. Within the Wind River subbasin, habitat acreage of alpine grasslands and shrublands has increased 244% from historical to current conditions, although this habitat type represents a small portion of the total subbasin acreage (Table P-19).

The climate is the coldest of any habitat in the region. Winters are characterized by moderate to deep snow accumulations, very cold temperatures, and high winds. Summers are relatively cool. Growing seasons are short because of persistent snow pack or frost. Blowing snow and ice crystals on top of the snow pack at and above treeline prevent vegetation such as trees from growing above the depth of the snow pack. Snow pack protects vegetation from the effects of this winter wind-related disturbance and from excessive frost heaving. Community composition is much influenced by relative duration of snow burial and exposure to wind and frost heaving 75. Elevation ranges from a minimum of 5,000 ft (1,524 m) in parts of the Olympics to 10,000 ft (3,048 m). The topography varies from gently sloping broad ridgetops, to glacial cirque basins, to steep slopes of all aspects. Soils are generally poorly developed and shallow, though in subalpine grasslands they may be somewhat deeper or better developed. Geologic parent material varies with local geologic history.

This habitat always occurs above upper treeline in the mountains or a short distance below it (grasslands in the subalpine parkland zone). Typically, it occurs adjacent to, or in a mosaic with, Subalpine Parkland. Occasionally, it may grade quickly from this habitat down into Montane Mixed Conifer Forest without intervening Subalpine Parkland. Small areas of Open Water, Herbaceous Wetlands, and Subalpine Parkland habitats sometimes occur within a matrix of this habitat. Cliffs, talus, and other barren areas are common features within or adjacent to this habitat. Land use is primarily recreation, but in some areas east of the Cascade Crest, it is grazing, especially by sheep.

Structure of this habitat is dominated by grassland, dwarf-shrubland (mostly evergreen microphyllous), or forbs. Cover of the various life forms is extremely variable, and total cover of vascular plants can range from sparse to complete. Patches of krummholz (coniferous tree species maintained in shrub form by extreme environmental conditions) are a common component of this habitat, especially just above upper treeline. In subalpine grasslands, which are considered part of this habitat, widely scattered coniferous trees sometimes occur. Five major structural types can be distinguished: (1) subalpine and alpine bunchgrass grasslands, (2) alpine sedge turf, (3) alpine heath or dwarf-shrubland, (4) fellfield and boulderfield, and (5) snowbed forb community. Fellfields have a large amount of bare ground or rocks with a diverse and variable open layer of forbs, graminoids, and less commonly dwarf-shrubs. Snowbed forb communities have relatively sparse cover of few species of mainly forbs. In the alpine zone, these types often occur in a complex fine-scale mosaic with each other.

Most subalpine or alpine bunchgrass grasslands are dominated by Idaho fescue (*Festuca idahoensis*), alpine fescue (*F. brachyphylla*), green fescue (*F. viridula*), Rocky Mountain fescue (*F. saximontana*), or timber oatgrass (*Danthonia intermedia*), and to a lesser degree, purple reedgrass (*Calamagrostis purpurascens*), downy oat-grass (*Trisetum spicatum*) or muttongrass (*Poa fendleriana*). Forbs are diverse and sometimes abundant in the grasslands. Alpine sedge turfs may be moist or dry and are dominated by showy sedge (*Carex spectabilis*), black alpine sedge (*C. nigricans*), Brewer's sedge (*C. breweri*), capitate sedge (*C. capitata*), nard sedge (*C. nardina*), dunhead sedge (*C. phaeocephala*), or western single-spike sedge (*C. pseudoscirpoidea*).

One or more of the following species dominates alpine heaths: pink mountain-heather (*Phyllodoce empetriformis*), green mountain-heather (*P. glanduliflora*), white mountain-heather (*Cassiope mertensiana*), or black crowberry (*Empetrum nigrum*). Other less extensive dwarf-shrublands may be dominated by the evergreen coniferous common juniper (*Juniperus communis*), the evergreen broadleaf kinnikinnick (*Arctostaphylos uva-ursi*), the deciduous shrubby cinquefoil (*Pentaphylloides floribunda*) or willows (*Salix cascadensis* and *S. reticulata ssp. nivalis*). Tree species occurring as shrubby krummholz in the alpine are subalpine fir (*Abies lasiocarpa*), whitebark pine (*Pinus albicaulis*), mountain hemlock (*Tsuga mertensiana*), Engelmann spruce (*Picea engelmannii*), and subalpine larch (*Larix lyallii*).

Fellfields and similar communities are typified by variable species assemblages and co-dominance of multiple species, including any of the previously mentioned species, especially the sedges, as well as golden fleabane (*Erigeron aureus*), Lobb's lupine (*Lupinus sellulus var. lobbii*), spreading phlox (*Phlox diffusa*), eight-petal mountain-avens (*Dryas octopetala*), louseworts (*Pedicularis contorta, P. ornithorhyncha*) and many others. Snowbed forb communities are dominated by Tolmie's saxifrage (*Saxifraga tolmiei*), Shasta buckwheat (*Eriogonum pyrolifolium*), or Piper's woodrush (*Luzula piperi*).

Most natural disturbances seem to be small scale in their effects or very infrequent. Herbivory and associated trampling disturbance by elk, mountain goats, and occasionally bighorn sheep seems to be an important disturbance in some areas, creating patches of open ground, though the current distribution and abundance of these ungulates is in part a result of introductions. Small mammals can also have significant effects on vegetation: e.g., the heather vole occasionally overgrazes heather communities (Edwards 1980). Frost heaving is a climatically related small-scale disturbance that is extremely important in structuring the vegetation (Edwards 1980). Extreme variation from the norm in snow pack depth and duration can act as a disturbance, exposing plants to winter dessication (Edwards 1980), shortening the growing season, or facilitating summer drought. Subalpine grasslands probably burn on occasion and can be formed or expanded in area by fires in subalpine parkland (Kuramoto and Bliss 1970).

Little is known about vegetation changes in these communities, in part because changes are relatively slow. Tree invasion rates into subalpine grasslands are relatively slow compared to other subalpine communities (Kuramoto and Bliss 1970). Seedling establishment for many plant species in the alpine zone is poor. Heath communities take about 200 years to mature after initial establishment and may occupy the same site for thousands of years (Kuramoto and Bliss 1970).

The major human impacts on this habitat are trampling and associated recreational impacts (e.g., tent sites). Resistance and resilience of vegetation to impacts varies by life form (Cole 1977). Sedge turfs are perhaps most resilient to trampling and heaths are least resilient. Trampling to the point of significantly opening an alpine heath canopy will initiate a degradation and erosion phase that results in continuous bare ground, largely unsuitable for vascular plant growth (Edwards 1980). Bare ground in the alpine zone left alone after recreational disturbance will typically not revegetate in a noticeable time frame. Introduction of exotic ungulates can have noticeable impacts (e.g., mountain goats in the Olympic Mountains). Domestic sheep grazing has also had dramatic impacts (Strickler and Hall 1980), especially in the bunchgrass habitats east of the Cascades.

This habitat is naturally very limited in extent in the region. There has been little to no change in abundance over the last 150 years. Most of this habitat is still in good condition and dominated by native species. Some areas east of the Cascade Crest have been degraded by livestock use. Recreational impacts are noticeable in some national parks and wilderness areas. Current trends seem to be largely stable, though there may be some slow loss of subalpine grassland to recent tree invasion. Threats include increasing recreational pressures, continued grazing at some sites, and, possibly, global climate change resulting in expansion of trees into this habitat.

Westside Riparian-Wetlands

This habitat is patchily distributed in the lowlands and low mountains throughout the area west of the Cascade Crest south into northwestern California and north into British Columbia. It also occurs less extensively at mid- to higher elevations in the Cascade and Olympic mountains, where it is limited to more specific environments. Within the Wind River subbasin, this habitat type was present historically but was not present during recent mapping efforts (Table P-19). It is not clear whether there has been an actual loss of Westside Riparian-Wetlands within the Wind River subbasin or the estimated habitat loss is an artifact of mapping. The loss of 1,228 acres of Westside Riparian-Wetlands was accompanied by the addition of 890 acres of Montane Coniferous Wetlands and 205 acres of Open Water habitat (Table P-19).

This habitat is characterized by wetland hydrology or soils, periodic riverine flooding, or perennial flowing freshwater. The climate varies from very wet to moderately dry and from mild to cold. Mean annual precipitation ranges from 20 to >150 inches (51 to >381 cm) per year. This habitat is found at elevations mostly below 3,000 ft (914 m), but it does extend up to 5,500 ft (1,676 m) in Washington and 6,500 ft (1,981 m) in Oregon in the form of Sitka alder communities. Topography is typically flat to gently sloping or undulating, but can include moderate to steep slopes in the mountains. Geology is extremely variable; gleyed or mottled mineral soils, organic soils, or alluvial soils are typical. Flooding regimes include permanently flooded (aquatic portion of small streams), seasonally flooded, saturated and temporarily flooded.

This habitat typically occupies patches or linear strips within a matrix of forest or regrowing forest. The most frequent matrix habitat is Westside Lowlands Conifer-Hardwood Forest. This habitat also forms mosaics with or includes small patches of Herbaceous Wetlands. Open Water habitat is often adjacent to Westside Riparian-Wetlands. The major land use of the forested portions of this habitat is timber harvest. Livestock grazing occurs in some areas. Peat mining occurs in some bogs.

Most often this habitat is either a tall (6-30 ft [2-10m]) deciduous broadleaf shrubland, woodland or forest, or some mosaic of these. Short to medium-tall evergreen shrubs or graminoids and mosses dominate portions of bogs. Trees are evergreen conifers or deciduous broadleaf or a mixture of both. Conifer-dominated wetlands in the lowlands are included here whereas mid-elevation conifer sites are part of Montane Coniferous Wetland habitat. Height of the dominant vegetation can be >200 ft (62 m). Canopy height and structure varies greatly. Typical understories are composed of shrubs, forbs, and/or graminoids. Water is sometimes present on the surface for a portion of the year. Large woody debris is abundant in late seral forests and adjacent stream channels. Small stream channels and small backwater channels on larger streams are included in this habitat.

Red alder (*Alnus rubra*) is the most widespread tree species, but is absent from sphagnum bogs. Other deciduous broadleaf trees that commonly dominate or co-dominate include black cottonwood (*Populus balsamifera* ssp. *trichocarpa*), bigleaf maple (*Acer macrophyllum*), Oregon ash (*Fraxinus latifolia*), and, locally, white alder (*Alnus rhombifolia*). Pacific willow (*Salix lucida* ssp. *lasiandra*) can form woodlands on major floodplains or co-dominate with other willows in tall shrublands. Oregon white oak (*Quercus garryana*) and California black oak (*Q. kelloggii*) can be important in the interior valleys of western Oregon. Conifers that frequently dominate or co-dominate include western redcedar (*Thuja plicata*), western hemlock (*Tsuga heterophylla*), and Sitka spruce (*Picea sitchensis*). Grand fir (*Abies grandis*) sometimes co-dominates, especially in drier climates and riverine floodplains. Douglas-fir (*Pseudotsuga menziesii*) is relatively uncommon. Dominant species in tall shrublands include Sitka willow (*Salix sitchensis*), Hooker's willow (*S. hookeriana*), Douglas' spirea (*Spirea douglasii*), red-osier dogwood (*Cornus sericea*), western crabapple (*Malus fusca*), salmonberry (*Rubus spectabilis*), stink currant (*Ribes bracteosum*), devil's-club (*Oplopanax horridum*), and sweet gale (*Myrica gale*). Labrador-tea (*Ledum groenlandicum*, *L. glandulosum*), western swamp-laurel (*Kalmia microphylla*), sweet gale, and salal (*Gaultheria shallon*) often dominate sphagnum bogs. Vine maple (*Acer circinatum*) or Sitka alder (*Alnus viridis* ssp. *sinuata*) dominate tall shrublands in the mountains that are located on moist talus or in snow avalanche tracks.

Forests and willow, spirea, and dogwood shrublands within this habitat are limited to the area west of the Cascade Crest. Oregon ash communities occur primarily in the southern Puget Lowland (King County south), Willamette Valley, and Klamath Mountains ecoregions. White alder occurs only in the Willamette Valley and southwestern Oregon. Sitka spruce communities are mainly found in the Coast Range ecoregion in areas of coastal fog influence. Western hemlock and western redcedar riparian and wetland habitats are largely absent from the southern Oregon Cascades and the Klamath Mountains. Sitka alder and vine maple communities are located in the mountains, mainly in western Washington but to a lesser degree on the east slope of the Cascades and in the Oregon Cascades. Sweet gale communities are found primarily at low elevations on the western Olympic Peninsula. Lodgepole pine-dominated communities are found as bogs in western Washington and along the outer coast of Oregon. Most sphagnum bogs are found in low elevation western Washington.

Shrubs that commonly dominate underneath a tree layer include salmonberry, salal, vine maple, red-osier dogwood, stink currant, Labrador-tea, devil's-club, thimbleberry (*Rubus parviflorus*), common snowberry (*Symphoricarpos albus*), beaked hazel (*Corylus cornuta*), and Pacific ninebark (*Physocarpus capitatus*). Understory dominant herbs include slough sedge (*Carex obnupta*), Dewey sedge (*C. deweyana*), Sitka sedge (*C. aquatilis* var. *dives*), skunk-cabbage (*Lysichiton americanus*), coltsfoot (*Petasites frigidus*), great hedge-nettle (*Stachys ciliata*), youth-on-age (*Tolmiea menziesii*), ladyfern (*Athyrium filix-femina*), oxalis (*Oxalis oregana, O. trillifolia*), stinging nettle (*Urtica dioica*), swordfern (*Polystichum munitum*), golden-saxifra (*Chrysosplenium glechomifolium*) great burnet (*Sanguisorba officinalis*), scouring-rush (*Equisetum hyemale*), blue wildrye (*Elymus glaucus*), and field horsetail (*Equisetum arvense*). Bogs often have areas dominated by 1 species of sedge (*Carex* spp.) or beakrush (*Rhynchospora alba*) and sphagnum moss (*Sphagnum* spp.) that are included within this habitat, despite their lack of woody vegetation. Sphagnum moss is a major ground cover in most bogs.

The primary natural disturbance is flooding. Flooding frequency and intensity vary greatly with hydro-geomorphic setting. Floods can create new surfaces for primary succession, erode existing streambank communities, deposit sediment and nutrients on existing communities, and selectively kill species not adapted to a particular duration or intensity of flood. Most plant communities are more or less adapted to a particular flooding regime (Kunze 1994), or they occupy a specific time in a successional sequence after a major disturbance (Fonda 1974). Debris flows/torrents are also an important, typically infrequent, and severe disturbance where topography is mountainous (Swanson et al. 1982). Fires were probably infrequent or absent because of the combination of landscape position and site moisture, although fires within the watershed would usually have effects on the habitat through impacts on flooding, sedimentation, and large woody debris inputs. Windthrow of trees can also be significant, especially near the outer coast or on saturated soils. Beavers act as important disturbances by changing the hydrology of a stream system through dams. Grazing by native ungulates (e.g. elk) can have a major effect on vegetation.

Riparian, i.e., streamside, habitats are extremely dynamic (NOAA 1993). Succession varies greatly depending on the hydro-geomorphic environment. A typical sequence on a riparian terrace on a large stream involves early dominance by Sitka willow, mid-seral dominance by red alder or cottonwood, with a gradual increase in conifers, and eventual late-seral dominance of spruce, redcedar, and/or hemlock. Such a sequence corresponds with increasing terrace height above the bankfull stream stage (Fonda 1974). Some communities in bogs or depressional wetlands, as opposed to riverine, seem to be relatively stable given a particular flooding regime and environment. Successional sequences are not completely understood and can be complex. Beaver dams or other alterations of flood regime often result in vegetation changes.

Intense logging disturbance in conifer or mixed riparian or wetland forests, except bogs, often results in establishment of red alder, and its ensuing long-term dominance. Salmonberry responds similarly to this disturbance and tends to dominate the understory. Logging activities reduce amounts of large woody debris in streams and remove sources of that debris (Bilby and Ward 1991). Timber harvest can also alter hydrology, most often resulting in post-harvest increases in peak flows (Harr and Coffin 1992). Mass wasting and related disturbances (stream sedimentation, debris torrents) in steep topography increase in frequency with road building and timber harvest (Swanson et al. 1987). Roads and other water diversion/retention structures change watershed hydrology with wide-ranging and diverse effects

(Furniss et al. 1991), including major vegetation changes. The most significant of these are the major flood controlling dams, which have greatly altered the frequency and intensity of bottomland flooding. Increases in nutrients and pollutants are other common anthropogenic impacts, the former with particularly acute effects in bogs. Reed canarygrass (*Phalaris arundinacea*) is an abundant non-native species in low-elevation, disturbed settings dominated by shrubs or deciduous trees. Many other exotic species also occur.

This habitat occupies relatively small areas and has declined greatly in extent with conversion to urban development and agriculture. What remains is mostly in poor condition, having experienced any of various anthropogenic impacts that have degraded the functionality of these ecosystems: channeling, diking, dams, logging, road-building, invasion of exotic species, changes in hydrology and nutrients, and livestock grazing. Current threats include all of the above as well as development. Some protection has been afforded to this habitat through government regulations that vary in their scope and enforcement with jurisdiction. Of the 77 plant associations representing this habitat in the National Vegetation Classification, almost half are considered imperiled or critically imperiled (Anderson et al. 1998).

Montane Coniferous Wetlands

This habitat occurs in mountains throughout much of Washington and Oregon, except the Basin and Range of southeastern Oregon, the Klamath Mountains of southwestern Oregon, and the Coast Range of Oregon. This includes the Cascade Range, Olympic Mountains, Okanogan Highlands, Blue and Wallowa mountains. Within the Wind River subbasin, this habitat type was not present historically but was present during recent mapping efforts (Table P-19). It is not clear whether there has been an actual gain of Montane Coniferous Wetlands within the Wind River subbasin or the estimated habitat gain is an artifact of mapping. The addition of 890 acres of Montane Coniferous Wetlands was accompanied by the loss of 1,228 acres of Westside Riparian-Wetlands (Table P-19).

This habitat is typified as forested wetlands or floodplains with a persistent winter snow pack, ranging from moderately to very deep. The climate varies from moderately cool and wet to moderately dry and very cold. Mean annual precipitation ranges from about 35 to >200 inches (89 to >508 cm). Elevation is mid- to upper montane, as low as 2,000 ft (610 m) in northern Washington, to as high as 9,500 ft (2,896 m) in eastern Oregon. Topography is generally mountainous and includes everything from steep mountain slopes to nearly flat valley bottoms. Gleyed or mottled mineral soils, organic soils, or alluvial soils are typical. Subsurface water flow within the rooting zone is common on slopes with impermeable soil layers. Flooding regimes include saturated, seasonally flooded, and temporarily flooded. Seeps and springs are common in this habitat.

This habitat occurs along stream courses or as patches, typically small, within a matrix of Montane Mixed Conifer Forest, or less commonly, Eastside Mixed Conifer Forest or Lodgepole Pine Forest and Woodlands. It also can occur adjacent to other wetland habitats: Eastside Riparian-Wetlands, Westside Riparian-Wetlands, or Herbaceous Wetlands. The primary land uses are forestry and watershed protection.

Structure of this habitat is a forest or woodland (>30% tree canopy cover) dominated by evergreen conifer trees. Deciduous broadleaf trees are occasionally co-dominant. The understory is dominated by shrubs (most often deciduous and relatively tall), forbs, or graminoids. The forb layer is usually well developed even where a shrub layer is dominant. Canopy structure includes single-storied canopies and complex multi-layered ones. Typical tree sizes range from small to very large. Large woody debris is often a prominent feature, although it can be lacking on less productive sites.

Indicator tree species for this habitat, any of which can be dominant or co-dominant, are Pacific silver fir (*Abies amabilis*), mountain hemlock (*Tsuga mertensiana*), and Alaska yellow-cedar (*Chamaecyparis* *nootkatensis*) on the westside, and Engelmann spruce (*Picea engelmannii*), subalpine fir (*Abies lasiocarpa*), lodgepole pine (*Pinus contorta*), western hemlock (*T. heterophylla*), or western redcedar (*Thuja plicata*) on the eastside. Lodgepole pine is prevalent only in wetlands of eastern Oregon. Western hemlock and redcedar are common associates with silver fir on the westside. They are diagnostic of this habitat on the east slope of the central Washington Cascades. Douglas-fir (*Pseudotsuga menziesii*) and grand fir (*Abies grandis*) are sometimes prominent on the eastside. Quaking aspen (*Populus tremuloides*) and black cottonwood (*P. balsamifera* ssp. *trichocarpa*) are in certain instances important to co-dominant, mainly on the eastside.

Dominant or co-dominant shrubs include devil's-club (*Oplopanax horridus*), stink currant (*Ribes bracteosum*), black currant (*R. hudsonianum*), swamp gooseberry (*R. lacustre*), salmonberry (*Rubus spectabilis*), red-osier dogwood (*Cornus sericea*), Douglas' spirea (*Spirea douglasii*), common snowberry (*Symphoricarpos albus*), mountain alder (*Alnus incana*), Sitka alder (*Alnus viridis* ssp. *sinuata*), Cascade azalea (*Rhododendron albiflorum*), and glandular Labrador-tea (*Ledum glandulosum*). The dwarf shrub bog blueberry (*Vaccinium uliginosum*) is an occasional understory dominant. Shrubs more typical of adjacent uplands are sometimes co-dominant, especially big huckleberry (*V. membranaceum*), oval-leaf huckleberry (*V. ovalifolium*), grouseberry (*V. scoparium*), and fools huckleberry (*Menziesia ferruginea*).

Graminoids that may dominate the understory include bluejoint reedgrass (*Calamagrostis canadensis*), Holm's Rocky Mountain sedge (*Carex scopulorum*), widefruit sedge (*C. angustata*), and fewflower spikerush (*Eleocharis quinquiflora*). Some of the most abundant forbs and ferns are ladyfern (*Athyrium filix-femina*), western oakfern (*Gymnocarpium dryopteris*), field horsetail (*Equisetum arvense*), arrowleaf groundsel (*Senecio triangularis*), two-flowered marshmarigold (*Caltha leptosepala* ssp. *howellii*), false bugbane (*Trautvetteria carolinensis*), skunk-cabbage (*Lysichiton americanus*), twinflower (*Linnaea borealis*), western bunchberry (*Cornus unalaschkensis*), clasping-leaved twisted-stalk (*Streptopus amplexifolius*), singleleaf foamflower (*Tiarella trifoliata* var. *unifoliata*), and five-leaved bramble (*Rubus pedatus*).

Flooding, debris flow, fire, and wind are the major natural disturbances. Many of these sites are seasonally or temporarily flooded. Floods vary greatly in frequency depending on fluvial position. Floods can deposit new sediments or create new surfaces for primary succession. Debris flows/torrents are major scouring events that reshape stream channels and riparian surfaces, and create opportunities for primary succession and redistribution of woody debris. Fire is more prevalent east of the Cascade Crest. Fires are typically high in severity and can replace entire stands, as these tree species have low fire resistance. Although fires have not been studied specifically in these wetlands, fire frequency is probably low. These wetland areas are less likely to burn than surrounding uplands, and so may sometimes escape extensive burns as old forest refugia (Agee 1993). Shallow rooting and wet soils are conducive to windthrow, which is a common small-scale disturbance that influences forest patterns. Snow avalanches probably disturb portions of this habitat in the northwestern Cascades and Olympic Mountains. Fungal pathogens and insects also act as important small-scale natural disturbances.

Succession has not been well studied in this habitat. Following disturbance, tall shrubs may dominate for some time, especially mountain alder, stink currant, salmonberry, willows (*Salix* spp.), or Sitka alder. Quaking aspen and black cottonwood in these habitats probably regenerate primarily after floods or fires, and decrease in importance as succession progresses. Pacific silver fir, subalpine fir, or Engelmann spruce would be expected to increase in importance with time since the last major disturbance. Western hemlock, western redcedar, and Alaska yellow-cedar typically maintain co-dominance as stand development progresses because of the frequency of small-scale disturbances and the longevity of these species. Tree size, large woody debris, and canopy layer complexity all increase for at least a few hundred years after fire or other major disturbance.

Roads and clearcut logging practices can increase the frequency of landslides and resultant debris flows/torrents, as well as sediment loads in streams (Swanson and Dyrness 1975, Ziemer 1981, Swanson et al. 1987). This in turn alters hydrologic patterns and the composition and structure of montane riparian habitats. Logging typically reduces large woody debris and canopy structural complexity. Timber harvest on some sites can cause the water table to rise and subsequently prevent trees from establishing (Williams et al. 1995). Wind disturbance can be greatly increased by timber harvest in or adjacent to this habitat.

This habitat is naturally limited in its extent and has probably declined little in area over time. Portions of this habitat have been degraded by the effects of logging, either directly on site or through geohydrologic modifications. This type is probably relatively stable in extent and condition, although it may be locally declining in condition because of logging and road building. Five of 32 plant associations representing this habitat listed in the National Vegetation Classification are considered imperiled or critically imperiled (Anderson et al. 1998).

Open Water-Lakes, Rivers, and Streams

Within the Wind River subbasin, this habitat type was not present historically but was present during recent mapping efforts (Table P-19). It is not clear whether there has been an actual gain of Open Water habitats within the Wind River subbasin or the estimated habitat gain is an artifact of mapping. The addition of 205 acres of Open Water habitat was accompanied by the loss of 1,228 acres of Westside Riparian-Wetlands (Table P-19).

Lakes and Reservoirs

Lakes in Oregon and Washington occur statewide and are found from near sea level to about 10,200 ft (3,110 m) above sea level. There are 3,887 lakes and reservoirs in western Washington and they total 176,920 acres (71,628 ha) (Winward 1970). In contrast, there are 4,073 lakes and reservoirs in eastern Washington that total 436,843 acres (176,860 ha) (Wolcott 1973b).

Continental glaciers melted and left depressions, where water accumulated and formed many lakes in the region. The lakes in the Cascades and Olympic ranges were formed through glaciation and range in elevation from 2,500 to 5,000 ft (762 to 1,524 m). Beavers create many ponds and marshes in Oregon and Washington. Craters created by extinct volcanoes, like Battleground Lake, Washington, also formed lakes. Human-made reservoirs created by dams impound water that creates lakes behind them, like Bonneville Dam on the main stem of the Columbia River. In the lower Columbia Basin, many lakes formed in depressions and rocky coulees through the process of seepage from irrigation waters (Wolcott 1973a).

There are 4 distinct structural zones within this aquatic system: (1) the littoral zone at the edge of lakes is the most productive with diverse aquatic beds and emergent wetlands (part of Herbaceous Wetland's habitat); (2) the limnetic zone is deep open water, dominated by phytoplankton and freshwater fish, and extends down to the limits of light penetration; (3) the profundal zone below the limnetic zone, devoid of plant life and dominated with detritivores; (4) and the benthic zone reflecting bottom soil and sediments. Nutrients from the profundal zone are recycled back to upper layers by the spring and fall turnover of the water. Water in temperate climates stratifies because of the changes in water density. The uppermost layer, the epilimnion, is where water is warmer (less dense). Next, the metalimnion or thermocline, is a narrow layer that prevents the mixing of the upper and lowermost layers. The lowest layer is the hypolimnion, with colder and most dense waters. During the fall turnover, the cooled upper layers are mixed with other layers through wind action.

There are seasonal and decadal variations in the patterns of precipitation. The Willamette Valley and the Cascades generally experience 1 month with no rain every year and a 2-month dry period every third year. Dry years, with <33% of normal precipitation occur once every 30 years along the coast, every 20 years in the Willamette Valley, every 30 years in the Cascades, and every 15 years in most of eastern Oregon (Bastasch 1998).

Floods occur in Oregon and Washington every year. Flooding season west of the Cascades occurs from October through April, with more than half of the floods occurring during December and January. Floods are the result of precipitation and snow melts. Floods west of the Cascades are influenced by precipitation mostly and thus are short-lived, while east of the Cascades floods are caused by melting snow, and the amount of flooding depends on how fast the snow melts. High water levels frequently last up to 60 days. The worst floods have resulted from cloudbursts caused by thunderstorms.

Anthropogenic factors affect open water habitat quality: sewage effluents cause eutrophication, where plants increase in biomass and cause decreased light transmission; irrigation projects aimed at watering drier portions of the landscape may pose flooding dangers; and natural salinity of lakes can decrease as a result of irrigation withdrawal and can change the biota associated with them (Frey 1966).

Rivers and Streams

Streams and rivers are distributed statewide in Oregon and Washington, forming a continuous network connecting high mountain areas to lowlands and the Pacific coast. Oregon's longest stretch of river is the Columbia (309 miles [497 km]) that borders Oregon and Washington. Washington has more streams than any other state except Alaska. The rivers and streams range from cold, fast-moving, high-elevation streams to warmer, lowland valley rivers (Williams et al. 1975). In all, there are 13,955 rivers and streams that add up to 24,774 miles (39,861 km); there are many more streams in Washington yet to be catalogued (Phinney and Bucknell 1975).

Climate of the region is generally wet. The southern portion in Washington is characterized by low-lying, rolling hills (Phinney and Bucknell 1975). Water from melting snowpacks and glaciers provide flow during the spring and winter. Annual rainfall in the lowlands ranges from 35 to 50 inches (89-127 cm), from 75 to 100 inches (191 to 254 cm) in the foothills, and from 100 to >200 inches (254 to 508 cm) in the mountains (mostly in the form of snow) (Phinney and Bucknell 1975).

The western Cascades in Washington and Oregon are composed of volcanically derived rocks and are more stable. They have low sediment-transport rates and stable beds composed largely of cobbles and boulders, which move only during extreme events (Everest 1987). Velocities of river flow ranges from as little as 0.2 to 12 mph (0.3 to19.3 km/hr) while large streams have an average annual flow of 10 cubic feet (0.3 m^3) per second or greater (ODF 1994, Bastasch 1998). Rivers and streams in the Cascades and Blue mountains are similar in that they have more runs and glides and fewer pools, similar fish assemblages, and similar water quality (Whittier et al. 1988).

This habitat occurs throughout Washington and Oregon. Ponds, lakes, and reservoirs are typically adjacent to Herbaceous Wetlands, while rivers and streams typically adjoin the Westside Riparian Wetlands, Eastside Riparian Wetlands, Herbaceous Wetlands, or Bays and Estuaries habitats.

Anthropogenic factors affect river and stream habitat quality in many ways. Removal of gravel results in reduction of spawning areas for anadromous fish. Overgrazing and loss of vegetation caused by logging produces increased water temperatures and excessive siltation, harming the invertebrate communities (Mac et al. 1998). Incorrectly installed culverts may act as barriers to migrating fish and may contribute to erosion and siltation downstream (Phinney and Bucknell 1975). Construction of dams is associated with changes in water quality, fish passage, competition between species, loss of spawning areas because of flooding, and declines in native fish populations (Mac et al. 1998). Historically, the region's rivers contained more braided multi-channels. Flood control measures such as channel straightening, diking, or removal of streambed material along with urban and agriculture development have all contributed to a loss of oxbows, river meanders, and flood plains. Unauthorized or over-appropriated withdrawals of water from natural drainages has also caused a loss of open water habitat that has been detrimental to fish and wildlife production, particularly in the summer (Phinney and Bucknell 1975).

Agricultural, industrial, and sewage runoff such as salts, sediments, fertilizers, pesticides, and bacteria harm aquatic species (Mac et al. 1998). Sludge and heavy waste buildup in estuaries is harmful to fish and shellfish. Unregulated aerial spraying of pesticides over agricultural areas also poses a threat to aquatic and terrestrial life (Phinney and Bucknell 1975). Direct loss of habitat and water quality occurs through irrigation (Knutson and Naef 1997). The Oregon Department of Environmental Quality, after a study of water quality of the Willamette River, determined that up to 80% of water pollution enters the river from nonpoint sources and especially agricultural activity (Bastasch 1998). Very large floods may change the channels permanently through the settling of large amounts of sediments from hillslopes, through debris flow, and through movement of large boulders, particularly in the montane areas. Clearcutting creates excessive intermittent runoff conditions and increases erosion and siltation of streams as well as diminishes shade, and therefore causes higher water temperatures, fewer terrestrial and aquatic food organisms, and increased predation. Landslides, which contributed to the widening of the channel, were a direct result of clearcutting. Clearcut logging can alter snow accumulation and increase the size of peak flows during times of snowmelt (Sullivan et al. 1987). Clearcutting and vegetation removal affects the temperatures of streams, increasing them in the summer and decreasing in winter, especially in eastern parts of the Oregon and Washington (Beschta et al. 1987). Building of roads, especially those of poor quality, can be a major contributor to sedimentation in the streams (Everest et al. 1987).

The principal trend has been in relationship to dam building or channelization for hydroelectric power, flood control, or irrigation purposes. As an example, in 1994, there were >900 dams in Washington alone. The dams vary according to size, primary purpose, and ownership (state, federal, private, local) (WDE 1994). In response to the damaging effects of dams on the indigenous biota and alteration and destruction of freshwater aquatic habitats, Oregon and Washington state governments questioned the benefits of dams, especially in light of the federal listing of several salmon species (Bastasch 1998).

P.3.7.Watershed Process Limitations

This section describes water shed process limitations that contribute to stream habitat conditions significant to focal fish species. Reach level stream habitat conditions are influenced by systemic watershed processes. Limiting factors such as temperature, high and low flows, sediment input, and large woody debris recruitment are often affected by upstream conditions and by contributing landscape factors. Accordingly, restoration of degraded channel habitat may require action outside the targeted reach, often extending into riparian and hillslope (upland) areas that are believed to influence the condition of aquatic habitats.

Watershed process impairments that affect stream habitat conditions were evaluated using a watershed process screening tool termed the Integrated Watershed Assessment (IWA). The IWA is a GIS-based assessment that evaluates watershed impairments at the subwatershed scale (3,000 to 12,000 acres). The tool uses landscape conditions (i.e. road density, impervious surfaces, vegetation, soil erodability, and topography) to identify the level of impairment of 1) riparian function, 2) sediment supply conditions, and 3) hydrology (runoff) conditions. For sediment and hydrology, the level of impairment is determined for local conditions (i.e. within subwatersheds, not including upstream drainage area) and at the watershed level (i.e. integrating the entire drainage area upstream of each subwatershed). See Appendix E for additional information on the IWA.

The Wind River watershed includes 25 subwatersheds, which make up the 144,000 acres in the basin. IWA results for the Wind River watershed are shown in

Table P-20. A reference map showing the location of each subwatershed in the basin is presented in Figure P-27. Maps of the distribution of local and watershed level IWA results are displayed in Figure P-28.

Hydrology

Current Conditions— IWA results were not developed for hydrologic and riparian conditions in the Wind River watershed due to the lack of GIS based data for forest cover. However, ratings for local hydrologic conditions can be derived from available sources of information. The 1996 watershed analysis conducted by the USFS indicates that 14% of the subbasin is in hydrologically immature forest cover (USFS 1996). The USFS watershed analysis divided the watershed into 26 subwatersheds, which are somewhat compatible with the 25 LCFRB recovery planning subwatersheds that comprise the Wind River drainage. Based on these results, all subwatersheds in the Wind River drainage appear to have hydrologically mature vegetation in excess of 50% of total area. In the IWA analysis, percent immature hydrologic vegetation and road density are used to rate likely hydrologic condition where impervious surface information is not available. Because of generally uniform coverage with hydrologically mature vegetation, road densities would be the determinants of hydrologic conditions in the IWA analysis.

Based on these derived ratings, hydrologic conditions in the upper Wind River are mixed. Local conditions are rated as moderately impaired in the upper mainstem (10102), lower Falls Creek (10201), and the middle mainstem (10401 and 10402). Conditions in remaining subwatersheds—including the upper mainstem key subwatershed 10101—are rated as locally functional. The upper Wind River is 97% publicly owned, with the vast majority of this area contained in national forest. This portion of the watershed has 48% of its area in the rain-on-snow zone, with much of the remainder in the snow-dominated zone. The high proportion of area in the rain-on-snow prone zone indicates a higher sensitivity to hydrologic impacts from poor forest cover and high road densities. Rain-on-snow area is particularly high (>70%) in the upper mainstem (10101 and 10102), Falls Creek (10201 and 10202), and the middle mainstem Wind River (10403). Road densities in excess of 3 mi/sq mi) are present in lower Falls Creek (10201) and the upper mainstem Wind (10102). This combination of factors suggests that these subwatersheds may be particularly prone to hydrologic impacts. This tendency is moderated somewhat by the presence of wetlands in the Wind River headwaters (10103) and Black Creek in the Falls Creek drainage (10203), covering approximately 3% and 6% of watershed area, respectively. These relatively extensive wetlands will serve to buffer hydrologic conditions in downstream subwatersheds.

Hydrologic conditions in Trout Creek and Panther Creek are similarly mixed in comparison to the upper Wind River. Based on ratings derived for these drainages from available data, local hydrologic conditions in the headwaters of Trout Creek (10504 and 10503) and Panther Creek (10604 and 10603) are moderately impaired. These ratings are attributed to the high road densities (3.0 to 4.7 mi/sq mi) present in these subwatersheds. Lower Trout Creek (10501) is also rated as moderately impaired, again due to high road densities (4.7 mi/sq mi). Remaining subwatersheds in these drainages are rated as functional. Over 90% of the land area in this portion of the watershed is in public lands, with significant portions of the Trout Creek drainage in the Wind River experimental forest. Trout Creek and Panther Creek have moderate to high proportion of total area in the rain-on-snow zone (ranging from 36-74%). These subwatersheds have the largest amount of rain-on-snow area, with upstream watersheds increasingly snow-dominated and downstream subwatersheds more rain-dominated.

Local level hydrologic conditions in the mainstem subwatersheds of the lower Wind River watershed and its tributaries are mixed. For example, the second upstream subwatershed of the lower middle Wind River (10802) is rated as functional while the lower mainstem (10801) is rated as moderately impaired. The Little Wind River (10803), which enters the lower Wind River approximately one mile above its mouth, is rated as moderately impaired. Approximately 3 miles upstream at RM 4 is the confluence of Bear Creek, with two subwatersheds (10701 and 10702) rated as hydrologically functional. Extensive private land holdings can be found in several of these subwatersheds, such as the Little Wind River (10803) and the lower mainstem (10801 and 10802) which average approximately 50% private lands. Private lands in this part of the watershed include rangelands, agriculture, residential development, and timber. Land uses on public and private lands in these subwatersheds are within the Columbia Gorge National Scenic Area and are subject to stricter land use and development regulations, thereby dampening the effects of land management in these areas.

When interpreting the hydrologic condition ratings for the mainstem subwatersheds (10802 and 10801), it is important to recognize that the local level hydrologic conditions do not reflect the influence of the upstream portions of the watershed. Watershed level conditions will consider both the local and the upstream effects, and may be quite different than the local conditions alone.

Predicted Future Trends— Because of the high proportion of area under public ownership, relatively high levels of mature vegetation, low development expectations, and the extent of restoration actions being implemented on federal lands in the watershed, overall hydrologic conditions in the Wind River Watershed are predicted to trend stable over the next 20 years, with gradual improvement as vegetation matures. Road and road-crossing removal as well as riparian restoration are likely to provide substantial hydrologic benefits.

Most of the upper watershed lies within the GPNF, and can be characterized by fairly good mature vegetation cover. Because of the high proportion of area in public ownership, and the extent of restoration actions being implemented on federal lands in the watershed, hydrologic conditions in the upper Wind River are predicted to trend stable over the next 20 years, with gradual improvement as vegetation matures. High road densities (in excess of 3 mi/sq mi) in subwatersheds within the rain-on-snow zone, such as the upper mainstem (10102) and lower Falls Creek (102 10202), may impede hydrologic recovery in affected reaches.

Given the high percentage of public lands in the Trout Creek and Panther Creek drainages, hydrologic conditions are predicted to trend stable in these subwatersheds over the next 20 years with some gradual improvement as vegetation matures.

While the influence of watershed level conditions in the lower mainstem Wind River (10801 and 10802) have not been analyzed, the general trends predicted for the upstream areas of the watershed will strongly influence conditions in these mainstem reaches. In general, the extensive coverage of hydrologically mature vegetation and the emphasis on habitat restoration on public lands in the watershed would suggest that hydrologic conditions in the watershed as a whole will trend towards improvement. Hydrologic conditions are predicted to trend stable over the next 20 years, given the higher proportion of private lands in these watersheds, the likelihood of ongoing land management activities under existing regulatory constraints, and the existing road densities. Some gradual improvement will occur as areas with immature vegetation recover, but these positive influences may be outweighed by the effects of road conditions.

Other important portions of the Wind River watershed include Bear Creek and the Little Wind River drainages. Hydrologic conditions for the Bear Creek drainage are predicted to remain stable over the next 20 years, based on the currently functional rating and the high proportion of public lands in the drainage. Road densities in the Bear Creek drainage are relatively low (averaging 2.0 mi/sq mi), with a relatively high proportion of mature vegetation. The hydrologic conditions in the Little Wind River (10803) are predicted to remain moderately impaired due to high road densities, with some moderation due to existing land use restrictions. Road densities in this subwatershed just exceed the threshold for hydrologic effects, by 0.1 mi/sq mi (3.1 mi/sq mi total).

Table P-20. IWA results for the Wind River Watershed

Subwatershed[a]	Local Process Conditions[b]			Watershed Level Process Conditions[c]		Upstream Subwatersheds[d]
	Hydrology	Sediment	Riparian	Hydrology	Sediment	
10101	ND	F	ND	ND	F	10102, 10103
10102	ND	M	ND	ND	F	10103
10103	ND	F	ND	ND	F	none
10104	ND	M	ND	ND	M	none
10201	ND	M	ND	ND	M	10202, 10203
10202	ND	F	ND	ND	F	10203
10203	ND	M	ND	ND	M	none
10301	ND	M	ND	ND	M	none
10302	ND	F	ND	ND	F	none
10401	ND	F	ND	ND	F	10101, 10102, 10103, 10104, 10201, 10202, 10203, 10301, 10302, 10402, 10403
10402	ND	F	ND	ND	F	10101, 10102, 10103, 10104, 10201, 10202, 10203, 10301, 10302, 10403
10403	ND	F	ND	ND	F	10101, 10102, 10103, 10104, 10201, 10202, 10203
10501	ND	M	ND	ND	M	10502, 10503, 10504
10502	ND	F	ND	ND	M	10503, 10504
10503	ND	F	ND	ND	M	10504
10504	ND	M	ND	ND	M	none
10601	ND	M	ND	ND	F	10602, 10603, 10604
10602	ND	F	ND	ND	F	10603, 10604
10603	ND	F	ND	ND	F	10604
10604	ND	F	ND	ND	F	none
10701	ND	F	ND	ND	F	10702
10702	ND	F	ND	ND	F	none
10801	ND	M	ND	ND	F	10101, 10102, 10103, 10104, 10201, 10202, 10203, 10301, 10302, 10401, 10402, 10403, 10501, 10502, 10503, 10504, 10601, 10602, 10603, 10604, 10701, 10702, 10802, 10803
10802	ND	F	ND	ND	M	10101, 10102, 10103, 10104, 10201, 10202, 10203, 10301, 10302, 10401, 10402, 10403, 10501, 10502, 10503, 10504
10803	ND	M	ND	ND	M	none

[a] LCFRB subwatershed identification code abbreviation. All codes are 14 digits starting with 170701051#####.
[b] IWA results for watershed processes at the subwatershed level (i.e., not considering upstream effects). This information is used to identify areas that are potential sources of degraded conditions for watershed processes, abbreviated as follows:

F: Functional
M: Moderately impaired
I: Impaired

ND: Not evaluated due to a lack of data

[c] IWA results for watershed processes at the watershed level (i.e., considering upstream effects). These results integrate the contribution from all upstream subwatersheds to watershed processes and are used to identify the probable condition of these processes in subwatersheds where key reaches are present.
[d] Subwatersheds upstream from this subwatershed.

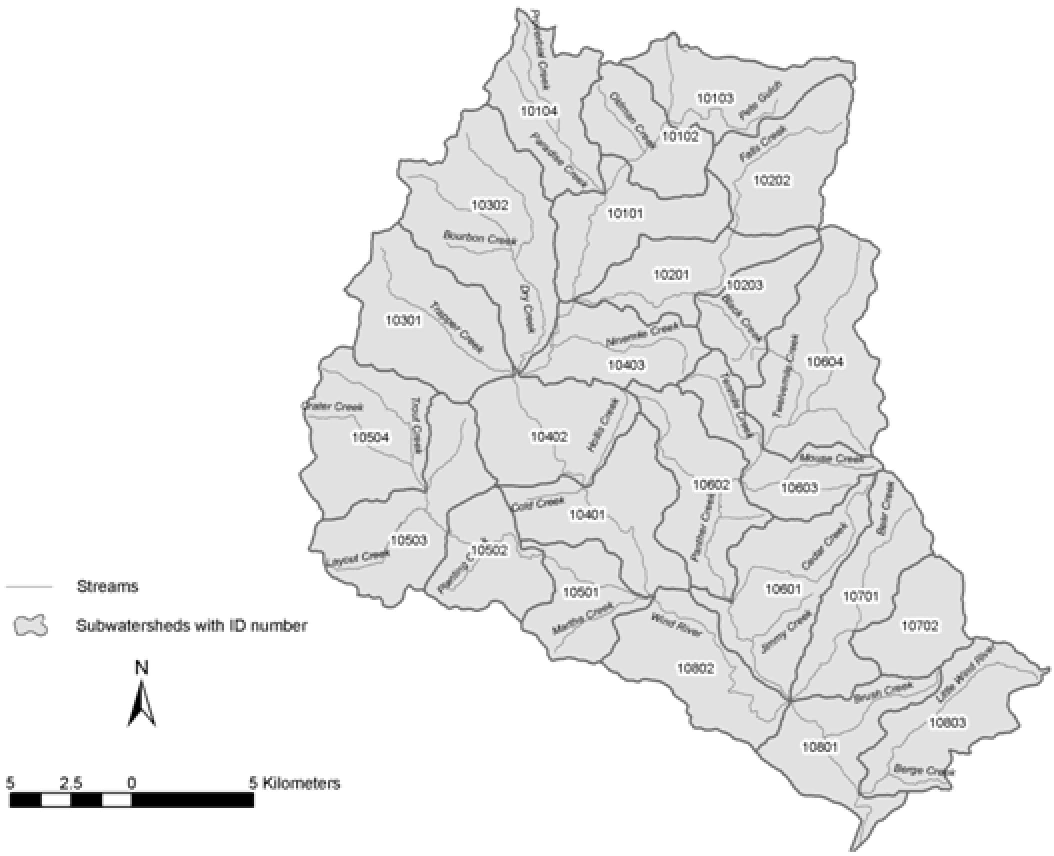


Figure P-27. Map of the Wind River basin showing the location of the IWA subwatersheds.

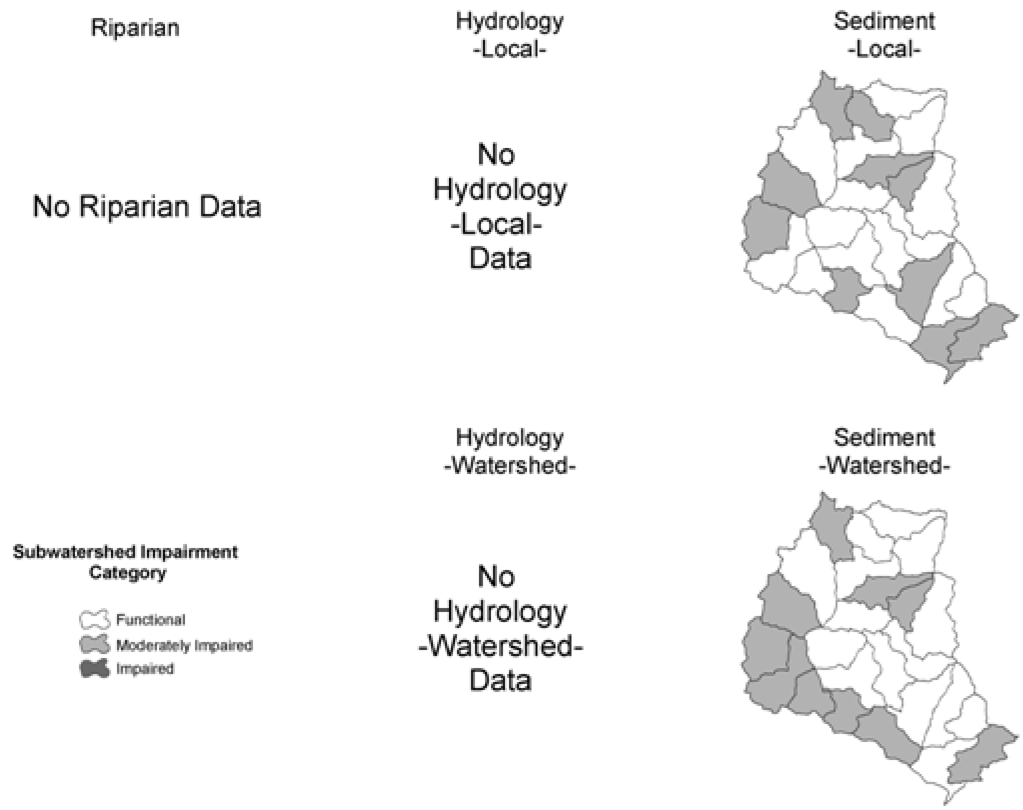


Figure P-28. IWA subwatershed impairment ratings by category for the Wind River basin

Sediment Supply

Current Conditions— As with hydrologic conditions, the local level sediment conditions in the upper Wind River are mixed. Functional sediment ratings are concentrated in the Wind River headwaters (10103), Upper Falls Creek (10202), Dry Creek (10302), the upper mainstem (10101), Ninemile Creek (10403), and the middle mainstem (10401 and 10402). Moderately impaired ratings for local level sediment conditions are found in Paradise Creek (10104), the upper Wind River (10102), Falls Creek (10201 and 10203), and Trapper Creek (10304). Watershed level ratings are identical to the local level conditions with one exception. The upper mainstem (10101) is rated functional and appears to benefit from functional conditions in the Wind River headwaters (10103). Natural erodability ratings in this part of the watershed range from low to moderate (5-30 on a scale of 0-126), with the more erodable subwatersheds including Dry Creek, Trapper Creek, Ninemile Creek and the middle mainstem subwatersheds of the Wind River. The functional watershed level ratings for the upper and middle mainstem (10101, 10401, 10402) are determined both by locally functional conditions and the buffering effect from upstream subwatersheds. The functional conditions in upstream subwatersheds appear to provide a buffering effect that balances the effect of moderately impaired subwatersheds at the watershed level.

Trapper Creek (10301 – moderately impaired) has relatively pristine forest cover and riparian conditions (USFS 1996). Road densities in this subwatershed are relatively low (<2.0 mi/sq mi), and the density of streamside roads is also moderately low (0.45 miles/stream mile). However, sediment conditions in this subwatershed are rated as moderately impaired due to the intersection of forest roads, steep slopes, and more erodable geology. While rain-on-snow zone density in Trapper Creek is moderate (43%), the combination of roads in sensitive areas with the potential for rapid runoff under rain-on-snow conditions may create significant sediment loading.

Lower Falls Creek (10201 - moderately impaired) has a low natural erodability rate (7 on the 0-126 scale), but has moderately impaired sediment conditions due to high rain-on-snow area (83%) and high streamside road densities (>2 miles/stream mile). Streamside roads are relatively large sources of sediment relative to overall unsurfaced road density.

Local level sediment conditions in Trout Creek subwatersheds are rated as moderately impaired at the headwaters and the mouth (10504 and 10501). The middle two watersheds in the Trout Creek drainage (10502 and 10503) are rated as functional for sediment conditions. In contrast, watershed level conditions in all four subwatersheds in this drainage are rated as moderately impaired. Based on this information, the moderately impaired conditions in the headwaters of Trout Large are strongly influencing downstream subwatersheds. Natural erodability rates for the Trout Creek drainage are moderate (13-31 on a scale of 0-126), with erodability ratings increasing on an upstream gradient. The watershed level effects of moderately impaired conditions in the headwaters suggests that the relatively high road densities in this subwatershed (>4 mi/sq mi) are concentrated in more erodable areas. Similarly, while erodability ratings at the lower end of Trout Creek (10501) are relatively low, the high road densities in this subwatershed (4.7 mi/sq mi) are concentrated in more erodable areas.

Sediment conditions in the Panther Creek drainage are functional at the local level in all subwatersheds except lower Panther Creek (10601). Watershed level conditions are functional in all subwatersheds, suggesting that the functional conditions in the headwaters and middle subwatersheds of the drainage provide a buffering effect on sediment conditions in the most downstream subwatersheds. Lower and middle Panther Creek (10601 and 10602) are important subwatersheds for summer steelhead. Natural erodability ratings in these areas are low to moderate (ranging from 18-30 on the 0-126 scale), suggesting that moderately impaired ratings are indicative of detrimental effects on instream habitat conditions.

Sediment conditions in the lower Wind River are strongly influenced by watershed level effects from upstream drainages. Sediment conditions in the lower middle Wind River (10802) and the lower Wind River (10801) are rated as functional and moderately impaired at the local level, respectively. These ratings reverse at the watershed level. The lower middle Wind (10802) is rated as moderately impaired at the watershed level due predominantly to the influence of watershed level degradation in the Trout Creek drainage. In contrast, the lower Wind River (10801) is rated as functional at the watershed level, due to the influence of generally functional sediment conditions in the Panther and Bear Creek drainages. The moderately impaired local level rating for the lower Wind River is borderline, suggesting that local level effects are relatively modest contributors of sediment relative to watershed level effects.

Sediment conditions in the Bear Creek drainage (10701 and 10702) are rated as functional at both local and watershed levels. Bear Creek has moderately low overall road densities (averaging 2.0 mi/sq mi). Streamside road densities are moderate, averaging 0.48 miles/stream mile, and rain-on-snow area ranges from 35% in lower Bear Creek (10701) to over 60% in upper Bear Creek (10702). Natural erodability rates are in the moderate range, averaging over 30 on the scale of 0-126. The functional rating for the headwaters of Bear Creek is borderline moderately impaired. This suggests that some roads may be located in particularly sensitive areas.

The moderately impaired rating for sediment conditions in the Little Wind River (10803) is driven by the relatively high level of natural erodability for this watershed (36 on the 0-126 scale) and moderately high road densities (3.1 mi/sq mi). In addition, the headwaters of this subwatershed are in the rain-on-snow zone. This subwatershed has significant area in private land ownership (41%); however, the proximity of this subwatershed to the Columbia Gorge National Scenic Area limits land uses and development on both public and private lands. Streamside road densities are high, exceeding 0.9 miles/stream mile.

Predicted Future Trends— Sediment conditions in the upper Wind River, Trout Creek, and Panther Creek are predicted to trend stable or to gradually improve over the next 20 years due to federal management that places emphasis on habitat preservation and restoration. Forest road maintenance and removal projects, as well as continued vegetation recovery from past clear cutting, will reduce sediment generation and delivery to stream channels. In moderately impaired subwatersheds where roads are not targeted for restoration, degraded conditions are expected to persist.

Sediment conditions in the lower middle (10802) and lower mainstem (10801) Wind River are expected to trend stable. Vegetation recovery and road maintenance/removal projects will improve sediment conditions in some areas, but these improvements will be offset by continued heavy logging practices on private timberlands. Given these balancing factors, the predicted trend over the next 20 years is for sediment conditions in these drainages to remain in their current condition.

The Bear Creek subwatersheds (10701, 10702) are predicted to trend stable for sediment conditions over the next 20 years, due to the high proportion of area in federal lands (approximately 95%). However, the borderline sediment conditions in the headwaters and the high rain-on-snow area suggest the potential for episodic sediment loading.

Given the protections offered by the Columbia Gorge National Scenic Area, sediment conditions in the Little Wind River subwatershed (10803) are predicted to trend generally stable over the next 20 years due to the natural erodability of the drainage and moderately high unsurfaced road and streamside road densities.

Riparian Condition

Current Conditions— Riparian conditions are rated in the USFS watershed analysis based on various measures of the riparian zone seral stage in selected stream reaches (USFS 1996). Thresholds of concern for riparian vegetation are not defined in the watershed analysis and no definitive ratings are provided. While the data in the watershed analysis cannot be directly evaluated using IWA thresholds, a general rating of riparian condition can be qualitatively derived using arbitrary thresholds for the proportion of the riparian zone in large (successionally mature) trees. For the purpose of this qualitative analysis, riparian ratings are defined as follows:

- Functional: riparian zone >50% large trees
- Moderately Impaired: riparian zone between 20-50% large trees
- Impaired: riparian zone <20% large trees

Based on this information, riparian conditions appear to vary widely across the Wind River watershed, with a general trend towards moderately impaired to impaired conditions. Functional riparian conditions are found in the Little Wind River (10803), the Bear Creek drainage (10701 and 10702), lower and upper middle Panther Creek (10701 and 10703), Trapper Creek (10301), and Dry Creek (10302). Riparian conditions are rated as impaired in the upper middle Wind River (10401 and 10401) and lower and middle Trout Creek (10501 and 10502). All remaining subwatersheds are rated as moderately impaired, with borderline impaired conditions present in lower middle Panther Creek (10602) and upper middle Trout Creek (10503).

Predicted Future Trends— Riparian protections are in place throughout the private and public lands in the basin. However, indiscriminate historical logging practices removed significant amounts of riparian vegetation over the last century, particularly along the middle and upper mainstem Wind River, the Wind River headwaters, Trout Creek and Panther Creek. In some areas (e.g. lower mainstem, middle mainstem), residential, agricultural, and transportation corridor impacts have denuded riparian vegetation. Although many riparian areas, especially those impacted by past timber harvests, are recovering, other areas continue to suffer from degraded conditions. In some places, riparian restoration efforts are restoring natural vegetation assemblages. Based on this information, riparian conditions are predicted to trend toward gradual recovery in most areas. This general trend must be considered against existing limitations. Some riparian areas suffer from residential development and/or streamside roads. High streamside road densities (exceeding 0.7 miles/stream mile) are present in all subwatersheds with impaired ratings for riparian conditions, with some subwatersheds including lower Trout Creek (10501) and the middle mainstem Wind River (10401) approaching 1.5 miles/stream mile. The potential for full recovery of riparian vegetation in these subwatersheds will be somewhat limited, unless road retirement projects are implemented with a goal of riparian restoration.

High streamside road densities are also present in subwatersheds rated moderately impaired for riparian condition. Lower Falls Creek (10201) has road densities exceeding 2 miles/stream mile, i.e., many stream reaches are effectively bracketed on both sides by roads. Streamside road densities in upper Wind River subwatersheds 10101 and 10102 are 0.74 and 1.31 miles/stream mile, respectively. Moderately impaired riparian conditions in these subwatersheds tend to indicate that there is some potential for additional recovery over time, again within the limits imposed by existing roads.

P.3.8. Other Factors and Limitations

Hatcheries

Hatcheries currently release over 50 million salmon and steelhead per year in Washington lower Columbia River subbasins. Many of these fish are released to mitigate for loss of habitat. Hatcheries can provide valuable mitigation and conservation benefits but may also cause significant adverse impacts if not prudently and properly employed. Risks to wild fish include genetic deterioration, reduced fitness and survival, ecological effects such as competition or predation, facility effects on passage and water quality, mixed stock fishery effects, and confounding the accuracy of wild population status estimates. This section describes hatchery programs in the Wind subbasin and discusses their potential effects.

Wind River Hatcheries: Washington operated a salmon hatchery near the mouth of the Wind River from 1899 to 1938, when the hatchery was flooded by the Bonneville Dam reservoir. The hatchery produced fall Chinook and broodstock was taken directly from the Wind River. Annual egg take was generally between 1 and 4 million; in some years, egg take was as high as 20 million.

The Carson National Fish Hatchery in the Wind River basin is at Tyee Springs (RM 18); the facility was constructed in 1937 and expanded in 1952–1955. Historically, the dominant species produced at the hatchery was tule fall Chinook. Many other species of salmon and trout were also raised intermittently in large numbers from 1938 to 1981. In 1981, production switched to spring Chinook exclusively, and this remains the only species produced. Current annual spring Chinook release goals are 1.42 million yearlings (Table P-21).

Skamania summer and winter steelhead were released in the basin until 1997; annual releases of summer steelhead ranged from 20,000 to 50,000 smolts while winter steelhead releases were generally fewer than 10,000 smolts. Steelhead releases were discontinued to promote wild steelhead management in the basin.

The Wind River historically had a naturally spawning tule fall Chinook population but only a small remnant of that population remains due to Bonneville reservoir inundating the spawning habitat in the lower river. In recent years, a self-sustaining population of mid-Columbia upriver bright late fall Chinook, historically not found in this basin, has been observed in the lower river below Shipperd Falls.

It most likely originated from hatchery strays, possibly from the two hatcheries in the area that produce this stock—the Little White Salmon (Willard) NFH and Bonneville Hatchery.

Table P-21. Wind River hatchery production

Hatchery	Release Location	Spring Chinook
Carson NFH	Wind River	1,420,000

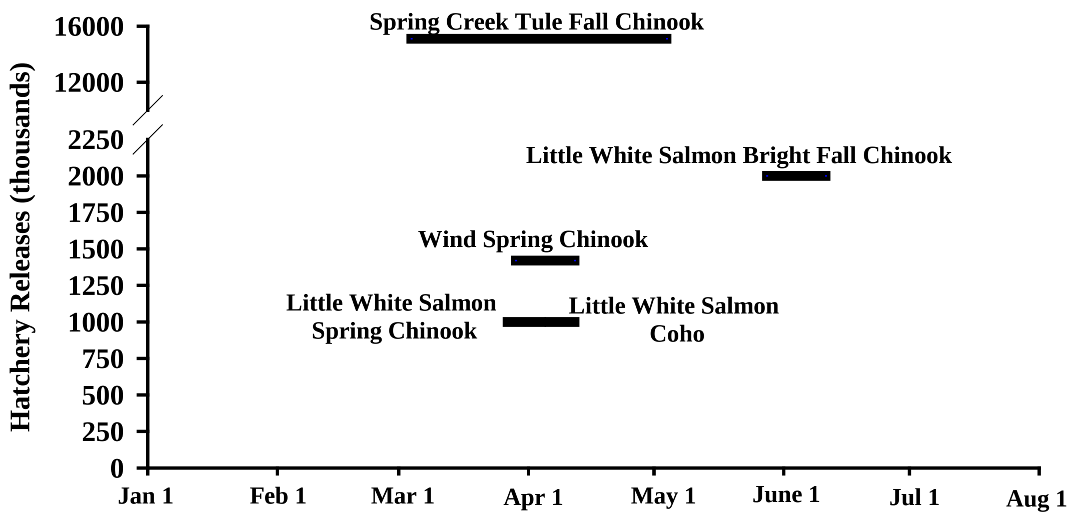


Figure P-29. Magnitude and timing of hatchery releases in the Wind and Little White Salmon Rivers and mainstem Columbia in the Bonneville Pool based on 2003 brood production goals.

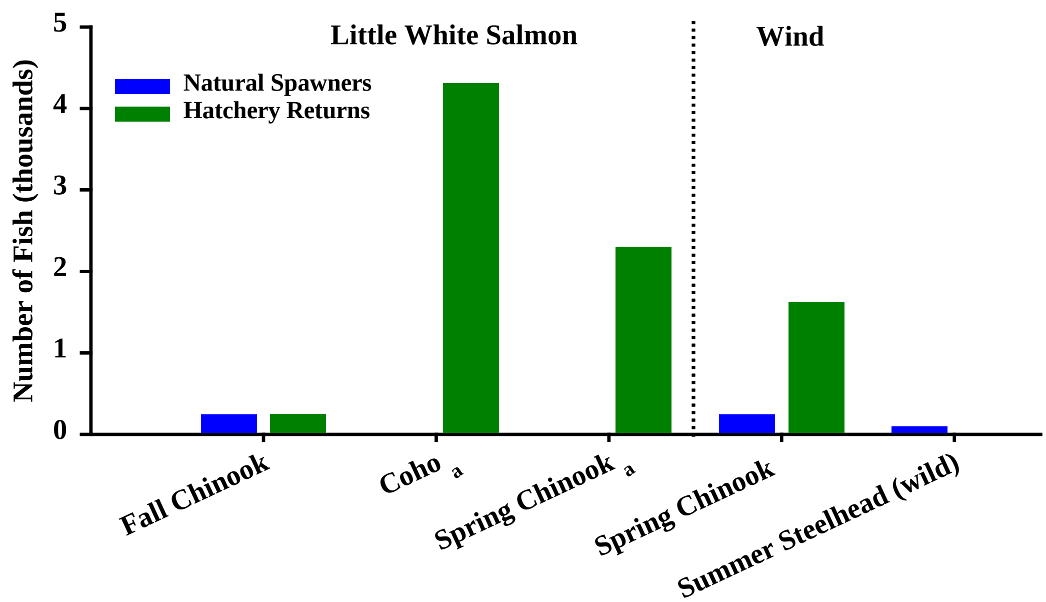


Figure P-30. Recent average hatchery returns and estimates of natural spawning escapement in the Little White Salmon and Wind River basins by species. The years used to calculate averages varied by species, based on available data. The data used to calculate average hatchery returns and natural escapement for a particular species and basin were derived from the same years in all cases. All data were from the period 1992 to the present. Calculation of each average utilized a minimum of 5 years of data, except for Little White Salmon fall Chinook, which represents the 1996–99 average.[a]

[a]A natural stock for this species and basin has not been identified based on populations in WDFW's 2002 SASSI report; escapement data are not available.

Hatchery Effects: Genetics—The former tule fall Chinook hatchery program at the Carson NFH used broodstock originating primarily from Spring Creek NFH stock, which was developed from the Big White Salmon River tule fall Chinook stock. Fall Chinook releases into the Wind River basin averaged 2 million from 1952 to 1976 but were discontinued in 1976. A small tule fall Chinook population persists in the basin; the current population likely is a hybridization between native Wind River tule fall Chinook and Spring Creek Hatchery tule fall Chinook.

Spring Chinook were not native to the Wind River. Historically, spring Chinook eggs were transferred to Carson NFH from the Clackamas River and a Willamette River hatchery in Oregon, and from Camas Creek in Idaho. All of these stocking efforts failed because of adult passage problems at Shipperd Falls (RM 2); fish passage facilities were constructed at the falls in 1954. During the 1950s and 1960s, approximately 500 spring Chinook were captured annually at Bonneville Dam were transferred to the Carson NFH for broodstock collection. Genetic data indicates that the Carson NFH spring Chinook stock was developed from a mixture of upper Columbia and Snake River spring Chinook passing Bonneville Dam. Current broodstock collection comes from adults returning to the Carson NFH. CWT data indicates that Carson NFH spring Chinook stray into the Little White Salmon NFH and are harvested in the Drano Lake fisheries, but because these stocks were developed from the same broodstock, there is little concern with genetic introgression. Carson NFH spring Chinook straying into other lower Columbia basins is not considered a problem.

Summer steelhead releases into the Wind River basin came from Skamania and Vancouver Hatchery stocks. Allozyme analysis in 1994 clustered mainstem Wind River and Panther Creek summer steelhead with a number of lower Columbia River summer and winter steelhead stocks, including Skamania Hatchery summer steelhead. Trout Creek summer steelhead stocks were part of an outlier group that included South Fork Nooksack River summer steelhead, Washougal steelhead, and Cowlitz native late winter steelhead. Winter steelhead releases into the Wind River basin came from Chambers Creek and Skamania Hatchery stocks. Only unmarked summer and winter steelhead have been allowed to pass Hemlock Dam and access the upper watershed of Trout Creek, thereby preserving the genetic integrity of this stock. Both hatchery summer and winter hatchery steelhead stocking programs have been discontinued.

Interactions—Fall Chinook hatchery releases were discontinued in 1976; the existing tule fall Chinook population is sustained from wild production and strays from Spring Creek NFH. There are no wild/hatchery tule fall Chinook interactions in the Wind River, other than from straying tule fall Chinook from other basins.

Spring Chinook are not native to the Wind River basin; the current population is sustained through hatchery production and any natural spawners are hatchery-origin fish (Figure P-30). Therefore, there is no interaction between hatchery and wild spring Chinook in the Wind River basin. However, hatchery spring Chinook adults may interact with wild fall Chinook, summer steelhead, and winter steelhead. Based on run timing, possible spring Chinook effects are more likely on summer steelhead than the other species. In 2001 and 2002, the Carson NFH adult collection facility was closed to adult spring Chinook entry on August 1; fish health personnel were concerned that this early closure may keep more spring Chinook adults in the river and increase potential transmission of IHNV to steelhead. Juvenile outmigration trapping and PIT tag monitoring at Bonneville Dam indicate that Carson spring Chinook exit the Wind River quickly after release and Carson spring Chinook are not known to residualize. Therefore, although steelhead parr occupy the mainstem Wind River below the hatchery, competition between hatchery spring Chinook and juvenile steelhead is thought to be minimal. Also, the size of steelhead parr (>80mm) that occupy the spring Chinook migration corridor suggests that steelhead are not susceptible to predation by Carson spring Chinook. Emigrant sampling conducted in the Wind River indicates that steelhead smolts and presmolts are not drawn out of the Wind River basin early by releases of hatchery spring Chinook.

Water Quality/Disease—The primary water source for the Carson NFH is Tyee Springs, approximately 3/8 mile from the hatchery; the springs produce 44 second-feet of 44°F, high-quality water. A feral brook trout population exists in Tyee Creek, which supplies the spring water to the Carson NFH. BKD is present in the brook trout population at low levels; periodic monitoring is conducted to determine the level of infection. The presence of this trout population in the hatchery water source has had no noticeable effect on the hatchery fish in recent years. The Wind River is a backup source of water for the hatchery and is used only as needed, primarily in September, after most spring Chinook carcasses have drifted below the hatchery intake. Because there is evidence that using Wind River water in the hatchery may contribute to outbreaks of IHNV, BKD, and furunculosis in hatchery fish, the use of this water source is minimized.

The Lower Columbia River Fish Health Center (FHC) in Underwood, Washington, provides fish health care for the Carson NFH under guidance of the Fish and Wildlife Service Manual, the Policies and Procedures for Columbia Basin Anadromous Salmonid Hatcheries, and the Co-Managers Salmonid Disease Control Policy. A pathologist from the FHC examines fish at various times during the hatchery operation. Adult certification examinations are performed at spawning; adult fish tissues are collected to ascertain viral, bacterial, and parasite infections and to provide a brood health profile for the progeny. Progeny from females with high levels of BKD are culled (if not needed to meet annual production goals) or segregated from progeny at lower risk. A ponding examination for viral infections is performed on newly hatched fish when approximately 50% of the fish are beyond the yolk-sac stage and begin feeding. Rearing fish are randomly examined monthly to determine general health. These monthly exams generally include a necropsy with detailed external and internal exams and tests for bacterial and viral infections are performed. Diagnostic exams are performed on rearing fish as needed, depending on unusual fish behavior or higher than normal mortality. Pre-release examinations are performed before fish are released or transferred from the hatchery and these focus on testing for listed pathogens. Numerous chemicals are used at various stages to prevent or treat infection. Erythromycin is injected into adults being held for broodstock collection; the number of injections ranges from 0-2, depending on the arrival time of fish to the hatchery compared to the actual egg take. Injections must be completed 30 days before spawning to be effective. Adults being held for broodstock also are treated with formalin three times per week to control external pathogens. All eggs received at the hatchery must be disinfected before they are allowed to come in contact with the hatchery's water or equipment. Salmonid eggs are hardened and disinfected with a 50-ppm iodine solution buffered in sodium bicarbonate. Formalin is also used to control fungus on eggs during incubation.

Mixed Harvest—The purpose of the spring Chinook hatchery program at the Carson NFH is to mitigate for loss of spring Chinook salmon as a result of hydroelectric and other development in the lower Columbia River basin and to contribute to terminal area tribal ceremonial and subsistence fisheries and non-tribal sport and commercial fisheries. Historically, exploitation rates of hatchery and wild spring Chinook likely were similar. Upriver spring Chinook are an important target species in Columbia River commercial and recreational fisheries, as well as in tributary recreational fisheries. Upriver spring Chinook are impacted less by ocean fisheries than other Columbia River Chinook stocks. CWT data suggests that Carson NFH spring Chinook are recovered primarily as recreational harvest, with the remaining fish recovered as tribal harvest, commercial harvest, and hatchery escapement. Carson NFH spring Chinook contribute primarily to terminal area sport and tribal fisheries at the mouth of the Wind River; average terminal area harvest rate from 1989–98 was 44% for years when fisheries occurred. Selective fishery regulations in recent years in the Columbia River basin have targeted hatchery fish and maintained low harvest rates of wild spring Chinook. Beginning with the 2000 brood, all Carson NFH spring Chinook have been externally marked with an adipose fin-clip to allow for selective fisheries.

Passage—The adult collection facility at the Carson NFH consists of a fish ladder adjacent to the mainstem and two holding ponds. Returning adults enter the hatchery fish ladder volitionally; a barrier dam does not exist across the Wind River. Fish are maintained in holding ponds until broodstock collection. Prior to 2001, all returning adults were allowed into the hatchery through August or the end of the spawning run; this practice likely minimized potential interactions and disease transmission between hatchery spring Chinook and wild steelhead. However, in 2001 and 2002, the hatchery ladder was closed to returning adults on August 1, allowing more spring Chinook to remain in the Wind River.

Supplementation—Supplementation is not the goal of the current spring Chinook hatchery program nor was it the goal of former fall Chinook, summer steelhead, or winter steelhead hatchery programs on the Wind River.

Hatchery Program Assessment: The evaluation of hatchery programs and implementation of hatchery reform in the Lower Columbia is occurring through several processes. These include: 1) the LCFRB recovery planning process; 2) Hatchery Genetic Management Plan (HGMP) preparation for ESA permitting; 3) FERC related plans on the Cowlitz River and Lewis River; 4) the federally mandated Artificial Production Review and Evaluation (APRE) process, and 5) the congressionally mandated, Hatchery Scientific Review Group (HSRG) review of all state, tribal and federal hatchery programs in Puget Sound and Coastal Washington, and in the Columbia River Basin. Through each of these processes, WDFW is applying a consistent framework to identify the hatchery program enhancements that will maximize fishing-related economic benefits and promote attainment of regional recovery goals. Developing hatcheries into an integrated, productive, stock recovery tool requires a policy framework for considering the acceptable risks of artificial propagation, and a scientific assessment of the benefits and risks of each proposed hatchery program.

The regional Hatchery Scientific Review Group (HSRG) completed an assessment of lower Columbia River hatcheries in 2009 (http://www.hatcheryreform.us/mfs/welcome_show.action). The HSRG is the independent scientific review panel of the Pacific Northwest Hatchery Reform Project established by Congress in 2000 in recognition that while hatcheries play a legitimate role in meeting harvest and conservation goals for Pacific Northwest salmon and steelhead, the hatchery system was in need of comprehensive reform. The HSRG has reviewed all state, tribal and federal hatchery programs in Puget Sound, Coastal Washington, and the Columbia River Basin. The HSRG concluded that hatcheries play an important role in the management of salmon and steelhead populations in the Columbia River Basin but that hatchery programs must be viewed not as surrogates or replacements for lost habitat, but as tools that can be managed as part of a coordinated strategy to meet watershed or regional resource goals, in concert with actions affecting habitat, harvest rates, water allocation and other important components of the human environment. The HSRG reached several critical, overarching conclusions regarding areas where current hatchery and harvest practices need to be reformed. Recommendation included:

- Manage hatchery broodstocks to achieve proper genetic integration with, or segregation from, natural populations;
- Promote of local adaptation of natural and hatchery populations;
- Minimize adverse ecological interactions between hatchery- and natural-origin fish;
- Minimize effects of hatchery facilities on the ecosystem in which they operate; and
- Maximize the survival of hatchery fish.

The HSRG developed a series of criteria for evaluating hatchery influence on wild populations based on Population Viability objectives identified in the Recovery Plan. Criteria are based on the proportion of effective hatchery-origin spawners (pHOS), the proportion of natural-origin adults in the broodstock (pNOB), and the proportionate natural influences (PNI) which is a product of pHOS and pNOB.

For Primary populations:

- pHOS should be less than 5% of the naturally spawning population, unless the hatchery population is integrated with the natural population.

- For integrated populations, pNOB should exceed pHOS by at least a factor of two, corresponding to a PNI (proportionate natural influence) value of 0.67 or greater and pHOS should be less than 0.30.

For Contributing populations:

- The proportion of effective hatchery-origin spawners (pHOS) should be less than 10% of the naturally spawning population, unless the hatchery population is integrated with the natural population.
- For integrated populations, pNOB should exceed pHOS, corresponding to a PNI value of 0.50 or greater and pHOS should be less than 0.30.

For Stabilizing populations:

- The current operating conditions were considered adequate to meet conservation goals. No criteria were developed for proportion of effective hatchery-origin spawners (pHOS) or PNI.

Evaluations of current hatchery programs relative to population recovery objectives and hatchery criteria led the HSRG to provide detailed recommendations for reform of specific hatchery programs for each species and programs. General recommendations are summarized below for each species. More specific recommendations for each hatchery program are detailed, along with analyses of alternatives, in the HSRG report (http://www.hatcheryreform.us/mfs/welcome_show.action). These recommendations inform the hatchery actions identified for this subbasin and hatchery reform implementation planning reflected in WDFW's Conservation and Sustainable Fisheries plans under current development.

For Chinook, the HSRG concluded that a major concern with these programs is the effect hatchery strays have on the long-term fitness of naturally spawning populations. Although programs provide significant harvest benefits, and in some cases, help preserve genetic resources in the ESU, there are many poorly segregated and poorly integrated programs. HSRG recommendations for Chinook hatchery reform included:

- In segregated programs, improve the ability to control hatchery fish on the spawning grounds so that harvest benefits can be maintained while improving natural-origin spawning abundance and productivity for instance, by installing weirs in specific drainages where straying limits the ability to meet conservation goals.
- Move production from some tributaries into larger segregated harvest programs in Select Area Fishery Evaluation areas, where excess hatchery fish can be removed by applying higher harvest rates.
- Reduce reliance of some programs on imported out-of-basin broodstock or rearing to improve homing and increase productivity.
- For integrated programs, increase the proportion of natural-origin fish used in hatchery broodstock and control the contribution of hatchery-origin fish to natural spawning areas. In some cases, meeting the criteria for the population designation requires reducing program size.

For coho, the HSRG concluded that a major concern with these programs is the effect hatchery strays have on the long-term fitness of naturally spawning populations. These programs provide significant harvest benefits, and in some cases, help preserve genetic resources in the ESU. However, the ESU is dominated by many poorly segregated and a few poorly integrated programs. HSRG recommendations for coho hatchery reform included:

- In segregated programs, improve the ability to control hatchery fish on the spawning grounds so that harvest benefits can be maintained while improving natural-origin spawning abundance and productivity for instance, by installing weirs in specific drainages where straying limits the ability to meet conservation goals.

- Move production from some tributaries into larger segregated harvest programs in Select Area Fishery Evaluation areas, where excess hatchery fish can be removed by applying higher harvest rates.
- For integrated programs, increase the proportion of natural-origin fish used in hatchery broodstock and control the contribution of hatchery-origin fish to natural spawning areas. In some cases, meeting the criteria for the population designation requires reducing program size.
- In some cases, harvest benefits could be maintained and conservation improved by developing highly integrated conservation programs with associated segregated harvest programs (stepping-stone programs).
- More emphasis on monitoring and evaluation programs to accurately estimate straying is also recommended.

For chum, the HSRG concluded that hatchery intervention can reduce demographic risk by boosting abundance and additional conservation propagation programs should be promptly initiated within each of the ESU's three geographic strata to reduce this risk. The HSRG had no recommendations to improve on single existing chum program (Grays River) and recommends its continued operation as an important safety net in the lower Columbia.

For steelhead, the HSRG concluded that all populations in this DPS meet or exceed the HSRG criteria for their population designation. No recommendations to change programs were made by the HSRG. However, due to uncertainty about the number of unharvested hatchery-origin fish from segregated programs that remain in the natural environment, the HSRG identified a need for additional monitoring to further clarify these values and to aid in assessing the ecological impacts to the natural populations.

Subbasin Specific Recommendations: The HSRG provided subbasin and population specific advice. For the Wind River, the following recommendations were made:

Wind River – Fall Chinook

The HSRG noted that the hatchery program was eliminated in 2004 and suggested that managers might consider establishing net pens to acclimate hatchery coho in Drano Lake. In addition, a new terminal fishery for tribal and sport fishermen could be created with little potential conflict with natural populations.

Wind River – Spring Chinook

The HSRG observed that the Wind River spring Chinook population is underdesignated as there is no natural population in the watershed.

Wind River – Summer Steelhead

The HSRG noted that given the Primary designation of this population, if the number of fish returning to the Wind River subbasin is consistently less than 250 fish, managers might consider implementing an integrated conservation program with a sunset clause.

Wind River – Winter Steelhead

The HSRG had no specific recommendations for this population.

Impacts: Impacts of hatchery fish on local wild populations are estimated in this plan, for the purposes of comparison with the relative magnitude of other factors, based on hatchery fractions and assumed fitness effects estimated by the HSRG. Detailed explanations of these impact estimates may be found in Volume I, Chapter 3 of this Recovery Plan.

Harvest

Fishing generally affects salmon populations through directed and incidental harvest, catch and release mortality, and size, age, and run timing alterations because of uneven fishing on different run components. From a population biology perspective, these affects can result in reduced survival (fewer spawners) and can alter age, size, run timing, fecundity, and genetic characteristics. Fewer spawners result in fewer eggs for future generations and diminish marine-derived nutrients delivered via dying adults, now known to be significant to the growth and survival of juvenile salmon in aquatic ecosystems. The degree to which harvest-related limiting factors influence productivity varies by species and location.

Most harvest of wild Columbia River salmon and steelhead occurs incidental to the harvest of hatchery fish and healthy wild stocks in the Columbia estuary, mainstem, and ocean. Fish are caught in the Canada/Alaska ocean, U.S. West Coast ocean, lower Columbia River commercial and recreational, tributary recreational, and in-river treaty Indian (including commercial, ceremonial, and subsistence) fisheries. Total exploitation rates have decreased for lower Columbia salmon and steelhead, especially since the 1970s as increasingly stringent protection measures were adopted for declining natural populations.

At the time of interim plan completion, fishing impact rates on lower Columbia River naturally-spawning salmon populations ranges from 2.5% for chum salmon to 45% for tule fall Chinook (Table P-22). These rates include estimates of direct harvest mortality as well as estimates of incidental mortality in catch and release fisheries. Fishery impact rates for hatchery produced spring Chinook, coho, and steelhead are higher than for naturally-spawning fish of the same species because of selective fishing regulations. These rates generally reflect recent year (2001-2003) fishery regulations and quotas controlled by weak stock impact limits and annual abundance of healthy targeted fish. Actual harvest rates will vary for each year dependent on annual stock status of multiple west coast salmon populations, however, these rates generally reflect expected impacts of harvest on lower Columbia naturally-spawning and hatchery salmon and steelhead under current harvest management plans.

Table P-22. Approximate annual exploitation rates (% harvested) for naturally-spawning lower Columbia salmon and steelhead under current management controls (represents 2001-2003 fishing period).

	AK./Can. Ocean	West Coast Ocean	Col. R. Comm.	Col. R. Sport	Trib. Sport	Wild Total	Hatchery Total	Historic Highs
Spring Chinook	13	5	1	1	2	22	53	65
Fall Chinook (Tule)	15	15	5	5	5	45	45	80
Fall Chinook (Bright)	19	3	6	2	10	40	n/a	65
Chum	0	0	1.5	0	1	2.5	2.5	60
Coho	<1	9	6	2	1	18	51	85
Steelhead	0	<1	3	0.5	5	8.5	70	75

Columbia River fall Chinook are subject to freshwater and ocean fisheries from Alaska to their rivers of origin in fisheries targeting abundant Chinook stocks originating from Alaska, Canada, Washington, Oregon, and California. Columbia tule fall Chinook harvest is constrained by a Recovery Exploitation Rate (RER) developed by NMFS for management of Coweeman naturally-spawning fall Chinook. Some tributary sport fisheries are closed to the retention of Chinook to protect naturally produced fall

Chinook populations. Harvest of lower Columbia bright fall Chinook is managed to achieve an escapement goal of 5,700 natural spawners in the North Fork Lewis.

Rates are very low for chum salmon, which are not encountered by ocean fisheries and return to freshwater in late fall when significant Columbia River commercial fisheries no longer occur. Chum are no longer targeted in Columbia commercial seasons and retention of chum is prohibited in Columbia River and Wind River sport fisheries. Chum are impacted incidental to fisheries directed at coho and winter steelhead.

Harvest of Wind coho occurs in the ocean commercial and recreational fisheries off the Washington and Oregon coasts and Columbia River as well as tribal fisheries in Zone 6. Wild coho impacts are limited in non-indian fisheries managed to retain marked hatchery fish and release unmarked wild fish.

Steelhead, like chum, are not encountered by ocean fisheries and non-Indian commercial steelhead fisheries are prohibited in the Columbia River. Incidental mortality of steelhead occurs in freshwater commercial fisheries directed at Chinook and coho and freshwater sport fisheries directed at hatchery steelhead and salmon. All recreational fisheries are managed to selectively harvest fin-marked hatchery steelhead and non-Indian commercial fisheries cannot retain hatchery or wild steelhead.

Access to harvestable surpluses of strong stocks in the Columbia River and ocean is regulated by impact limits on weak populations mixed with the strong. Weak stock management of Columbia River fisheries became increasingly prevalent in the 1960s and 1970s in response to continuing declines of upriver runs affected by mainstem dam construction. In the 1980s coordinated ocean and freshwater weak stock management commenced. More fishery restrictions followed ESA listings in the 1990s. Each fishery is controlled by a series of regulating factors. Many of the regulating factors that affect harvest impacts on Columbia River stocks are associated with treaties, laws, policies, or guidelines established for the management of other stocks or combined stocks, but indirectly control impacts of Columbia River fish as well. Listed fish generally comprise a small percentage of the total fish caught by any fishery. Every listed fish may correspond to tens, hundreds, or thousands of other stocks in the total catch. As a result of weak stock constraints, surpluses of hatchery and strong naturally-spawning runs often go unharvested. Small reductions in fishing rates on listed populations can translate to large reductions in catch of other harvestable stocks and reduce recreational trips to communities which provide access to fishing, resulting in significant economic consequences to those communities.

Selective fisheries for adipose fin-clipped hatchery spring Chinook (since 2001), coho (since 1999), and steelhead (since 1984) have substantially reduced fishing mortality rates for naturally-spawning populations and allowed concentration of fisheries on abundant hatchery fish. Selective fisheries occur in the Columbia River and tributaries, for spring Chinook and steelhead, and in the ocean, Columbia River, and tributaries for coho. Columbia River hatchery fall Chinook are not marked for selective fisheries, but likely will be in the future because of recent legislation enacted by Congress.

Mainstem and Estuary Habitat

Conditions in the Columbia River mainstem, estuary, and plume affect all anadromous salmonid populations within the Columbia Basin. Juvenile and adult salmon may be found in the mainstem and estuary at all times of the year, as different species, life history strategies and size classes continually rear or move through these waters. A variety of human activities in the mainstem and estuary have decreased both the quantity and quality of habitat used by juvenile salmonids. These include floodplain development; loss of side channel habitat, wetlands and marshes; and alteration of flows due to upstream hydro operations and irrigation withdrawals.

Effects on salmonids of habitat changes in the mainstem and estuary are complex and poorly understood. Effects are similar for Wind populations to those of most other subbasin salmonid populations. Effects are likely to be greater for chum and fall Chinook which rear for extended periods in the mainstem and estuary than for steelhead and coho which move through more quickly. Estimates of the impacts of human-caused changes in mainstem and estuary habitat conditions are available based on changes in river flow, temperature, and predation as represented by EDT analyses for the NPCC Multispecies Framework Approach (Marcot et al. 2002). These estimates generally translate into a 10-60% reduction in salmonid productivity depending on species (Appendix E). Estuary effects are described more fully in the estuary subbasin volume of this Plan (Volume II-A).

Hydropower Construction and Operation

There are no hydro-electric dams in the Wind River Basin. However, Wind River species are affected by changes in Columbia River mainstem and estuary related to Columbia basin hydropower development and operation. The mainstem Columbia River and estuary provide important habitats for anadromous species during juvenile and adult migrations between spawning and rearing streams and the ocean where they grow and mature. These habitats are particularly important for fall Chinook and chum which rear extensively in the Columbia mainstem and estuary. Aquatic habitats have been fundamentally altered throughout the Columbia River basin by the construction and operation of a complex of tributary and mainstem dams and reservoirs for power generation, navigation, and flood control.

The hydropower infrastructure and flow regulation affects adult migration, juvenile migration, mainstem spawning success, estuarine rearing, water temperature, water clarity, gas supersaturation, and predation. Dams block or impede passage of anadromous juveniles and adults. Bonneville Dam affects Wind River anadromous populations in juvenile and adult passage as well as lower Wind River spawning habitat inundation by Bonneville Reservoir. Columbia River spring flows are greatly reduced from historical levels as water is stored for power generation and irrigation, while summer and winter flows have increased. These flow changes affect juvenile and adult migration, and have radically altered habitat forming processes. Flow regulation and reservoir construction have increased average water temperature in the Columbia River mainstem and summer temperatures regularly exceed optimums for salmon. Supersaturation of water with atmospheric gases, primarily nitrogen, when water is spilled over high dams causes gas bubble disease. Predation by fish, bird, and marine mammals has been exacerbated by habitat changes. The net effect of these direct and indirect effects is difficult to quantify but is expected to be less significant for populations originating from lower Columbia River subbasins than for upriver salmonid populations. Additional information on hydropower effects can be found in Volume I.

Ecological Interactions

Ecological interactions focus on how salmon and steelhead, other fish species, and wildlife interact with each other and the subbasin ecosystem. Salmon and steelhead are affected throughout their lifecycle by ecological interactions with non native species, food web components, and predators. Each of these factors can be exacerbated by human activities either by direct actions or indirect effects of habitat alternation. Effects of non-native species on salmon, effects of salmon on system productivity, and effects of native predators on salmon are difficult to quantify. Strong evidence exists in the scientific literature on the potential for significant interactions but effects are often context- or case-specific.

Predation is one interaction where effects can be estimated although interpretation can be complicated. In the lower Columbia River, northern pikeminnow, Caspian tern, and marine mammal predation on salmon has been estimated at approximately 5%, 10-30%, and 3-12%, respectively of total salmon numbers (see Appendix E for additional details). Predation has always been a source of salmon mortality but predation rates by some species have been exacerbated by human activities.

Ocean Conditions

Salmonid numbers and survival rates in the ocean vary with ocean conditions and low productivity periods increase extinction risks of populations stressed by human impacts. The ocean is subject to annual and longer-term climate cycles just as the land is subject to periodic droughts and floods. The El Niño weather pattern produces warm ocean temperatures and warm, dry conditions throughout the Pacific Northwest. The La Niña weather patterns is typified by cool ocean temperatures and cool/wet weather patterns on land. Recent history is dominated by a high frequency of warm dry years, along with some of the largest El Niños on record—particularly in 1982-83 and 1997-98. In contrast, the 1960s and early 1970s were dominated by a cool, wet regime. Many climatologists suspect that the conditions observed since 1998 may herald a return to the cool wet regime that prevailed during the 1960s and early 1970s.

Abrupt declines in salmon populations throughout the Pacific Northwest coincided with a regime shift to predominantly warm dry conditions from 1975 to 1998 (Beamish and Bouillon 1993, Hare et al 1999, McKinnell et al. 2001, Pyper et al. 2001). Warm dry regimes result in generally lower survival rates and abundance, and they also increase variability in survival and wide swings in salmon abundance. Some of the largest Columbia River fish runs in recorded history occurred during 1985–1987 and 2001–2002 after strong El Niño conditions in 1982–83 and 1997–98 were followed by several years of cool wet conditions.

The reduced productivity that accompanied an extended series of warm dry conditions after 1975 has, together with numerous anthropogenic impacts, brought many weak Pacific Northwest salmon stocks to the brink of extinction and precipitated widespread ESA listings. Salmon numbers naturally ebb and flow as ocean conditions vary. Healthy salmon populations are productive enough to withstand these natural fluctuations. Weak salmon populations may disappear or lose the genetic diversity needed to withstand the next cycle of low ocean productivity (Lawson 1993).

Recent improvements in ocean survival may portend a regime shift to generally more favorable conditions for salmon. The large spike in recent runs and a cool, wet climate would provide a respite for many salmon populations driven to critical low levels by recent conditions. The Natural Research Council (1996) concluded: "*Any favorable changes in ocean conditions—which could occur and could increase the productivity of some salmon populations for a time—should be regarded as opportunities for improving management techniques. They should not be regarded as reasons to abandon or reduce rehabilitation efforts, because conditions will change again*". Additional details on the nature and effects of variable ocean conditions on salmonids can be found in Volume I.

P.3.9. Summary of Human Impacts on Focal Fish Species

Stream habitat, estuary/mainstem habitat, harvest, hatchery and ecological interactions have all contributed to reductions in productivity, numbers, and population viability. Pie charts in Figure P-31 describe the relative magnitude of potentially-manageable human impacts in each category of limiting factor. Impact values were developed for a base period corresponding to species listing dates. This depiction is useful for identifying which factors are most significant for each species and where improvements might be expected to provide substantial benefits. Larger pie slices indicate greater significance and scope for improvement in an impact for a given species. These numbers also serve as a working hypothesis for factors limiting salmonid numbers and viability.

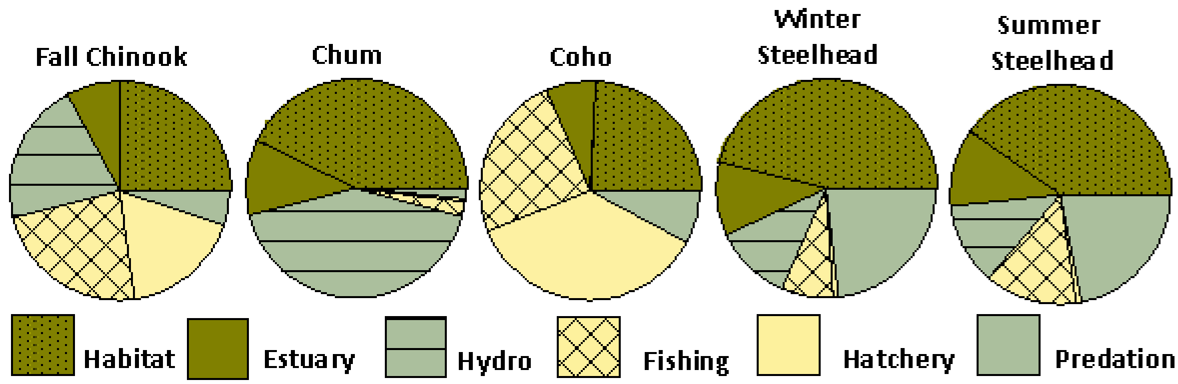


Figure P-31. Relative contribution of potentially manageable impacts for Wind populations.

This assessment indicates that current salmonid status is the result of large impacts distributed among several factors. No single factor accounts for a majority of effects on all species. Thus, substantial improvements in salmonid numbers and viability will require significant improvements in several factors. Loss of tributary habitat quality and quantity accounts for the largest relative impact on all species, except for coho and fall Chinook where harvest has an equally sizeable impact. Loss of estuary habitat quantity and quality is moderate for all species. Harvest has a relatively sizeable effect on fall Chinook and coho, while harvest impacts to steelhead and chum are moderate. Coho and fall Chinook are the only species impacted by hatcheries in the subbasin. Predation impacts are relatively moderate for all species, except steelhead where they are quite significant. The impact of hydrosystem access and passage is one of the more important relative impacts for chum which are substantial enough to minimize the relative importance of all other potentially manageable impact factors.

Impacts were defined as the proportional reduction in average numbers or productivity associated with each effect. Subbasin and estuary habitat impacts are the differences between the pre-development historical baseline and current conditions. Hydro impacts identify the percentage of historical habitat blocked by impassable dams and the mortality associated with juvenile and adult passage of other dams. Fishing impacts are the direct and indirect mortality in ocean and freshwater fisheries. Hatchery impacts include the equilibrium effects of reduced natural population productivity caused by natural spawning of less-fit hatchery fish and also effects of inter-specific predation by larger hatchery smolts on smaller wild juveniles. Hatchery impacts do not include other potentially negative indirect effects or potentially beneficial effects of augmentation of natural production. Predation includes mortality from northern pikeminnow, Caspian terns, and marine mammals in the Columbia River mainstem and estuary. Predation is not a direct human impact but was included because of widespread interest in it's relative significance. Methods and data for these analyses are detailed in Appendix E.

Potentially-manageable human impacts were estimated for each factor based on the best available scientific information. Proportions are standardized to a total of 1.0 for plotting purposes. The index is intended to illustrate order-of-magnitude rather than fine-scale differences. Only the subset of factors we can potentially manage were included in this index – natural mortality factors beyond our control (e.g. naturally-occurring ocean mortality) are excluded. Not every factor of interest is included in this index – only readily-quantifiable impacts are included.

P.3.10. Wildlife Habitat Limitations

Wildlife managers emphasized an ecosystem approach through use of focal habitat types while including components of single-species, guild, or indicator species assemblages. This approach is based on the following assumption: a conservation strategy that emphasizes focal habitats at the subbasin scale is more desirable than one that emphasizes individual species.

By combining the “coarse filter” (focal habitats) with the “fine filter” (focal wildlife species assemblage) approach, subbasin planners believe there is a much greater likelihood of maintaining, protecting and/or enhancing key focal habitat attributes and providing functioning ecosystems for wildlife. This approach not only identifies priority focal habitats, but also describes the most important habitat conditions and attributes needed to sustain obligate wildlife populations within these focal habitats. Although conservation and management is directed towards focal species, establishment of conditions favorable to focal species also will benefit a wider group of species with similar habitat requirements.

To ensure that species dependent on given habitats remain viable, Haufler (2002) advocated comparing the current availability of the habitat against its historic availability. According to Haufler (2002), this “coarse filter” habitat assessment can be used to quickly evaluate the relative status of a given habitat and its suite of obligate species. To ensure that “nothing drops through the cracks,” Haufler (2002) also advocated combining the coarse filter habitat analysis with a single species or “fine filter” analysis of one or more obligate species to further ensure that species viability for the suite of species is maintained.

The following rationale was used to guide selection of focal habitats for an illustration of the focal habitat/species selection process:

- Identification of habitats that can be used to evaluate ecosystem health and establish management priorities at the subbasin level (coarse filter)
- Identification of habitats that have experienced a dramatic reduction in acreage or quality within the subbasin
- Identification of habitats that are naturally sensitive and have likely undergone reduction in quantity and quality, although historical records may be lacking (riparian habitats)
- Other considerations included cultural, economical, ecological and special factors.
- Riparian Wetland Habitats

Protection of riparian wetlands wildlife habitat may yield the greatest gains for fish and wildlife per unit of area (Knutson and Naef 1997). Riparian habitat represents a relatively small portion of the subbasin's total area, but supports a higher diversity and abundance of fish and wildlife than any other habitat type. Riparian habitat provides important fish and wildlife breeding habitat, seasonal ranges, and movement corridors. Many species that primarily dwell in other habitat types depend on riparian areas during key portions of their life history.

Riparian habitat has important social values, including water purification, flood control, recreation, and aesthetics. But riparian wetlands are also highly vulnerable to alteration. The riparian wetlands have suffered degradation and losses to hydrological function as well as fragmentation of habitat. This phenomenon fragments movement corridors for fish and wildlife.

Riparian wetland habitats may be associated with any of the habitat types present within the Wind River subbasin (Table P-19). Riparian wetland habitats generally comprise microhabitats within forest habitat types within the Wind River basin or may be present as either micro or macrohabitat components of Westside Riparian-Wetlands, Montane Coniferous Wetlands, or Open Water habitats. The key findings, limiting factors, and working hypotheses for riparian wetland habitats and associated wildlife species are presented in Table P-23.

Old Growth Forest

Old growth forests may be associated with any of the forest habitat types in the Wind River subbasin (Table P-19). Old growth forested stands represent late seral stage forests with mature trees and defined habitat structure. Fire suppression activities generally promote old growth forest development while logging and development reduces old growth forest acreage. The key findings, limiting factors, and working hypotheses for old growth forest habitats and associated wildlife species are presented in Table P-24.

Table P-23. Riparian wetland habitat key findings, limiting factors, and working hypotheses.

Key Findings	Limiting Factors	Working Hypotheses
		RIPARIAN - WETLANDS
Habitat has suffered degradation and loss of hydrological function.	Overall Loss of Riparian Vegetation	Compliance with state and federal forest practices guidelines will assist in providing adequate riparian buffers. Shoreline development for residential property along key streams and rivers will contribute to overall riparian decline.
	Reduction in Floodplain Acreage	In riparian habitat, avoiding road-building activities, restoring habitat on abandoned roads or railroads and relocating problematic roads would decrease stream bank erosion, decrease sediment, and decrease disturbance to nesting species.
	Displacement of Native Riparian Vegetation with Non-native Vegetation	Reduction of the number of acres dominated by invasive non-native plant species will assist in improving riparian habitat condition for focal species and overall riparian habitat viability. (Weeds replace native trees and shrub)
	Incised Stream Reaches	Increasing floodplain area in selected reaches will allow for hydrologic reconnection into wetland habitats.
	Loss of Hydrological Function	Increasing beaver presence to historic level would help restore hydrological function to floodplains.
	Loss of Stream Complexity and Increased Flows	Appropriate silvicultural practices that maintain and enhance riparian habitat will increase presence of large woody debris in streams. This will increase both fish and wildlife focal species presence and population sizes.
Habitat has suffered habitat loss and fragmentation, removing corridors necessary for wildlife movement.	Hydrological diversions (e.g., irrigation, dams)	Re-establishment of natural floodplain habitat conditions and hydrological pathways would benefit wildlife habitat and result in population increases of focal species.
	Loss of Riparian Habitat and Function	Appropriate silvicultural practices that maintain and enhance terrestrial riparian habitat will decrease sediment discharge, maintain bank stabilization, and increase presence of large woody debris in streams. This will increase both fish and wildlife focal species presence and population sizes.
	Fragmentation of Habitat	Restoring and maintaining adequate riparian amounts of riparian habitat will restore and retain corridors used by wildlife as well as available habitat and forage. This will also retain water storage availability of riparian terrestrial habitat for release in drier seasons.
Yellow Warbler		
Habitat loss and degradation has negatively affected yellow warblers in the subbasin.	Reduction in Floodplain Acreage Overall Habitat Loss	Yellow warblers are an important indicator of riparian habitat. Identifying critical warbler habitat, inventorying habitat remaining, and monitoring habitat changes, both locally and at a landscape level, will measure the effectiveness future management and protection of riparian areas.

RIPARIAN - WETLANDS

Key Findings	Limiting Factors	Working Hypotheses
	Fragmentation of Habitat	
	Land Conversion	
	Reduced Food Base	Decrease misuse of herbicides and pesticides in riparian areas will decrease mortality of prey based need by yellow warblers.
Western Pond Turtle		
Western Pond Turtles have declined in number largely due to the loss and fragmentation of their historical habitat.	Fragmentation of Habitat	Reducing wetland conversion will decrease the amount of suitable turtle habitat that is lost and populations will increase.
		Reducing the development of wetlands will decrease the amount of suitable turtle habitat that is lost and populations will increase.
	Reduction in Floodplain Acreage	In wetlands, avoiding road-building activities and restoring habitat on abandoned roads / railroads and relocating problematic roads would decrease current and future fragmentation of potential and suitable habitat.
	Land Use Practices associated with Western Pond Turtle Habitat	Removing grazing from known turtle locations and better management of grazing in potential turtle habitat will reduce damage to aquatic and terrestrial wetland vegetation and increase survival of eggs and hatchlings.
Much of the western pond turtle's suitable habitat has become unsuitable due to habitat degradation.	Loss of Meadow and Grassland Habitat	Meadows and grasslands are needed for nesting in close association with wetlands occupied by western pond turtles.
	Displacement of Native Riparian Vegetation with Non-native Vegetation	Scot's broom and blackberry have impacted suitable western pond turtle habitat and will impact recovery efforts.
	Predation by Non-Native Animal Species	Control of non-native animal species, such bullfrogs and non-native fish, in occupied wetlands would increase turtle survival by reducing competition. It would also increase vegetation quality and structural complexity.
	Increase in Human Disturbance	Decreasing human recreational activities around known wetlands used by turtles would increase reproduction success and increase overall population growth.

Table P-24. Old growth forest key findings, limiting factors, and working hypotheses.

Key Findings	Limiting Factors	Working Hypotheses
OLD GROWTH FORESTS		
Habitat communities have changed considerably in stand structure and composition compared to historical conditions.	Reduction of Large Diameter Trees and Snags	Appropriate silvicultural practices that retain old overstory trees, increase average diameter of dominant trees, and decrease understory density will recover late seral composition and structure. These conditions increase habitat and forage available to wildlife.
	Increased Stand Density and Decreased Average Tree Diameter	Reintroduction of an ecologically-based fire regime (or fire mimicking silvicultural practices when fire cannot be reintroduced) will recover late seral stand dynamics, ecological function and habitat quality for wildlife. (Absence of fire leads to increased stand and stem density and susceptibility to disease and stand replacement fire).
	Loss of Native Understory Vegetation and Composition	Anthropogenic factors have resulted in the loss of old growth forest structure and have altered species composition.
Habitat communities have suffered habitat loss and fragmentation.	Loss of Large Tracts of Old Growth, or Late Seral, Forests	Silvicultural practices that retain large tracts of intact late seral forests will decrease temporary fragmentation of focal species habitat.
Western Gray Squirrel		
Western gray squirrels have suffered fragmentation between populations due in large part to fragmentation and degradation of late seral conditions on which they depend.	Reduction of Large Diameter Trees and Snags	Silvicultural practices that retain large tracts of intact late seral forests will decrease temporary fragmentation of western gray squirrel habitat.
	Increased Stand Density and Decreased Average Tree Diameter	Reintroducing fire into used and potentially used squirrel habitat will increase the quality of the habitat and result in greater numbers of western gray squirrels.
	Loss of Native Understory Vegetation and Composition	Proper subbasin management will decrease spread of non-native understory plant species and help reestablish a native plant community, thereby increasing habitat quality for western gray squirrels.
	Loss of Individual, Late Seral Trees (From Woodcutting)	Discouraging woodcutting in old growth stands will help retain late seral trees in landscape.

OLD GROWTH FORESTS

Key Findings	Limiting Factors	Working Hypotheses
Focal species have suffered declines in their population from competition and introduction of disease due to the presence of exotic squirrel species.	Increased Competition to Western Gray Squirrels	Reduction of California ground squirrels and eastern gray squirrels will increase survival of western gray squirrels locally, increasing numbers present in the subbasin.
Pileated Woodpecker		
Focal species has suffered a decline and degradation of their habitat resulting in loss of nesting and foraging habitat.	Reduction of Large Diameter Trees and Snags	Increasing the number of larger, late seral trees within pileated woodpecker range, with the use of selective silviculture practices and the reintroduction of a more historical fire regime, will increase available nesting trees and forage, resulting in increase in presence and numbers of pileated woodpecker in the subbasin.
	Loss of Large Tracts of Old Growth, or Late Seral Forests	Silvicultural practices and land use that retain large tracts of intact late seral forests will decrease temporary fragmentation of pileated woodpecker habitat.

Montane Coniferous Wetlands

The Montane Coniferous Wetlands wildlife habitat is ecologically and culturally important. This habitat type is naturally limited in its extent. The key findings, limiting factors, and working hypotheses for montane coniferous wetlands and associated wildlife species are presented in Table P-25.

Categories within this habitat type include wet meadows, streams, ponds, seeps, bogs, swamps, and other forested wetlands. Upland meadows have been declining steadily in numbers, size and quality. Meadows are extremely important to the functioning of the surrounding riparian systems as well as for adding habitat diversity within an otherwise forested matrix. They act as a water storage reserve and provide a continuing source of water for many surrounding streams throughout the summer. In many montane wetland types, forest practices and grazing activities over time have compressed the soil, caused stream channel incisement, increased sediment delivery, and decreased riparian cover. Loss of upland meadow habitat translates to functional losses, such as increased channel sedimentation, channel instability and bank erosion, lowered water table, and increased summer stream temperature. Fire suppression has contributed to forest encroachment on meadow habitats. Loss of wetland function and meadow structure decreases habitat quantity and suitability for native plant and wildlife species, and results in greater runoff peaks and lower baseflows. Meadows are also important culturally, supporting many species of edible and medicinal plants collected by tribal people.

Other montane wetlands (e.g. streams, ponds, seeps, bogs, and swamps) also provide unique habitat that is important to vegetation, fish, wildlife and people. This zone has wide ranging impacts on the terrestrial zones surrounding it and beyond. Likewise, terrestrial zones have an impact on riparian habitat.

Many animal species directly depend on streams for all or part of their life cycle (e.g. amphibians, aquatic insects, and fish). Aquatic secondary production (e.g. insects, tadpoles, and fish) provides food for riparian species such as birds, bats, and adult amphibians. Riparian lands and their vegetation also provide important habitat for land-based plants and animals. Not only is there an increased availability of water, there is often the presence of taller and denser vegetation, a more favorable microclimate, more or higher quality shelter and nesting sites, and greater concentration of food resources. Riparian lands often have the highest level of plant and animal biodiversity in the forest. Riparian land also provides critical corridors for movement of plants and animals across the landscape. Healthy streams are important to fish, but since all wildlife are connected within a food web, water quality is a fisheries, wildlife, and cultural concern.

Healthy riparian zones are also vital to forest health and sustainable land management. Predation upon aquatic organisms (insects, fish, or amphibians) could be a major pathway for movement of aquatic nutrients and energy, through riparian food webs, back into terrestrial ecosystems. This movement of nutrients makes healthy riparian habitats an important forest health issue.

Table P-25. Montane coniferous wetlands key findings, limiting factors, and working hypotheses.

	MONTANE CONIFEROUS WETLANDS	
Key Findings	**Limiting Factors**	**Working Hypotheses**
Montane Coniferous Wetlands have been and reduced in size and quality. Wet meadows have been especially reduced in size and number because of fire suppression, roads and other factors.	Tree and Shrub Encroachment into Wet Meadows	Reintroduction of an ecologically-based fire regime will decrease encroachment of conifers into montane wet meadows, increasing the water table and help reestablish proper hydrological function.
	Incised Streams and Loss of Wetland Function	Restoring stream channels in selected reaches will allow for hydrologic reconnection into wetland habitats.
	Displacement of Native Plant Communities by Non-native Plant Species	Removing reed canary grass (decreasing monotypic stands) will increase presence of native species, and increase habitat quality for wildlife.
	Overall Loss of Native Vegetation and Wetland Function	Appropriate management of livestock grazing in wetland areas minimizes damage to native meadow and streamside vegetation, reduces damage to stream banks, and reduces pollution in streams and ponds.
	Hydrological Alteration	Relocating wetland meadow roads, reducing or improving stream crossings, and locating motorized recreation to more appropriate sites improves hydrologic conditions, reduces fragmentation, and decreases disturbance to sensitive wildlife.
	Upland Hydrological Effects	Limiting silvicultural practices above meadows and enforcing a buffer around meadows will decrease sediment release in meadow hydrology and will increase water quality for fish and wildlife needs.
	Loss of Hydrological Function	Increasing beaver presence to historic level would help restore hydrological function to floodplains.
Oregon Spotted Frog		
Oregon spotted frogs have declined in number largely because of the loss and fragmentation of their historical habitat.	Loss of Wetlands	Decreasing the loss of wetlands to development and conversion would stabilize the populaton.
Much of the Oregon spotted frog's suitable habitat has become	Tree and Shrub Encroachment into Wet Meadows	Reintroduction of an ecologically-based fire regime will decrease encroachment of conifers into montane wet meadows, increasing the water table and help reestablish proper hydrological function.

MONTANE CONIFEROUS WETLANDS

Key Findings	Limiting Factors	Working Hypotheses
unsuitable because of habitat degradation.	Decrease in Water Quality	Increasing water quality in important breeding ponds would increase survivorship of tadpoles.
	Displacement of Native Plant Communities by Non-Native Plant Species	Removing reed canary grass (decreasing monotypic stands) will increase presence of native species, and increase habitat quality for Oregon spotted frog.
	Competition and Predation by Non-Native Species	Control of non-native animal species, such bullfrogs and non-native fish, in wetlands used by Oregon spotted frogs and western pond turtle would increase survival. It would also increase vegetation quality and structural complexity.
	Reduced Viability	Reduction of chemical runoff into key breeding ponds would decrease mortality of frogs.

P.4. Key Programs and Projects

This section provides brief summaries of current federal, state, local, and non-governmental programs and projects pertinent to recovery, management, and mitigation measures and actions in this subbasin. These descriptions provide a context for descriptions of specific actions and responsibilities in the management plan portion of this Plan. More detailed descriptions of these programs and projects can be found in the Comprehensive Program Directory (Appendix C).

P.4.1.Federal Programs

NMFS

NMFS is responsible for conserving, protecting and managing pacific salmon, ground fish, halibut, marine mammals and habitats under the Endangered Species Act, the Marine Mammal Protection Act, the Magnusen-Stevens Act, and enforcement authorities. NMFS administers the ESA under Section 4 (listing requirements), Section 7 (federal actions), and Section 10 (non-federal actions).

U.S. Army Corps of Engineers

The U.S. Army Corps of Engineers (USACE) is the Federal government's largest water resources development and management agency. USACE programs applicable to Lower Columbia Fish & Wildlife include: 1) Section 1135 – provides for the modification of the structure or operation of a past USACE project, 2) Section 206 – authorizes the implementation of aquatic ecosystem restoration and protection projects, 3) Hydroelectric Program – applies to the construction and operation of power facilities and their environmental impact, 4) Regulatory Program – administration of Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act.

Environmental Protection Agency

The Environmental Protection Agency (EPA) is responsible for the implementation of the Clean Water Act (CWA). The broad goal of the CWA is to restore and maintain the chemical, physical, and biological integrity of the nation's waters so that they can support the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water. The CWA requires that water quality standards (WQS) be set for surface waters. WQS are aimed at translating the broad goals of the CWA into waterbody-specific objectives and apply only to the surface waters (rivers, lakes, estuaries, coastal waters, and wetlands) of the United States.

U.S. Forest Service

The Unites States Forest Service (USFS) manages federal forest lands within the Gifford Pinchot National Forest (GPNF), the Columbia River Gorge National Scenic Area (CRGNSA), and Wilderness Areas. The GPNF operates under the Gifford Pinchot Forest Plan (GPFP). Management prescriptions within the GPFP have been guided by the 1994 Northwest Forest Plan, which calls for management of forests according to a suite of management designations including Reserves (e.g. late successional forests, riparian forests), Adaptively-Managed Areas, and Matrix Lands. Most timber harvest occurs in Matrix Lands. The GPNF implements a wide range of ecosystem restoration activities. The CRGNSA was established in 1986 to protect and provide for the enhancement of the scenic, cultural, recreational and natural resources of the Gorge; and to protect and support the economy of the Columbia River Gorge area. CRGNSA lands designated as General Management Area are subject to review of new development and land use. Lands within Wilderness areas are managed for protection and/or passive restoration of ecosystem processes.

Natural Resources Conservation Service

Formerly the Soil Conservation Service, the USDA Natural Resources Conservation Service (NRCS) works with landowners to conserve natural resources on private lands. The NRCS accomplishes this through various programs including, but not limited to, the Conservation Technical Assistance Program, Soil Survey Program, Conservation Reserve Enhancement Program, and the Wetlands Reserve Program. The NRCS works closely with local Conservation Districts; providing technical assistance and support.

Northwest Power and Conservation Council

The Northwest Power and Conservation Council, an interstate compact of Idaho, Montana, Oregon, and Washington, has specific responsibility in the Northwest Power Act of 1980 to mitigate the effects of the hydropower system on fish and wildlife of the Columbia River Basin. The Council does this through its Columbia River Basin Fish and Wildlife Program, which is funded by the Bonneville Power Administration. Beginning in Fiscal Year 2006, funding is guided by locally developed subbasin plans that are expected to be formally adopted in the Council's Fish and Wildlife Program in December 2004.

P.4.2.State Programs

Washington Department of Natural Resources

The Washington Department of Natural Resources governs forest practices on non-federal lands and is steward to state owned aquatic lands. Management of DNR public forest lands is governed by tenets of their proposed Habitat Conservation Plan (HCP). Management of private industrial forestlands is subject to Forest Practices regulations that include both protective and restorative measures.

Washington Department of Fish & Wildlife

WDFW's Habitat Division supports a variety of programs that address salmonids and other wildlife and resident fish species. These programs are organized around habitat conditions (Science Division, Priority Habitats and Species, and the Salmon and Steelhead Habitat Inventory and Assessment Program); habitat restoration (Landowner Incentive Program, Lead Entity Program, and the Conservation and Reinvestment Act Program, as well as technical assistance in the form of publications and technical resources); and habitat protection (Landowner Assistance, GMA, SEPA planning, Hydraulic Project Approval, and Joint Aquatic Resource Permit Applications).

Washington Department of Ecology

The Department of Ecology (Ecology) oversees: the Water Resources program to manage water resources to meet current and future needs of the natural environment and Washington's communities; the Water Quality program to restore and protect Washington's water supplies by preventing and reducing pollution; and Shoreline and the Environmental Assistance program for implementing the Shorelines Management Act, the State Environmental Protection Act, the Watershed Planning Act, and 401 Certification of USACE Permits.

Washington Department of Transportation

The Washington State Department of Transportation (WSDOT) must ensure compliance with environmental laws and statutes when designing and executing transportation projects. Programs that consider and mitigate for impacts to salmonid habitat include: the Fish Passage Barrier Removal program; the Regional Road Maintenance ESA Section 4d Program, the Integrated Vegetation Management & Roadside Development Program; Environmental Mitigation Program; the Stormwater Retrofit Program; and the Chronic Environmental Deficiency Program.

Washington Recreation and Conservation Office

Created through the enactment of the Salmon Recovery Act (Washington State Legislature, 1999), the Salmon Recovery Funding Board provides grant funds to protect or restore salmon habitat and assist related activities with local watershed groups known as lead entities. SRFB has helped finance over 500 salmon recovery projects statewide. The Aquatic Lands Enhancement Account (ALEA) was established in 1984 and is used to provide grant support for the purchase, improvement, or protection of aquatic lands for public purposes, and for providing and improving access to such lands. The Washington Wildlife and Recreation Program (WWRP), established in 1990 and administered by the RCO, provides funding assistance for a broad range of land protection, park development, preservation/conservation, and outdoor recreation facilities.

Lower Columbia Fish Recovery Board

The Lower Columbia Fish Recovery Board encompasses five counties in the Lower Columbia River Region. The 15-member board has four main programs, including habitat protection and restoration activities, watershed planning for water quantity, quality, habitat, and instream flows, facilitating the development of an integrated recovery plan for the Washington portion of the lower Columbia Evolutionarily Significant Units, and conducting public outreach activities.

P.4.3. Local Government Programs

Skamania County

Skamania County is not planning under the State's Growth Management Act in its Comprehensive Planning process. Skamania County manages natural resources primarily through a Critical Areas Ordinance. Skamania County has adopted special land use and environmental regulations implementing the Columbia River Gorge National Scenic Area Act for some areas within their jurisdiction.

Underwood Conservation District

The Underwood CD provides technical assistance, cost-share assistance, project and water quality monitoring, community involvement and education, and support of local stakeholder groups within the district. UCD implements a wide variety of programs, including conservation and restoration projects, water quality monitoring, a spring tree sales program, education and outreach activities, and support for local watershed committees.

P.4.4.Non-governmental Programs

Columbia Land Trust

The Columbia Land Trust is a private, non-profit organization founded in 1990 to work exclusively with willing landowners to find ways to conserve the scenic and natural values of the land and water. Landowners donate the development rights or full ownership of their land to the Land Trust. CLT manages the land under a stewardship plan and, if necessary, will legally defend its conservation values.

Lower Columbia Fish Enhancement Group

The Washington State Legislature created the Regional Fisheries Enhancement Group Program in 1990 to involve local communities, citizen volunteers, and landowners in the state's salmon recovery efforts. RFEGs help lead their communities in successful restoration, education and monitoring projects. Every group is a separate, nonprofit organization led by their own board of directors and operational funding from a portion of commercial and recreational fishing license fees administered by the WDFW, and other sources. The mission of the Lower Columbia RFEG (LCFEG) is to restore salmon runs in the lower Columbia River region through habitat restoration, education and outreach, and developing regional and local partnerships.

Wind River Watershed Council

The Wind River Watershed Council is a multi-stakeholder watershed group that addresses natural resource issues in the Wind River Basin through a collaborative approach. The Council has been active since 1998. The council has prioritized watershed restoration projects in the basin and has assisted with project funding and implementation. The group is facilitated by the Underwood Conservation District.

P.4.5.Tribal Programs

Cowlitz Indian Tribe

The Cowlitz Indian Tribe's Natural Resources program participates in research and restoration efforts in the lower Columbia region. The focus of their fish research and restoration efforts includes salmon, steelhead, eulachon, and lamprey.

P.4.6.NPCC Fish & Wildlife Program Projects

Wind River Watershed Restoration (Project 199801900)

Abstract: Restore habitat within the Wind River subbasin to support healthy populations of wild steelhead. Funding Status: funded 2000, 2001, 2002, recommended 2003.

Western Pond Turtle Recovery: The Bonneville Power Administration is currently funding a reintroduction of western pond turtles at Pierce National Wildlife Refuge (Skamania County) in the Columbia River Gorge. This program is part of the recovery effort for the western pond turtle in Washington. This reintroduction will represent the third population of western pond turtles in the Columbia River Gorge. A total of 250 turtles were released during the first four years of the reintroduction program (40 in 2000; 38 in 2001; 59 in 2002; 51 in 2003; and 62 in 2004). All years, turtles were released at two of the four main bodies of water on the refuge. Currently WDFW is monitoring this population. A representative subset of these turtles was tracked by radio telemetry to determine survival and habitat use.

P.4.7.Washington Salmon Recovery Funding Board Projects

Type	Project Name	Subbasin
Res	Hemlock Dam Assessment	Wind
Restoration	Upper Trout Creek Restoration	Wind
Restoration	Trout Creek Restoration/Hemlock Dam Removal	Wind

P.4.8.Wildlife Programs

Western Gray Squirrel

WDFW has conducted periodic surveys and studies of western gray squirrel populations and habitat. WDFW is currently conducting research on the ecology of the western gray squirrel in Klickitat County.

Yellow Warbler

There are no known on-going or completed yellow warbler-targeted conservation projects. Any project focused on riparian or wetland conservation or restoration is likely to benefit yellow warblers in the vicinity.

Pileated Woodpecker

There are no known on-going or completed pileated woodpecker-targeted conservation projects in the Wind River subbasin.

Band-tailed Pigeon

There are no known on-going or completed band-tailed pigeon-targeted conservation projects in the Wind River subbasin.

Western Pond Turtle

The Washington Department of Fish and Wildlife is actively engaged in management and recovery efforts for the western pond turtle. The Bonneville Power Administration is currently funding the majority of recovery work for the western pond turtle in the Columbia River Gorge. Western pond turtle conservation activities are also being conducted in cooperation with the Woodland Park Zoo and the Oregon Zoo. Surveys to determine the status of the pond turtle constituted most of the early work in Washington (Milner 1986, Zimmerman 1986). In 1990, the Department funded an intensive study of the Klickitat County population (Holland 1991); this work is currently ongoing.

Habitat Acquisition: Habitat for the Klickitat County population was purchased by the Department in the early 1990s. The Klickitat pond complex was purchased in 1992 and the lake was purchased in 1994. The USFS has recently purchased western pond turtle habitat in Skamania County. Current plans are to purchase additional small parcels of habitat in the Gorge for western pond turtles.

Habitat Enhancement: Grazing was discontinued at the Klickitat lake site after it was acquired by the Department. Also, at the request of the Department, the landowners of the Skamania County sites have reduced or discontinued grazing of uplands adjacent to some of the wetlands. The Nature Conservancy provided assistance to the Department and private landowners for habitat enhancement in Skamania County. Artificial rafts have been placed at a number of sites to improve opportunities for emergent basking. During 1991 and 1992, 45 rafts were distributed at 31 sites in five counties (Nordby 1992). In

1992, 24 rafts were placed in 22 lakes and marshes at Fort Lewis (Stringer 1992). Use of the woodenplank rafts by western pond turtles in Klickitat County appears to be high.

Surveys: In 1991, 128 wetlands in western Washington and the Columbia River Gorge were surveyed for western pond turtles (WDFW, unpubl. data). The following year, 88 sites in eight counties were surveyed by a group of biologists and 30 trained volunteers using a standardized survey protocol (Nordby 1992). Surveys were completed over an extensive area within the known range of the species based on historical pond turtle records and recent sighting reports (Nordby 1992; Scott 1995a, 1995b). Surveys were conducted during the annual peak of emergent basking activity March 15 through June 15. Each site was visited prior to this time to assess habitat, scout for observation points, and install artificial rafts. Basking rafts were constructed of 2" × 12" wooden planks nailed together to form a triangle or square. Such platforms can increase the probability of observing turtles and increase the number observed. Most sites were surveyed three times during the peak emergent basking period. Observations of suitable emergent basking sites were completed during times when basking was expected (Nordby 1992). Surveys in the Columbia River Gorge were continued in 1993 and 1994 (Scott 1995a, 1995b). The highest count of turtles simultaneously visible, air and water temperatures, weather conditions, a gross habitat assessment, land uses, and other wildlife observed were recorded on a standard form.

The results of these surveys reinforced previous impressions that western pond turtles are no longer present in many lakes and ponds within their historic range. However, knowledge of the distribution of turtles within the Skamania ponds population was greatly enhanced (Nordby 1992, Scott 1995b). These surveys identified potential reintroduction sites, sources of animals for captive propagation, and habitats used.

A draft *Western Pond Turtle Survey and Monitoring Plan* has been developed by the Interagency Western Pond Turtle Working Group (Barkhurst et al. 1997). The plan describes techniques and a standard protocol for inventorying and monitoring western pond turtle populations.

Toxicology: Following the disease outbreak in the Klickitat population in 1990, a toxicology study was conducted to assess water quality in the lake/pond complex. The lake had higher levels of aluminum than the ponds (Landis and Storch 1991) but the level was not high enough to cause acute toxicity, and there was no other evidence of chemical contamination.

Captive Breeding: In 1991, the Department of Wildlife, the Woodland Park Zoo, and the Center for Wildlife Conservation initiated a captive breeding program for western pond turtles. The objective of the program was to produce about 40 hatchlings per year for eventual release into suitable habitat in the state. The sex of hatchling turtles in part is determined by incubation temperature (Ewart et al. 1994), and the pond turtle eggs are incubated at a temperature that will produce mostly females.

The captive breeding program has included 9 adult turtles from Washington and 3 adult turtles from Oregon. Three groups of breeding turtles have been established: one of Columbia River Gorge origin, one likely of Puget Sound lowlands origin, and one of out-of-state origin. These stocks differ morphologically and genetically (Holland 1992, Gray 1995). Adults of Columbia River Gorge origin (3 females and 1 male) have been obtained from extant populations and four captive-bred sub-adults are being kept at the zoo for future captive breeding. Turtles collected from the Puget Sound lowlands were opportunistically obtained when turtles were found by private citizens and reported to the Department. This included: a male found in Tacoma, a female (now deceased) from Port Orchard, a female from Fife, and a male from Ravensdale (released at Lakewood in 1996; found dead in 1997). The third captive breeding group, composed of turtles from outside of Washington, has been assembled from zoos, veterinarians, and wildlife rehabilitators. This group included the 3 turtles from Oregon, and two males of unknown origin that were later released at a pond at Northwest Trek near Eatonville. This third group was used to help refine captive breeding techniques, and has not been used to provide juveniles for release in Washington.

Over the 7-year history of the captive breeding program all 38 juveniles released to the wild were the progeny of 6 adults (4 females and 2 males). Twelve were released into ponds in the Columbia River Gorge and 26 at the Lakewood pond complex in the Puget Sound lowlands.

Head Start Program: The Woodland Park Zoo, the Oregon Zoo, the Center for Wildlife Conservation, and the Department of Wildlife initiated a joint project in 1990 to improve recruitment in the Columbia Gorge populations. The objective of the program is to increase the survival chances of young turtles in the wild by "head starting" them at Woodland Park Zoo to a size where they can escape predation by bullfrogs. Headstarting has been demonstrated to improve survival of hatchling freshwater turtles where predation by bullfrogs is a problem (Haskell et al. 1996). Hatchlings are captive reared in an environment optimally suited for rapid growth. Juvenile turtles kept in these conditions year round can attain the size of a 2-year old wild turtle in a single year.

To obtain hatchlings from wild nests, adult female turtles are trapped in the spring and equipped with transmitters. All captured turtles (except for the smallest juveniles) are marked for individual identification by filing notches in the marginal scutes of the carapace according to the system described by Bury (1972). Transmitter-equipped turtles are monitored at two-hour intervals from 8:00 a.m. until dark starting on May 15 each year, and monitoring is continuous when a female is discovered to have left the pond. Monitoring of transmitter-equipped females continues until the turtle has laid eggs or until July 15, whichever comes first. This program relies heavily on volunteers to monitor the transmitter-equipped females.

Once a female has nested, a frame is placed over the nest to exclude predators and hold in any hatchlings that might emerge. Expected hatching dates are calculated based on the known dates on which the eggs are laid. Arrangements are made to visit nests at the appropriate time to check on the status of the eggs. Once hatching is underway, the hatchling turtles are taken to the zoo to begin a 1 to 2-year stay in captivity. Prior to release back to the wild, juvenile turtles are individually marked with notches in the marginal scutes of the carapace and a Passive Integrated Transponder (PIT tag) is inserted under the skin of a hind leg. The PIT tag is a computer chip encapsulated in medically safe glass that is pre-programmed with an identifying number that can be read with a portable reader.

The Head Start Program has successfully reared and released 805 juvenile western pond turtles since 1991 in the Columbia River Gorge. Of the 805 juvenile turtles, 359 were released in Klickitat County and 167 in Skamania County. Of 142 juveniles released by fall 1997, 61 had been recaptured at least once by fall 1998 (K. Slavens, unpubl. data). Each was weighed and found to have grown significantly since release. Visual surveys suggest that the survival of these head-started turtles is better than is indicated by the recapture information. Re-sightings of juveniles indicate that the program is likely to be successful at producing recruits that will eventually bolster the breeding population. Size distribution of captured turtles appears to be showing an increase in size classes between 80 and 120mm.

Predator Removal: To further improve the survival of juvenile turtles, considerable effort has been directed toward the removal of non-native predators such as bullfrogs and warmwater fish. Bullfrog control efforts were initiated under permit from the Department in the summer of 1990 (Slavens 1992). Bullfrogs were killed using a variety of techniques including spear and fishing gear. Bullfrogs and bullfrog tadpoles were also removed opportunistically in the course of other work such as when tadpoles were captured in hoop traps set for turtles. During May and June, the shorelines of ponds were searched for bullfrog egg masses and those discovered were removed using a dip net. Introduced warmwater fish (bass, bullheads, pumpkinseed, and bluegills) were gill-netted and removed from the Klickitat lake during a one-time seining operation in 1991. Other fish, primarily bullheads, were removed when caught in hoop traps incidental to turtle trapping. Control efforts at the Klickitat County sites have resulted in the removal of about 500 bullfrogs, 250 bullfrog tadpoles, over 175 bullfrog egg masses, over 400 kg (850 lbs) of warmwater fish, and 2 red-eared sliders. In addition, a local aquaculturist was employed by Woodland Park Zoo in 1998 to find and remove bullfrog egg masses.

Habitat Use: The climate and vegetation at the Skamania County pond complex are similar to areas in the south Puget Sound region, so the area was studied to answer questions about habitat use in a moist, forested environment. This information was also used to help characterize types of sites that should be considered for future reintroductions in the south Puget Sound area.

Since 1995 pond turtles have been monitored with radio-transmitters from May through December and data collected on movements as well as selection of nesting and overwintering sites. Monitoring was limited to twice per week in early summer and once per week after that continuing into December.

Because grazing had recently been discontinued at the Skamania ponds, the grass in the open pasture areas had grown tall and thick. In an attempt to determine how turtles might use these areas, broad paths were mowed through the tall grass. It was expected that turtles might show preference for mowed areas both for travel and, possibly, for nesting. The turtles, however, often moved through the tallest and densest grass rather than the paths that had been mowed.

Reintroduction: An investigation was conducted in 1995-96 to locate a site for the first reintroduction of captive-bred western pond turtles to the Puget Sound lowlands. Survey forms from previous turtle surveys were reviewed and sites were selected for field evaluation. In addition, areas of the south Puget Sound region with naturally open vegetation, such as the oak woodlands of Pierce and Thurston County, were reviewed. National Wetlands Inventory maps were used to find additional potentially suitable wetlands.

Criteria were developed to evaluate potential reintroduction sites. Desired conditions were:

- a complex of small ponds near sea level,
- abundant emergent basking sites,
- isolated by at least one half mile from busy roads and other centers of human activity,
- isolated from large bodies of water and streams
- emergent vegetation and a mud bottom,
- abundant invertebrate and larval amphibian prey,
- few or no non-native predators like largemouth bass and bullfrogs, and
- diversity of upland habitats, including open, grassy areas for nesting and dense clumps of deciduous trees or shrubs for overwintering.

Twenty-one sites were visited and evaluated during 1995-96. Several sites had habitat conditions conducive to successful reintroduction including Camp Pond in Mason County, Nisqually Lake on Fort Lewis in Pierce County, and a pond complex near Lakewood. The Lakewood pond complex was selected for the first reintroduction in part because the property is owned by the Department of Fish and Wildlife. The ponds are permanent, free of introduced aquatic predators, surrounded by open, grass-dominated vegetation, and are beginning to develop a deep silt bottom with abundant emergent and aquatic vegetation. The fence surrounding the site was repaired and a new section of fence was constructed so turtles would be retained within a 5 ha (12+ acre) area. A screen was installed over the stream outflow culvert and emergent basking logs were installed.

Releases were conducted in summer to give the turtles time to acclimate to the ponds prior to overwintering. During July and August 1996, 15 captive bred pond turtles at least one year of age and one adult turtle were released into the pond complex. Seven of the 15 juveniles selected for release were large enough to carry transmitters which were glued to their carapaces prior to release. Additional captive bred turtles were released at the site in 1997 (6), and 1998 (5). Behavior, growth, and survival are being monitored.

Larch Mountain Salamander

There are no known on-going or completed Larch Mountain salamander-targeted conservation projects in the Wind River subbasin.

Fisher

Fisher-targeted surveys have not been conducted, although general forest carnivore surveys have recently been completed. Survey techniques were developed in recent years to improve assessments of the status of rare forest carnivores in the West (Zielinski and and Kucera 1995). These techniques, and variations thereof, have been used to assess the status of fisher. WDFW, in cooperation with the USDA Forest Service, conducted marten surveys in 1992 and carnivore surveys in 1995-97 which would be expected to detect the presence of fisher. Most surveys failed to detect fishers.

In 1994, the Forest Service published a Conservation Assessment for forest carnivores including the lynx, American marten, wolverine, and fisher (Ruggiero et al. 1994). They also produced an extensive literature review and a proposed adaptive management strategy for fishers in the western U. S. (Heinemeyer and Jones 1994). These documents resulted from greater attention to the conservation, research and monitoring of forest carnivores. The Western Forest Carnivore Committee has produced maps of potential fisher habitat, draft Conservation Strategy overlays, and draft management recommendations for the Northern Rockies and for Idaho (Heinemeyer 1995, Ruediger 1994).

WDFW produced a Fact Sheet for the fisher in 1998, and is currently revising Priority Habitats and Species management recommendations for the fisher. Most jurisdictions have developed information brochures, packets, or classes for trappers that include information on techniques to avoid incidentally capturing fishers and other non-target species.

Bald Eagle

Consideration of bald eagles in land use management has increased tremendously since the federal listing of the species in 1978. In Washington, the special needs of bald eagles are incorporated in land management plans developed by all of the major federal landowners, including the U.S. Forest Service, the National Park Service, the Bureau of Land Management, the Department of Energy, and the Department of Defense. Washington tribes, most notably the Quinault and Colville Indian tribes, are also committed to monitoring and managing the bald eagles under their jurisdiction.

The Endangered Species Act also extends additional consideration of bald eagle needs to every project which receives federal funds or requires a federal permit. This requirement produces benefits to bald eagles through project modifications and mitigation associated with a wide variety of activities including transportation projects, developments in or near wetlands, hydroelectric dam licensing, irrigation systems operation, airport operations, and any work done with federal grant monies.

Surveys: The U.S. Fish and Wildlife Service and Washington Department of Game (WDG) conducted statewide annual aerial nesting surveys, from 1976 through 1979. In 1980, the WDG initiated annual inventories of nesting bald eagles. These statewide, comprehensive activity and productivity surveys (usually 2 aerial surveys) were conducted annually from 1980-1992. Statewide single flight nest activity surveys were continued through 1998. Aerial surveys of portions of western Washington where eagles are most abundant and development conflicts are most frequent were done in 1999 and 2000. The USFWS is developing a population monitoring scheme as part of the proposed federal de-listing of the species.

Winter counts of bald eagles began in 1962 when data was collected during the Mid-winter Waterfowl Inventory conducted by personnel from the USFWS and WDG. In 1979, the National Wildlife Federation assumed the task of coordinating a nation-wide combined agency and private volunteer winter count that involved 26,000 participants (Knight et al. 1981). WDG coordinated the Washington portion of the effort that involved 359 individuals in 1979. In subsequent years, the mid-winter survey involved as many as 1,100 volunteer observers (Taylor 1988, 1989). In 1982, the survey was standardized to 1,241 geographic survey units, 8 x 12 mi in area. The standardized Mid-winter Survey was conducted each winter from 1982-89. The state-wide Mid-winter Survey, which required much WDFW staff time to coordinate, compile, and report, was discontinued when it became apparent that the bald eagle was recovering and that much of the year-to-year variation in the number of wintering eagles was at least in part produced by conditions outside of Washington, such as prey abundance in British Columbia. Mid-winter surveys have been continued by volunteers and other agencies for discrete parts of the state (e.g. Skagit River, Whatcom County, Lake Roosevelt, etc.).

Management Plans: In 1984, the Washington legislature enacted state laws to protect the bald eagle and its habitat based on public concern for the species' precarious status, recognition of its role within ecological systems, and its value to human quality of life. Bald eagle protection rules were developed by a group with broad representation from interest groups, including farmers, realtors, tribes, timber companies, environmentalists, counties, and state agencies (Solomon and Newlon 1991). The Washington Wildlife Commission subsequently adopted the rules in November 1986. The rules specifically directed the Washington Department of Wildlife to work with landowners to cooperatively develop site-specific bald eagle management plans when landowner-proposed activities may adversely impact bald eagle habitat. Bald eagle plans consider the unique characteristics of individual eagle pairs, nest and roost sites, and surrounding land uses, as well as the goals of the landowner. Plans apply to individual landowners, and since most territories have multiple landowners, these plans are not a comprehensive territory management plan.

Bald eagle plan development by WDFW biologists began in earnest in 1987. From the inception of Washington's bald eagle protection rules to present, 1,154 bald eagle plans have been developed between WDFW and various landowner entities for activities on private, state, and municipal lands in 26 of 39 (67%) counties in Washington (Waterbury 2000). These bald eagle plans represent agreements for 393 discrete bald eagle occurrences (nest territories or roosts) throughout the state (mean = 2.9 plans/occurrence, range = 1-19). The number of bald eagle plans developed per year showed a steady rise from 9 plans in 1987 to 122 in 1999.

Land use activities prompting the development of bald eagle plans fall under 8 general categories: residential development, forest practice, forest practice with road building, forest conversion (i.e. to nonforestry use, usually residential development), non-residential commercial development, road building, shoreline development, and other development.

A key component of the management plan process is determining habitat protection and/or timing conditions based on landowner objectives and site specific factors. The conditions negotiated in bald eagle plans then become the key components of a legally-binding contract between WDFW and landowners. Nearly all plans (97%) assigned habitat protection or a combination of habitat protection and timing conditions (Waterbury 2000). The remaining 3% involved only timing restrictions and were typically for forest practice/ road building activities. In bald eagle plans prescribing habitat protection measures, four general types of vegetation management strategies were employed: no cut buffer; partial retention of trees; large tree retention; and tree planting, often in combination. 'Partial retention' was most frequently used, appearing in 76% of total bald eagle plans, while the 'no cut buffer' prescription was used in 38% of plans. In several bald eagle plans conditions were negotiated to relocate proposed home sites and roads, reconfigure lots in residential developments, maintain community open space in planned unit developments and curtail pedestrian access in residential commons. A review of plan conditions for minimum distance-to-activity revealed 39% of bald eagle plans permitted conditioned activity within 400 feet of bald eagle nests or roost sites (Waterbury 2000). This occurs primarily in territories where land is platted in many small lots.

Research: The bald eagle is one of the most studied species in the world, and the basics of reproduction, development, behavior, diet, and habitat use are well understood. There are still many unknowns about patterns of habitat use, the effects of various types of disturbance, etc. Filling some important gaps that remain in our knowledge require long term and often expensive studies of parameters such as survival rates, dispersal distance from natal nest to adult nesting location, and mean longevity. Research conducted in Washington is varied and includes most aspects of eagle ecology. Most of the earlier work is summarized in books by Stalmaster (1987) and Gerrard and Bortolotti (1988). There are numerous recent publications about work in Washington on: population inventory and monitoring (McAllister et al. 1986, Taylor 1989, Watson and Pierce 1998a); diet, foraging, and carrying capacity (Knight et al.1990, Knight and Anderson 1990, Hunt et al. 1992, Watson et al. 1991, Watson and Pierce 1998a); the effects of habitat change and human disturbance (Knight et al. 1991, McGarigal et al. 1991, Stalmaster and Kaiser 1997, 1998, Parson 1994, Watson and Pierce 1998a); contaminants (Anthony et al. 1993, Mahaffy et al. 2001); migration and movements (Watson and Pierce 1998a, 1998b, 2001); and perch and roost trees (Eisner 1991).

Habitat Acquisition: Conservation of bald eagles and their habitats was already underway before the federal listing of the Washington population in 1978. From 1990-98, 22 parcels of land encompassing a total of 2,267 ac of riparian and wetland habitat were acquired through state grants from the Washington Wildlife & Recreation Program that protected habitat for bald eagles.

Other Activities: Many private landowners have willingly retained nest, perch, and screening trees to contribute to bald eagle conservation. Many people appreciate having eagles on their property and have made sacrifices to accommodate them. Farmers and ranchers sometimes purposely leave carrion in their fields to provide food for eagles.

Lead shot was banned from use in hunting waterfowl in 1991, in part because of documented deaths of bald eagles and other protected species from lead poisoning. Eagles and other predators ingest shot incidental to consumption of waterfowl. The switch to non-toxic shot types for waterfowl hunting has probably reduced eagle fatalities resulting from lead poisoning, and poisonings should continue to decline as residual lead shot deposits break down or become unavailable to waterfowl.

Injured eagles have long been treated and cared for by licensed rehabilitators around the state. The Woodland Park Zoo has rehabilitated numerous injured bald eagles and released them at the Skagit River in fall and winter. A telemetry study of the fate of rehabilitated bald eagles in Minnesota found that 13 of 19 survived at least 6 weeks after release, and one female was known to have nested for 3 years after release (Martell et al. 1991).

The EagleCam was the first WDFW WildWatchCam project to appear on the agency website. It was initiated in May 2000, using newly available surveillance technology where a camera was installed at a Puget Sound bald eagle nest. The project was possible through a loan of cameras, volunteer installation by Tim Brown, and the involvement of the owners of the home below the nest. The project brought the home life of a family of eagles into homes all over the world via the internet (www.wa.gov/wdfw/). The website has been visited by over 400,000 people and provided an incredible opportunity to inform and educate the public about eagles and their conservation.

Oregon Spotted Frog

WDFW, WDNR, and the USFWS have surveyed Oregon spotted frog egg masses in Klickitat County since 1996. Currently no surveys have been conducted to locate any remnant populations in the Wind River subbasin.

Other Projects

Since the 1950s, WDFW has surveyed black-tailed deer populations, gathered hunting statistics and has worked with landowners on habitat projects that have benefited many species that use a variety of wildlife habitat. Watershed planning under the Washington Watershed Planning Act for water quanitity purposes has commenced in the Wind and White Salmon watersheds and is expected to produce a final report before summer 2005.

P.5. Management Plan

P.5.1. Vision

Washington lower Columbia salmon, steelhead, and bull trout are recovered to healthy, harvestable levels that will sustain productive sport, commercial, and tribal fisheries through the restoration and protection of the ecosystems upon which they depend and the implementation of supportive hatchery and harvest practices.

The health of other native fish and wildlife species in the lower Columbia will be enhanced and sustained through the protection of the ecosystems upon which they depend, the control of non-native species, and the restoration of a balanced predator/prey relationships.

The Wind Subbasin will play a key role in the regional recovery of salmon and steelhead. Salmonid recovery efforts will provide broad ecosystem benefits to a variety of subbasin fish and wildlife species. Recovery will be accomplished through a combination of improvements in subbasin, Columbia River mainstem, and estuary habitat conditions as well as careful management of hatcheries, fisheries, and ecological interactions among species.

Habitat protection or restoration will involve a wide range of Federal, State, Local, and non-governmental programs and projects. Success will depend on effective programs as well as a dedicated commitment to salmon recovery across a broad section of society.

Some hatchery programs will be realigned to focus on protection, conservation, and recovery of native fish. The need for hatchery measures will decrease as productive natural habitats are restored. Where consistent with recovery, other hatchery programs will continue provide fish for fishery mitigation purposes in the interim until habitat conditions are restored to levels adequate to sustain healthy, harvestable natural populations.

Directed fishing on sensitive wild populations will be eliminated and incidental impacts of mixed stock fisheries in the Columbia River and ocean will be regulated and limited consistent with wild fish recovery needs. Until recovery is achieved, fishery opportunities will be focused on hatchery fish and harvestabable surpluses of healthy wild stocks.

Columbia basin hydropower effects on Wind subbasin salmonids will be addressed by mainstem Columbia and estuary habitat restoration measures. Hatchery facilities in the Wind River will also be called upon to produce fish to help mitigate for hydropower impacts on upriver stocks where compatible with wild fish recovery.

This Plan uses a planning period or horizon of 25 years. The goal is to achieve recovery of the listed salmon species and the biological objectives for other fish and wildlife species of interest within this time period. It is recognized, however, full restoration of habitat conditions and watershed process for all species of interest will likely take 75 years or more.

P.5.2. Biological Objectives

Biological objectives for Wind subbasin salmonid populations are based on recovery criteria developed by Scientists of a Willamette/Lower Columbia Technical Recovery Team convened by NMFS. Criteria involve a hierarchy of ESU, Strata, and Population standards. A recovery scenario describing population-scale biological objectives for all species in all three strata in the lower Columbia ESUs was developed through a collaborative process with stakeholders based on biological significance, expected progress as a result of existing programs, the absence of apparent impediments, and the existence of other management opportunities. Under the preferred alternative, individual populations will variously contribute to recovery according to habitat quality and the population's perceived capacity to rebuild. Criteria, objectives, and the regional recovery scenario are described in greater detail in Volume I.

Focal populations in the Wind subbasin are targeted to improve to a level that contributes to recovery of the species. The scenario differentiates the role of populations by designating primary, contributing, and stabilizing categories. *Primary populations* are those that would be restored to high or better probabilities of persistence. *Contributing populations* are those where low to medium improvements will be needed to achieve stratum-wide average of moderate persistence probability. *Stabilizing populations* are those maintained at current levels.

Recovery goals call for restoring summer steelhead to above high viability level, providing for greater than 99% chance of persistence over 100 years, restoring coho to a high viability level, providing for a 95% probability of persistence over 100 years, restoring chum and fall Chinook to a medium level of viability, providing for a 75-94% probability of persistence over 100 years, and maintaining winter steelhead at low viability levels, providing for a 40-74% probability of persistence over 100 years.. Cutthroat will benefit from improvements in stream habitat conditions for anadromous species. Lamprey are also expected to benefit from habitat improvements in the estuary, Columbia River mainstem, and Wind subbasin although specific spawning and rearing habitat requirements are not well known. Bull trout do not occur in the subbasin.

Figure P-32. Current viability status of Wind River populations and the biological objective status that is necessary to meet the recovery criteria for the Coastal strata and the lower Columbia ESU.

Species	Population	Recovery priority[1]	Viability Status[2]	Viability Obj.[3]	Improve-ment[4]	Abundance Historic[5]	Abundance Current[6]	Abundance Target[7]
Fall Chinook (Tule)	Upper Gorge	Contributing	VL	M	>500%	n/a[8]	<50	1,200
Chum	Upper Gorge	Contributing	VL	M	>500%	11,000	<50	900
Winter Steelhead	Upper Gorge	Stabilizing	L	L	0%[9]	n/a[8]	200	200
Summer Steelhead	Wind	Primary	H	VH	0%[9]	n/a[8]	1,000	1,000
Coho	Upper Gorge	Primary	VL	H	400%	n/a[8]	<50	1,900

[1] Primary, Contributing, and Stabilizing designations reflect the relative contribution of a population to major population group recovery goals.
[2] Baseline viability is based on Technical Recovery Team viability rating approach.
[3] Viability objective is based on the scenario contribution.
[4] Improvement is the relative increase in population production required to reach the prescribed viability goal
[5] Historical population size inferred from presumed habitat conditions using Ecosystem Diagnosis and Treatment Model and NMFS back-of-envelope calculations.
[6] Approximate current annual range in number of naturally-produced fish returning to the watershed.
[7] Abundance target were estimated by population viability simulations based on viability goals.
[8] Historical abundance and recovery goal information is not available at this time due to a lack of information regarding population dynamics.
[9] Improvement increments are based on abundance and productivity, however, this population will require improvements in spatial structure or diversity to meet recovery objectives.

P.5.3.Integrated Strategy

An Integrated Regional Strategy for recovery emphasizes that 1) it is feasible to recover Washington lower Columbia natural salmon and steelhead to healthy and harvestable levels; 2) substantial improvements in salmon and steelhead numbers, productivity, distribution, and diversity will be required; 3) recovery cannot be achieved based solely on improvements in any one factor; 4) existing programs are insufficient to reach recovery goals, 5) that all effects on fish and habitat conditions must contribute to recovery, 6) actions needed for salmon recovery will have broader ecosystem benefits for all fish and wildlife species of interest, and 7) strategies and measures likely to contribute to recovery can be identified but estimates of the incremental improvements resulting from each specific action are highly uncertain. The strategy is described in greater detail in Volume I.

The Integrated Strategy recognizes the importance of implementing measures and actions that address each limiting factor and risk category, prescribing improvements in each factor/threat category in proportion to its magnitude of contribution to salmon declines, identifying an appropriate balance of strategies and measures that address regional, upstream, and downstream threats, and focusing near term actions on species at-risk of extinction while also ensuring a long term balance with other species and the ecosystem.

Population productivity improvement increments identify proportional improvements in productivity needed to recover populations from current status to medium, high, and very high levels of population viability consistent with the recovery scenario. Productivity is defined as the inherent population replacement rate and is typically expressed by models as a median rate of population increase (PCC model) or a recruit per spawner rate (EDT model). Corresponding improvements in spawner numbers, juvenile outmigrants, population spatial structure, genetic and life history diversity, and habitat are implicit in productivity improvements.

Improvement targets were developed for each impact factor based on desired population productivity improvements and estimates of potentially manageable impacts (see Section 3.7). Impacts are estimates of the proportional reduction in population productivity associated with human-caused and other potentially manageable impacts from stream habitats, estuary/mainstem habitats, hydropower, harvest, hatcheries, and selected predators. Reduction targets were driven by the strategy for equitable allocation of recovery responsibilities among all impact factors. Given the ultimate uncertainty in the effects of recovery actions and the need to implement an adaptive recovery program, this approximation should be adequate for developing order-of-magnitude estimates to which recovery actions can be scaled consistent with the current best available science and data. Objectives and targets will need to be confirmed or refined during Plan implementation based on new information and refinements in methodology.

The following table identifies population and factor-specific improvements consistent with the biological objectives for this subbasin. Per factor increments are less than the population net because factor affects are compounded at among different life stages and density dependence is largely limited to freshwater tributary habitat. Thus, productivity of Wind River fall Chinook must increase by 50% to reach population viability goals. For example, productivity of Wind River chum must increase by 500% to reach population viability goals. This requires a 50% reduction in impact in each of six factor categories. Thus, tributary habitat impacts on fall Chinook must decrease 30% relative to the current condition where habitat potential is only 50% of the historical potential.

Table P-26. Productivity improvements consistent with biological objectives for the Wind subbasin.

	Net	Per	Baseline impacts					
Species	**increase**	**factor**	**Hab.**	**Estuary**	**Dams**	**Pred.**	**Fishery**	**Hatch.**
Fall Chinook	500%	50%	0.70	0.22	0.58	0.14	0.65	0.50
Chum	500%	50%	0.97	0.25	0.96	0.03	0.05	0.01
Coho	400%	39%	0.50	0.15	0.10	0.19	0.50	0.75
Steelhead (Summer)	0%	0%	0.50	0.14	0.15	0.273	0.17	0.01

P.5.4.Habitat

Habitat assessment results were synthesized in order to develop specific prioritized measures and actions that are believed to offer the greatest opportunity for species recovery in the subbasin. As a first step toward measure and action development, habitat assessment results were integrated to develop a multi-species view of 1) priority areas, 2) factors limiting recovery, and 3) contributing land-use threats. For the purpose of this assessment, limiting factors are defined as the biological and physical conditions serving to suppress salmonid population performance, whereas threats are the land-use activities contributing to those factors. Limiting Factors refer to local (reach-scale) conditions believed to be directly impacting fish. Threats, on the other hand, may be local or non-local. Non-local threats may impact instream limiting factors in a number of ways, including: 1) through their effects on habitat-forming processes – such as the case of forest road impacts on reach-scale fine sediment loads, 2) due to an impact in a contributing stream reach – such as riparian degradation reducing wood recruitment to a downstream reach, or 3) by blocking fish passage to an upstream reach.

Priority areas and limiting factors were determined through the technical assessment, including primarily EDT analysis and the Integrated Watershed Assessment (IWA). As described later in this section, priority areas are also determined by the relative importance of subbasin focal fish populations to regional recovery objectives. This information allows for scaling of subbasin recovery effort in order to best accomplish recovery at the regional scale. Land-use threats were determined from a variety of sources including Washington Conservation Commission Limiting Factors Analyses, the IWA, the State 303(d) list, air photo analysis, the Barrier Assessment, personal knowledge of investigators, or known cause-effect relationships between stream conditions and land-uses.

Priority areas, limiting factors and threats were used to develop a prioritized suite of habitat measures. Measures are based solely on biological and physical conditions. For each measure, the key programs that address the measure are identified and the sufficiency of existing programs to satisfy the measure is discussed. The measures, in conjunction with the program sufficiency considerations, were then used to identify specific actions necessary to fill gaps in measure implementation. Actions differ from measures in that they address program deficiencies as well as biophysical habitat conditions. The process for developing measures and actions is illustrated in Figure P-33 and each component is presented in detail in the sections that follow.

Priority Areas, Limiting Factors and Threats

Priority habitat areas and factors in the subbasin are discussed below in two sections. The first section contains a generalized (coarse-scale) summary of conditions throughout the basin. The second section is a more detailed summary that presents specific reach and subwatershed priorities.

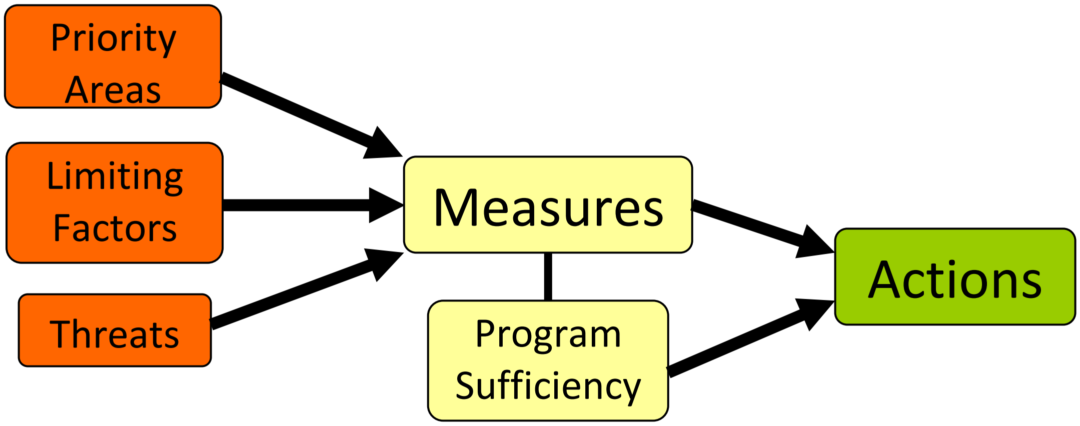


Figure P-33. Flow chart illustrating the development of subbasin measures and actions.

Summary: Decades of human activity in the Wind River Subbasin have significantly altered watershed processes and reduced both the quality and quantity of habitat needed to sustain viable populations of salmon and steelhead. Moreover, with the exception of fall Chinook, stream habitat conditions within the Wind Subbasin have a high impact on the health and viability of salmon and steelhead relative to other limiting factors. The following bullets provide a brief overview of each of the priority areas in the basin. These descriptions are a summary of the reach-scale priorities that are presented in the next section. These descriptions summarize the species most affected, the primary limiting factors, the contributing land-use threats, and the general type of measures that will be necessary for recovery. A tabular summary of the key limiting factors and land-use threats can be found in Table P-27.

- **Lower mainstem and Little Wind** *(reaches Wind 1-3; Little Wind 1)* – The lower mainstem and Little Wind River reaches provide habitat for fall Chinook, coho, and winter steelhead (and chum historically), all of which do not typically ascend Shipherd Falls at river mile 2. These reaches are impacted by the Bonneville Dam impoundment, development activities around the towns of Carson and Home Valley, and basin-wide forest practices. Effective recovery measures here will include controlling excessive runoff and soil erosion from the Carson Golf Course, floodplain reconnection near the mouth of the Little Wind, and passive restoration of riparian areas. Emphasis should also be placed on addressing sediment supply conditions in the Little Wind Basin.

- **Middle & upper mainstem Wind** *(reaches Wind 5a-7b)* – Productive reaches in the middle and upper mainstem are located between Stabler and Paradise Creek. These reaches have been impacted by upper basin forest practices and by localized riparian and floodplain development. Although restoration opportunities exist in these reaches, the primary recovery emphasis is preservation. The lower (privately-owned) reaches are likely to witness increased development along the river valley bottom. It is imperative that land-use planning and critical areas protections are adequate to prevent impairment of habitat and habitat-forming processes.

- **Trout Creek** *(reaches Trout 1a-2b; Martha Creek)* – The Trout Creek system contains productive steelhead spawning habitat in the Trout Creek flats area (reach Trout 1d) and good rearing in the reach just upstream of Hemlock Lake. Trout Creek flats was heavily impacted by past forest practices and has undergone significant restoration in recent years. The primary recovery emphasis is for preservation. These reaches are almost entirely within the Gifford Pinchot National Forest and there is good potential for continued preservation and passive restoration of watershed processes.

- **Wind and Panther Creek Canyons** *(reaches Wind 4a-4b; Panther 1a-1b)* – The lower Wind and Panther Creek canyons have good current production and have been identified in the technical assessment as having high preservation value. The Wind Canyon is located between Shipherd Falls and Trout Creek. Panther Creek Canyon extends from the mouth of Panther Creek to approximately

Cedar Creek. Although these reaches are surrounded by private lands, they are relatively protected from riparian impacts due to steep, inaccessible canyons. Residential development encroaches into the riparian corridor of Panther Creek in a few places but the impacts are minor. These reaches are most important for steelhead parr rearing. The recovery emphasis is for preservation and therefore no limiting factors or threats are identified for these areas.

- **Upper Panther** *(reaches Panther 1e-2a)* – Upper Panther Creek has high preservation value. These relatively functioning stream reaches support summer steelhead spawning and rearing and are completely within the Gifford Pinchot National Forest. There are good opportunities for passive restoration and preservation of watershed process conditions in the Panther Creek Basin.

Specific Reach and Subwatershed Priorities: Specific reaches and subwatersheds have been prioritized based on the Plan's biological objectives, fish distribution, critical life history stages, current habitat conditions, and potential fish population performance. Reaches have been placed into Tiers (1-4), with Tier 1 reaches representing the areas where recovery measures would yield the greatest benefits towards accomplishing the biological objectives. The reach tiering factors in each fish population's importance relative to regional recovery objectives, as well as the relative importance of reaches within the populations themselves. Reach tiers are most useful for identifying habitat recovery measures in channels, floodplains, and riparian areas. Reach-scale priorities were initially identified within individual populations (species) through the EDT Restoration and Preservation Analysis. This resulted in reaches grouped into categories of high, medium, and low priority for each population (see Stream Habitat Limitations section). Within a subbasin, reach rankings for all of the modeled populations were combined, using population designations as a weighting factor. Population designations for this subbasin are described in the Biological Objectives section. The population designations are 'primary', 'contributing', and 'stabilizing'; reflecting the level of emphasis that needs to be placed on population recovery in order to meet ESA recovery criteria.

Spatial priorities were also identified at the subwatershed scale. Subwatershed-scale priorities were directly determined by reach-scale priorities, such that a Group A subwatershed contains one or more Tier 1 reaches. Scaling up from reaches to the subwatershed level was done in recognition that actions to protect and restore critical reaches might need to occur in adjacent and/or upstream upland areas. For example, high sediment loads in a Tier 1 reach may originate in an upstream contributing subwatershed where sediment supply conditions are impaired because of current land use practices. Subwatershed-scale priorities can be used in conjunction with the IWA to identify watershed process restoration and preservation opportunities. The specific rules for designating reach tiers and subwatershed groups are presented in Table P-28. Reach tier designations for this basin are included in Table P-29. Reach tiers and subwatershed groups are displayed on a map in Figure P-34.

Table P-27. Salmonid habitat limiting factors and threats in priority areas. Priority areas include the lower mainstem & Little Wind (LW), middle & upper mainstem Wind (UW), and Trout Creek (TR). Linkages between each threat and limiting factor are not displayed – each threat directly and indirectly affects a variety of habitat factors.

Limiting Factors	LW	UW	TR
Habitat connectivity			
Blockages to off-channel habitats		✓	
Blockages to channel habitats			✓
Habitat diversity			
Lack of stable instream woody debris	✓	✓	✓
Altered habitat unit composition	✓	✓	✓
Loss of off-channel and/or side-channel habitats	✓	✓	✓
Channel stability			
Bed and bank erosion	✓	✓	✓
Channel down-cutting (incision)	✓	✓	✓
Mass wasting	✓		
Riparian function			
Reduced stream canopy cover	✓	✓	✓
Reduced bank/soil stability	✓	✓	✓
Exotic and/or noxious species	✓	✓	
Reduced wood recruitment	✓	✓	✓
Floodplain function			
Altered nutrient exchange processes	✓	✓	✓
Reduced flood flow dampening	✓	✓	✓
Restricted channel migration	✓	✓	✓
Disrupted hyporheic processes	✓	✓	✓
Stream flow			
Altered magnitude, duration, or rate of change	✓	✓	✓
Water quality			
Altered stream temperature regime	✓	✓	✓
Bacteria	✓	✓	
Substrate and sediment			
Excessive fine sediment	✓	✓	✓
Embedded substrates	✓	✓	✓

Threats	LW	UW	TR
Rural development			
Clearing of vegetation	✓	✓	
Floodplain filling	✓	✓	
Increased impervious surfaces	✓		
Increased drainage network	✓		
Roads – riparian/floodplain impacts	✓	✓	
Leaking septic systems	✓	✓	
Forest practices			
Timber harvests –sediment supply impacts	✓	✓	✓
Timber harvests – impacts to runoff		✓	✓
Riparian harvests	✓		✓
Forest roads – impacts to sediment supply	✓	✓	✓
Forest roads – impacts to runoff		✓	✓
Forest roads – riparian/floodplain impacts			✓
Splash-dam logging (historical)		✓	
Channel manipulations			
Bank hardening	✓	✓	
Channel straightening	✓	✓	
Artificial confinement	✓	✓	

Table P-28. Rules for designating reach tier and subwatershed group priorities. See Biological Objectives section for information on population designations.

Designation	Rule
Reaches	
Tier 1:	All high priority reaches (based on EDT) for one or more primary populations.
Tier 2:	All reaches not included in Tier 1 and which are medium priority reaches for one or more primary species and/or all high priority reaches for one or more contributing populations.
Tier 3:	All reaches not included in Tiers 1 and 2 and which are medium priority reaches for contributing populations and/or high priority reaches for stabilizing populations.
Tier 4:	Reaches not included in Tiers 1, 2, and 3 and which are medium priority reaches for stabilizing populations and/or low priority reaches for all populations.
Subwatersheds	
Group A:	Includes one or more Tier 1 reaches.
Group B:	Includes one or more Tier 2 reaches, but no Tier 1 reaches.
Group C:	Includes one or more Tier 3 reaches, but no Tier 1 or 2 reaches.
Group D:	Includes only Tier 4 reaches.

Table P-29. Reach Tiers in the Wind River Subbasin

Tier 1	Tier 2	Tier 4
Little Wind 1	Wind 2	Cedar
Panther 1a	Wind 3	CNFH
Panther 1b	Martha	Compass
Trout 1a	Panther 1e	Crater
Wind 4a	Panther 2a	Dry 1
Wind 4b	Trout 1c	EF Trout
Wind 6b	Trout 1d	Falls
	Trout 2a	Hemlock Dam
	Trout 2b	Hemlock Lake
	Wind 5b	Layout
	Wind 5c	Ninemile
	Wind 6a	Panther 1c
	Wind 6c	Panther 1d
	Wind 6d	Panther 2b
	Wind 7b	Paradise
		Shipherd Falls
		Trapper
		Trout 1b
		Trout 2c
		Trout 2d
		Wind 1
		Wind 5a
		Wind 5d
		Wind 7a
		Wind 7c
		Wind 7d

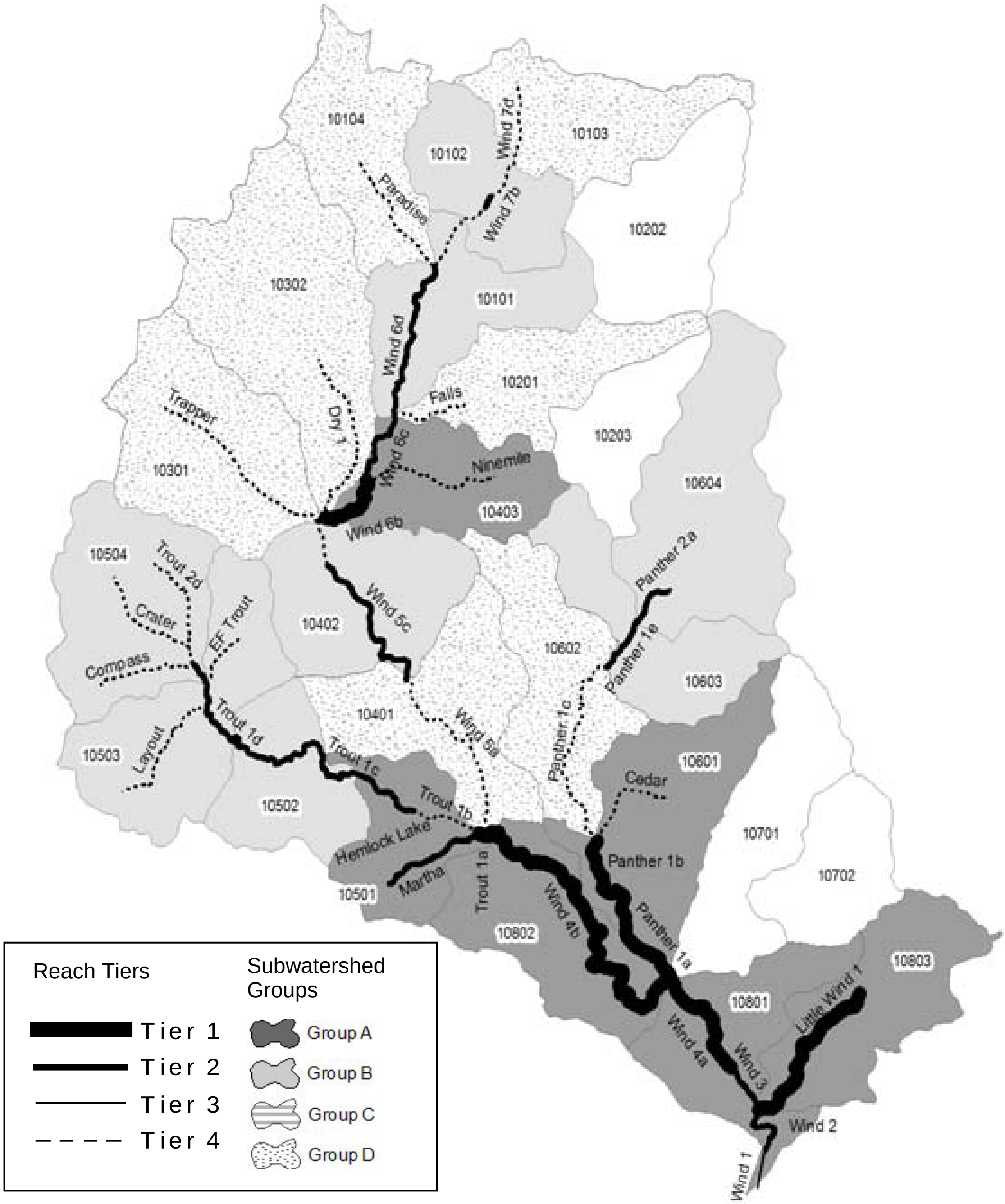


Figure P-34. Reach tiers and subwatershed groups in the Wind River Basin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives. The subwatershed groups are based on Reach Tiers. Priorities at the reach scale are useful for identifying stream corridor recovery measures. Priorities at the subwatershed scale are useful for identifying watershed process recovery measures. Watershed process recovery measures for stream reaches will need to occur within the surrounding (local) subwatershed as well as in upstream contributing subwatersheds.

Habitat Measures

Measures are means to achieve the regional strategies that are applicable to the Wind subbasin and necessary to accomplish the biological objectives for focal fish species. Measures are based on the technical assessments for this subbasin (Section 3.0) as well as on the synthesis of priority areas, limiting factors, and threats presented earlier in this section. The measures applicable to the Wind Subbasin are presented in priority order in Table P-30. Each measure has a set of submeasures that define the measure in greater detail and add specificity to the particular circumstances occurring within the subbasin. The table for each measure and associated submeasures indicates the limiting factors that are addressed, the contributing threats that are addressed, the species that would be most affected, and a short discussion. Priority locations are given for some measures. Priority locations typically refer to either stream reaches or subwatersheds, depending on the measure. Addressing measures in the highest priority areas first will provide the greatest opportunity for effectively accomplishing the biological objectives.

Following the list of priority locations is a list of the programs that are the most relevant to the measure. Each program is qualitatively evaluated as to whether it is sufficient or needs expansion with respect to the measure. This exercise provides an indication of how effectively the measure is already covered by existing programs, policy, or projects; and therefore indicates where there is a gap in measure implementation. This information is summarized in a discussion of Program Sufficiency and Gaps.

The measures themselves are prioritized based on the results of the technical assessment and in consideration of principles of ecosystem restoration (e.g. NRC 1992, Roni et al. 2002). These principles include the hypothesis that the most efficient way to achieve ecosystem recovery in the face of uncertainty is to focus on the following priorities for approaches: 1) protect existing functional habitats and the processes that sustain them, 2) allow no further degradation of habitat or supporting processes. 3) re-connect isolated habitat, 4) restore watershed processes (ecosystem function), 5) restore habitat structure, and 6) create new habitat where it is not recoverable. These priorities are adjusted depending on the results of the technical assessment and on the specific circumstances occurring in the basin. For example, re-connecting isolated habitat could be adjusted to a lower priority if there is little impact to the population created from passage barriers.

Habitat Actions

The prioritized measures and associated gaps are used to develop specific Actions for the subbasin. These are presented in Table P-31. Actions are different than the measures in a number of ways: 1) actions have a greater degree of specificity than measures, 2) actions consider existing programs and are therefore not based strictly on biophysical conditions, 3) actions refer to the agency or entity that would be responsible for carrying out the action, and 4) actions are related to an expected outcome with respect to the biological objectives. Actions are not presented in priority order but instead represent the suite of activities that are all necessary for recovery of listed species. The priority for implementation of these actions must consider the priority of the measures they relate to, the “size” of the gap they are intended to fill, and feasibility considerations.

Table P-30. Prioritized Measures for the Wind River Subbasin.

#1 – Protect stream corridor structure and function

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Protect floodplain function and channel migration processes B. Protect riparian function C. Protect access to habitats D. Protect instream flows through management of water withdrawals E. Protect channel structure and stability F. Protect water quality G. Protect the natural stream flow regime	Potentially addresses many limiting factors	Potentially addresses many limiting factors	All Species	The Wind Canyon (reaches 4a-4b) contains important juvenile steelhead rearing habitat and is in relatively good condition due to steep valley hillslopes. This privately owned area is a high priority for stream corridor protection measures. Other healthy and productive stream corridors that are a high priority for protection are located in the Little Wind and Panther Creek. The lower Wind, middle Wind (Wind 5c), lower Trout, and Martha Creek are other areas that are important for fish but that may be at risk of further degradation from land-use. Preventing further degradation of stream channel structure, riparian function, and floodplain function will be an important component of recovery.

Priority Locations

1st- Tier 1 or 2 reaches in the Wind Canyon and other reaches with functional riparian conditions according to the 1996 USFS Watershed Analysis Reaches: Wind 4a-4b; Little Wind 1; Panther 1a, 1b, & 1e

2nd- Tier 1 or 2 reaches in mixed-use lands at risk of further degradation Reaches: Wind 1-3 & 5c; Trout 1a; Martha Creek

3rd- All remaining reaches

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
NMFS	ESA Section 7 and Section 10	✓	
USFS	Northwest Forest Plan, National Gorge Scenic Act Ordinance	✓	
U.S. Army Corps of Engineers (USACE)	Dredge & fill permitting (Clean Water Act sect. 404); Navigable waterways protection (Rivers & Harbors Act Sect, 10)	✓	
WA Department of Natural Resources (WDNR)	State Lands HCP, Forest Practices Rules, Riparian Easement Program, Aquatic Lands Authorization	✓	
WA Department of Fish and Wildlife (WDFW)	Hydraulics Projects Approval	✓	
Skamania County	Comprehensive Planning		✓
Underwood Conservation District / Natural Resources Conservation Service (NRCS)	Landowner technical assistance, Conservation Programs (e.g. CREP)		✓
Noxious Weed Control Boards (State and County level)	Noxious Weed Education, Enforcement, Control		✓
Non-Governmental Organizations (NGOs) (e.g. Columbia Land Trust) and public agencies	Conservation easements		✓

Program Sufficiency and Gaps

Alterations to stream corridor structure that may impact aquatic habitats are regulated through the WDFW Hydraulics Project Approval (HPA) permitting program. Other regulatory protections are provided through USACE permitting, ESA consultations, HCPs, DNR Aquatic Lands Authorization, Northwest Forest Plan prescriptions, and County and Scenic Area Act regulations. Riparian areas within private timberlands are protected through the Forest Practices Rules (FPR) administered by WDNR. The FPRs came out of an extensive review process and are believed to adequately protect riparian areas with respect to stream shading, bank stability, and LWD recruitment. The program is new, however, and careful monitoring of the effect of the regulations is necessary. Land-use conversion and development are increasing in portions of the basin and current programs are inadequate to ensure that habitat will be protected. Conversion of land-use from forest to residential use has the potential to increase impairment of aquatic habitat, particularly when residential development is paired with flood control measures. Counties and the Gorge Commission can limit potentially harmful land-use conversions by thoughtfully directing growth through comprehensive planning and tax incentives, by providing consistent protection of critical areas across jurisdictions, and by preventing development in floodplains. In cases where programs are unable to protect critical habitat due to inherent limitations of regulatory mechanisms, land acquisition or conservation easements may be necessary. Public land acquisition should be used as a last resort due to strong opposition by Skamania County to reducing their tax base in an area that is already overwhelming publicly owned.

#2 – Protect hillslope processes

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Manage forest practices to minimize impacts to sediment supply processes, runoff regime, and water quality B. Manage growth and development to minimize impacts to sediment supply processes, runoff regime, and water quality	• Excessive fine sediment • Excessive turbidity • Embedded substrates • Stream flow – altered magnitude, duration, or rate of change of flows • Water quality impairment	• Timber harvest – impacts to sediment supply, water quality, and runoff processes • Forest roads – impacts to sediment supply, water quality, and runoff processes • Development – impacts to sediment supply, water quality, and runoff processes	All species	Hillslope runoff and sediment delivery processes have been degraded due to past intensive timber harvest and road building. Curtailed forest practices on public lands, however, have initiated natural recovery of hillslope processes throughout the middle and upper basin. In privately owned portions of the basin, timber harvest, rural residential development, and past agricultural activities have impacted sediment supply, runoff, and water quality processes. Protecting healthy areas and limiting additional degradation in impaired areas will be necessary for species recovery.

Priority Locations

1st- Functional subwatersheds contributing to Tier 1 or 2 reaches (impairment ratings are from the "local" sediment rating of IWA and from USFS for hydrology)
Subwatersheds: All subwatersheds

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDNR	Forest Practices Rules, State Lands HCP	✓	
USFS	Northwest Forest Plan	✓	
Skamania County	Comprehensive Planning		✓
Underwood Conservation District / NRCS	Conservation Programs; Landowner Technical Assistance		✓

Program Sufficiency and Gaps

Hillslope processes on federal timber lands are protected through the provisions of the Northwest Forest Plan. Private forest lands are protected through Forest Practices Rules administered by the WDNR. These rules, developed as part of the Forests & Fish Agreement, are believed to be adequate for protecting watershed sediment supply, runoff processes, and water quality on private forest lands. Small private landowners may be unable to meet some of the requirements on a timeline commensurate with large industrial landowners. Financial assistance to small owners would enable greater and quicker compliance. On non-forest lands, County and Gorge Scenic Act comprehensive planning is the primary nexus for protection of hillslope processes. County and Gorge Scenic Act ordinances can control impacts through zoning that protects open-space, through stormwater management ordinances, and through tax incentives to prevent forest land from becoming developed. These protections are especially important in the Stabler area where residential development is increasing. A recent report of water quantity and quality in the Stabler area cautions that land-use changes that reduce infiltration (i.e. added imperviousness) or that have the potential to release pollutants should be avoided in important aquifer recharge areas such as the former Wind River Nursery site, areas upstream of Hemlock Dam, and the area north of Stabler (Kennedy/Jenks Consultants 2004).

#3 - Restore floodplain function and channel migration processes

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Set back, breach, or remove artificial confinement structures	• Bed and bank erosion • Altered habitat unit composition • Restricted channel migration • Disrupted hyporheic processes • Reduced flood flow dampening • Altered nutrient exchange processes • Channel incision • Loss of off-channel and/or side-channel habitat • Blockages to off-channel habitats	• Floodplain filling • Channel straightening • Artificial confinement	All species	There has been significant degradation of floodplain connectivity and constriction of channel migration zones in portions of the basin. Some of the greatest impairments are located along the middle mainstem (between Stabler and Trapper Creek) and are related to roads and flood protection levees. Forest road related confinement exists on many other stream segments. Selective breaching, setting back, or removing confining structures would help to restore floodplain and CMZ function as well as facilitate the creation of off-channel and side channel habitats. There are challenges with implementation due to private lands, existing infrastructure already in place, potential flood risk to property, and large expense.

Priority Locations

1st- Tier 1 reaches with hydro-modifications (obtained from EDT ratings)
Reaches: Wind 2; Little Wind 1

2nd- Tier 2 reaches with hydro-modifications
Reaches: Wind 5b, 5c & 6d; Trout 1c, 2a & 2b

3rd- Other reaches with hydro-modifications
Reaches: Wind 5a & 5d; Trout 2c; Panther 1c-1d; Compass; Crater; Layout

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDFW	Habitat Program		✓
USFS	Habitat Projects		✓
USACE	Water Resources Development Act (Sect. 1135 & Sect. 206)		✓
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
Washington Department of Transportation	Roads		✓
NGOs, tribes, Conservation Districts, agencies, landowners	Habitat Projects		✓
Wind River Watershed Council	Habitat Projects		✓
WDNR	Aquatic Lands Authorization		✓

Program Sufficiency and Gaps

There currently are no programs that set forth strategies for restoring floodplain function and channel migration processes in the Wind Basin. Without programmatic changes, projects are likely to occur only seldom as opportunities arise and only if financing is made available. Means of increasing restoration activity include building partnerships with landowners, increasing landowner participation in conservation programs, allowing restoration projects to serve as mitigation for other activities, and increasing funding for NGOs, government entities, and landowners to conduct restoration projects. Floodplain restoration projects are often expensive, large-scale efforts that require partnerships among many agencies, NGOs, and landowners. Building partnerships is a necessary first step toward floodplain and CMZ restoration.

#4- Restore degraded hillslope processes on forest and developed lands

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Upgrade or remove problem forest roads B. Reforest heavily cut areas not recovering naturally C. Reduce watershed imperviousness D. Reduce effective stormwater runoff from developed areas	• Excessive fine sediment • Excessive turbidity • Embedded substrates • Stream flow – altered magnitude, duration, or rate of change of flows • Water quality impairment	• Timber harvest – impacts to sediment supply, water quality, and runoff processes • Forest roads – impacts to sediment supply, water quality, and runoff processes • Development – impacts to water quality and runoff processes	All species	Hillslope runoff and sediment delivery processes on forest lands have been degraded due to past intensive timber harvest and road building. These processes are currently recovering, aided by road maintenance and removal projects conducted by the USFS. Runoff and sediment delivery processes on private lands have been degraded through timber harvest, road building, and development. Of particular concern is runoff generated from the Carson Golf Course that has caused severe erosion in the lower river corridor. Degraded hillslope processes throughout the basin must be addressed for reach-level habitat recovery to be successful.

Priority Locations

1st- Moderately impaired or impaired subwatersheds contributing to Tier 1 reaches (based on "local" sediment rating from IWA and hydrologic condition from USFS)

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDNR	State Lands HCP, Forest Practices Rules	✓	
WDFW	Habitat Program	✓	
USFS	Northwest Forest Plan	✓	
Underwood Conservation District / NRCS	Conservation Programs; Landowner Technical Assistance; Habitat Projects		✓
Wind River Watershed Council	Habitat Projects		✓
Skamania County	Stormwater Controls		✓
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
NGOs, tribes, Conservation Districts, agencies, landowners	Habitat Projects		✓

Program Sufficiency and Gaps

Forest management programs including the Northwest Forest Plan (National Forest lands), the new Forest Practices Rules (private timber lands) and the WDNR's HCP (state timber lands) are expected to afford protections that will passively and actively restore degraded hillslope conditions. Timber harvest rules are expected to passively restore sediment and runoff processes. The road maintenance and abandonment requirements for private timber lands are expected to actively address road-related impairments within a 15 year time-frame. While these strategies are believed to be largely adequate to protect watershed processes, the degree of implementation and the effectiveness of the prescriptions will not be fully known for at least another 15 or 20 years. Of particular concern is the capacity of some forest land owners, especially small forest owners, to conduct the necessary road improvements (or removal) in the required timeframe. Additional financial and technical assistance would enable small forest landowners to conduct the necessary improvements in a timeline parallel to large industrial timber land owners. Ecological restoration of existing developed lands occurs relatively infrequently and there are no programs that specifically require restoration in these areas. Restoring existing developed lands can involve retrofitting buildings with new materials, replacing existing systems, adopting new management practices, and creating or re-configuring landscaping. Means of increasing restoration activity include increasing landowner participation through education and incentive programs, requiring Best Management Practices through permitting and ordinances, and increasing available funding for entities to conduct restoration projects.

#5 - Restore riparian conditions throughout the basin

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Restore the natural riparian plant community B. Eradicate invasive plant species from riparian areas	• Reduced stream canopy cover • Altered stream temperature regime • Reduced bank/soil stability • Reduced wood recruitment • Lack of stable instream woody debris • Exotic and/or invasive species	• Timber harvest – riparian harvests • Clearing of vegetation for residential development and agriculture (historical)	All species	Riparian conditions in the upper, forested portion of the basin have been degraded by past timber harvests but are now protected and are recovering. Riparian conditions in privately owned areas, especially along the middle mainstem between Stabler and Beaver Campground, have been degraded by past practices and recovery is limited due to existing land-uses and invasive species. There is a high potential benefit of riparian restoration due to the many limiting factors that are addressed. Riparian restoration projects are relatively inexpensive and are often supported by landowners.

Priority Locations

1st- Tier 1 reaches
2nd- Tier 2 reaches
3rd- Tier 3 reaches
4th- Tier 4 reaches

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDNR	State Lands HCP, Forest Practices Rules	✓	
WDFW	Habitat Program	✓	
USFS	Northwest Forest Plan, Habitat Projects	✓	
Underwood Conservation District / NRCS	Conservation Programs; Landowner Technical Assistance; Habitat Projects		✓
Wind River Watershed Council	Habitat Projects		✓
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
NGOs, tribes, Conservation Districts, agencies, landowners	Habitat Projects		✓
Noxious Weed Control Boards (State and County level)	Noxious Weed Education, Enforcement, Control		✓

Program Sufficiency and Gaps

There are no regulatory mechanisms for actively restoring riparian conditions; however, existing programs will afford protections that will allow for the *passive* restoration of riparian forests. These protections are believed to be adequate for riparian areas on forest lands that are subject to the Northwest Forest Plan, Forest Practices Rules or the State forest lands HCP. Other lands receive variable levels of protection through the Skamania County Comprehensive Plan. Many degraded riparian zones in rural residential or transportation corridor uses will not passively restore with existing regulatory protections and will require active measures that are not called for in any existing policy. Riparian restoration in these areas may entail tree planting, road relocation, invasive species eradication, and adjusting current land-use in the riparian zone. Means of increasing restoration activity include building partnerships with landowners, increasing landowner participation in conservation programs, allowing restoration projects to serve as mitigation for other activities, and increasing funding for NGOs, government entities, and landowners to conduct restoration projects.

#6 – Restore degraded water quality with emphasis on temperature impairments

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Increase riparian shading B. Decrease channel width-to-depth ratios C. Address leaking septic systems	• Altered stream temperature regime • Bacteria	• Timber harvest – riparian harvests • Clearing of vegetation due to rural development • Leaking septic systems	All species	Stream temperatures have been measured extensively throughout the Wind Basin. There are several stream segments that are known to have stream temperature impairment. Temperature impairment is believed to be related to riparian condition and channel width-to-depth ratios. There are also concerns with fecal coliform bacteria impairment in the mainstem Wind River and Trout Creek (WDOE 2002/2004 303d list). Bacteria contamination is more of a human health concern than a fish health concern. Leaking septic systems may be contributing to bacteria levels in some areas.

Priority Locations

1st- Tier 1 or 2 reaches with 303(d) listings
2nd- Other reaches with 303(d) listings
3rd- All remaining reaches

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
Washington Department of Ecology	Water Quality Program		✓
WDNR	State Lands HCP, Forest Practices Rules	✓	
WDFW	Habitat Program	✓	
USFS	Northwest Forest Plan, Wind River Water Quality Restoration Plan, Habitat Projects		✓
Underwood Conservation District / NRCS	Conservation Programs; Landowner Technical Assistance; Habitat Projects		✓
Wind River Watershed Council	Habitat Projects		✓
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
NGOs, tribes, Conservation Districts, agencies, landowners	Habitat Projects		✓
Skamania County	Comprehensive Planning, Carson Stormwater Ordinance, Stabler Area Water Quantity and Quality Study		✓
Skamania County Health Department	Septic System Program		✓

Program Sufficiency and Gaps

Ecology's Water Quality Program manages the State 303(d) list of impaired water bodies. There are several listings in the Wind River for temperature impairment and several areas of concern for fecal coliform bacteria (WDOE 2004). A temperature Water Quality Clean-up Plan (TMDL) has been prepared by Ecology in response to the 1998 303(d) temperature listings (Howard 2002). The Detailed Implementation Plan (DIP) based on the TMDL was issued in 2004 (Howard 2004). The DIP specified that "the basic implementation concept for achieving temperature reductions in the Wind River Watershed is that existing programs and requirements, if fully implemented, should result in meeting the plan targets." These existing programs include a USFS Wind River Watershed Water Quality Restoration Plan (Tracy et al. 2001), State Forest Practices Rules, a soon to be released Carson Stormwater Ordinance, a Stabler Area Water Quantity and Quality Study, and other various existing or anticipated agency programs (Howard 2002). The TMDL relies on an adaptive management approach to ensure that objectives are accomplished. It will be crucial that Ecology provides the necessary accountability to the various entities implementing the plan and that any deficiencies are adequately addressed. The 303(d) listings are believed to address the primary water quality concerns in the basin; however, other impairments may exist that the current monitoring effort is unable to detect. Additional monitoring is needed to fully understand the degree of water quality impairment in the basin, especially regarding agricultural pollutants.

#7 – Address passage issues at Hemlock Lake and Dam and at other barriers

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Restore access to isolated habitats blocked by culverts, dams, or other barriers	• Blockages to channel habitats • Blockages to off-channel habitats	Dams, culverts, in-stream structures	Summer steelhead	Hemlock Dam and Lake on Trout Creek are believed to create passage issues for adult and juvenile steelhead. Dam removal would improve passage conditions and allow for the restoration of aquatic habitat at the existing dam and lake site. Other passage barriers in the basin are located on small tributaries and are not believed to block a significant portion of habitat. Passage restoration projects should focus only on cases where it can be demonstrated that there is good potential benefit.

Priority Locations

1st- Hemlock Dam on Trout Creek

2nd- Other small tributaries with blockages

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDNR	Forest Practices Rules, Family Forest Fish Passage, State Forest Lands HCP	✓	
WDFW	Hydraulic Permit Approval	✓	
USFS	Dam Removal Assessment, Northwest Forest Plan, Habitat Projects		✓
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
Washington Department of Transportation / WDFW	Fish Passage Program	✓	
Skamania County	Roads	✓	

Program Sufficiency and Gaps

The USFS plans to remove Hemlock Dam in 2008 according to the selected alternative outlined in the Final EIS. The reservoir sediments will be excavated and moved off-site, the dam and associated facilities will be removed, and the stream channel will be rehabilitated through the site. For private timber lands, the Forest Practices Rules require forest landowners to restore fish passage at artificial barriers by 2016. Small forest landowners are given the option to enroll in the Family Forest Fish Program in order to receive financial assistance to fix blockages. The Washington State Department of Transportation, in a cooperative program with WDFW, manages a program to inventory and correct blockages associated with state highways. The Salmon Recovery Funding Board, through the Lower Columbia Fish Recovery Board, funds barrier removal projects. Past efforts have corrected major blockages and have identified others in need of repair. Additional funding is needed to correct remaining blockages. Further monitoring and assessment is needed to ensure that all potential blockages have been identified.

#8 - Restore channel structure and stability

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Place stable woody debris in streams to enhance cover, pool formation, bank stability, and sediment sorting B. Structurally modify channel morphology to create suitable habitat C. Restore natural rates of erosion and mass wasting within river corridors	• Lack of stable instream woody debris • Altered habitat unit composition • Reduced bank/soil stability • Excessive fine sediment • Excessive turbidity • Embedded substrates	• None (symptom-focused restoration strategy)	All species	Many stream channels lack the structure and habitat types to adequately support anadromous fish. Past splash-dam logging and riparian timber harvests have increased channel instability and decreased the availability of instream wood. Large wood installation projects could benefit habitat conditions in many areas although watershed processes contributing to wood deficiencies should be considered and addressed prior to placing wood in streams. There are a few areas along the lower mainstem where landslides, debris flows, and gullies have contributed large quantities of sediment to the river. Inadequate control of runoff at the Carson Golf Course is a major contributor. There are also portions of the middle Wind with severe bank erosion concerns. Recovery measures should focus on controlling stormwater runoff and using bio-engineered approaches that rely on structural as well as vegetative techniques to stabilize erosion-prone areas.

Priority Locations

1st- Tier 1 reaches
2nd- Tier 2 reaches
3rd- Tier 3 reaches
4th- Tier 4 reaches

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
NGOs, tribes, agencies, landowners	Habitat Projects		✓
WDFW	Habitat Program		✓
USACE	Water Resources Development Act (Sect. 1135 & Sect. 206)		✓
USFS	Northwest Forest Plan, Habitat Projects		✓
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
Skamania County	Comprehensive Planning (Stormwater Ordinance)		✓
Wind River Watershed Council	Habitat Projects		✓
Underwood Conservation District / NRCS	Conservation Programs; Landowner Tech Assistance; Habitat Projects		✓

Program Sufficiency and Gaps

There are no regulatory mechanisms for actively restoring channel stability and structure. Passive restoration is expected to slowly occur as a result of protections afforded to riparian areas and hillslope processes. There has been a significant amount of activity by the USFS to restore channel structure, stability, and key habitat types through LWD installation, bank stabilization, and channel adjustment. Similar projects have been conducted by the UCD and other cooperators on private lands. These projects have largely been opportunistic and have been completed due to the efforts of local biologists; such projects are likely to continue in a piecemeal fashion as opportunities arise and only if financing is made available. The lack of LWD in stream channels, and the importance of wood for habitat of listed species, places an emphasis on LWD supplementation projects. Means of increasing restoration activity include building partnerships with landowners, increasing landowner participation in conservation programs, allowing restoration projects to serve as mitigation for other activities, and increasing funding for NGOs, government entities, and landowners to conduct restoration projects. Erosion in the lower mainstem river corridor associated with gullying and landslides needs further assessment. This erosion is related to stormwater runoff and could be managed through local stormwater ordinance.

#9 – Provide for adequate instream flows during critical periods

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Protect instream flows through water rights closures and enforcement B. Restore instream flows through acquisition of existing water rights C. Restore instream flows through implementation of water conservation measures	• Stream flow – maintain or improve flows in tributaries during low-flow Summer months	• Water withdrawals	All species	Current and predicted consumptive water withdrawals are believed to represent a negligible amount of the low flow volume of the Wind River (Envirovision 2002). However, if new groundwater pumping were to occur at the former Wind River Nursery Site, there could be an impact on down-gradient private wells (Kennedy/Jenks 2004). This same study cautions that land-use changes at the former nursery site could reduce infiltration rates to this important aquifer recharge area. This measure applies to instream flows associated with water withdrawals and diversions, generally a concern only during low flow periods. Hillslope processes also affect low flows but these issues are addressed in separate measures.

Priority Locations

Entire Basin

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WRIA 29 Watershed Planning Unit	Watershed Planning		✓
Washington Department of Ecology	Water Resources Program		✓

Program Sufficiency and Gaps

The Water Resources Program of Ecology, in cooperation with the WDFW and other entities, manages water rights and instream flow protections. A collaborative process for setting and managing instream flows was launched in 1998 with the Watershed Planning Act (HB 2514), which called for the establishment of local watershed planning groups who's objective was to recommend instream flow guidelines to Ecology through a collaborative process. The current status and near-term direction of this planning effort is outlined in the WDOE's Action Plan for Setting, Achieving, and Protecting Instream Flows (WDOE 2004). The action plan is a working document that describes the strategies that will be used to set, achieve, and protect instream flows in each WRIA using the recommendations of local watershed planning units. In the case of the Wind River, "The [WRIA 29] Planning Unit developed a detailed instream flow proposal, but ultimately voted to not request a supplemental instream flow grant from Ecology. This was largely due to concerns with having responsibility for developing flow recommendations." (from Ecology's Watershed Planning website). The role of the Planning Unit in setting instream flows therefore remains uncertain. If the Planning Unit does not make any recommendations to Ecology, Ecology would have until 2007 to establish minimum instream flows.

#10 – Create/restore off-channel and side-channel habitat

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Restore historical off-channel and side-channel habitats where they have been eliminated B. Create new channel or off-channel habitats (i.e. spawning channels)	• Loss of off-channel and/or side-channel habitat	• Floodplain filling • Channel straightening • Artificial confinement	All species	There has been loss of off-channel and side-channel habitats, especially along the lower mainstem (below Little Wind Confluence) and in the middle Wind (between Stabler and Trapper Creek). Chum habitat in the lower Wind has been essentially eliminated by Bonneville Pool inundation and channelization; creation of off-channel habitats may be the only way to provide any chum habitat. In the middle Wind, targeted restoration or creation of habitats would increase available habitat where full floodplain and CMZ restoration is not possible.

Priority Locations

1st- Lower mainstem (below Little Wind confluence) and middle mainstem (Stabler to Trapper Creek)
2nd- Other reaches that may have potential for off-channel and side-channel habitat restoration or creation

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDFW	Habitat Program		✓
USFS	Habitat Projects		✓
Native American Tribes	Habitat Projects		✓
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
Wind River Watershed Council	Habitat Projects		✓
NGOs, tribes, Conservation Districts, agencies, landowners	Habitat Projects		✓
USACE	Water Resources Development Act (Sect. 1135 & Sect. 206)		✓

Program Sufficiency and Gaps

There are no regulatory mechanisms for creating or restoring off-channel and side-channel habitat. Means of increasing restoration activity include building partnerships with landowners, increasing landowner participation in conservation programs, allowing restoration projects to serve as mitigation for other activities, and increasing funding for NGOs, government entities, and landowners to conduct restoration projects.

Table P-31. Habitat actions for the Wind River Subbasin.

Action	Status	Responsible Entity	Measures Addressed	Spatial Coverage of Target Area[1]	Expected Biophysical Response[2]	Certainty of Outcome[3]
Wind 1. Continue to manage federal forest lands according to the Northwest Forest Plan	Activity is currently in place	USFS	1, 2, 4, 5, 6 & 7	High: National Forest lands	High: Increase in instream LWD; reduced stream temperature extremes; greater streambank stability; reduction in road-related fine sediment delivery; decreased peak flow volumes; restoration and preservation of fish access to habitats	High
Wind 2. Conduct floodplain restoration where feasible along the middle/upper mainstem and the lower mainstem. Build partnerships with landowners and agencies and provide financial incentives	New program or activity	NRCS, UCD, NGOs, WDFW, LCFRB, USACE, LCFEG	3, 5, 6, 7 & 8	Medium: Several reaches of the mainstem	High: Restoration of floodplain function, habitat diversity, and habitat availability.	High
Wind 3. Prevent floodplain impacts through land use controls and Best Management Practices	New program or activity	Skamania County, WDOE	1	Low: Applies to privately owned floodprone lands under county jurisdiction	High: Protection of floodplain function, CMZ processes, and off-channel/side-channel habitat. Prevention of reduced habitat diversity and key habitat availability	High
Wind 4. Expand standards in County Comprehensive Plans to afford adequate protections of ecologically important areas (i.e. stream channels, riparian zones, floodplains, CMZs, wetlands, unstable geology), particularly with respect to stormwater runoff	Expansion of existing program or activity	Skamania County	1 & 2	Low: Applies to private lands under county jurisdiction	High: Protection of water quality, riparian function, stream channel structure (e.g. LWD), floodplain function, CMZs, wetland function, runoff processes, and sediment supply processes	High
Wind 5. Manage future growth and development patterns to ensure the protection of watershed processes. This includes limiting the conversion of lands to developed uses through zoning regulations and tax incentives	Expansion of existing program or activity	Skamania County	1 & 2	Low: Applies to all private lands under county jurisdiction	High: Protection of water quality, riparian function, stream channel structure (e.g. LWD), floodplain function, CMZs, wetland function, runoff processes, and sediment supply processes	High
Wind 6. Increase funding available to purchase easements in sensitive areas in order to protect watershed function	Expansion of existing program or	LCFRB, NGOs, WDFW, USFWS,	1 & 2	Low: Residential or forest lands at risk of	High: Protection of riparian function, floodplain function, water quality, wetland function, and runoff and	High

[1] Relative amount of basin affected by action
[2] Expected response of action implementation
[3] Relative certainty that expected results will occur as a result of full implementation of action

Action	Status	Responsible Entity	Measures Addressed	Spatial Coverage of Target Area[1]	Expected Biophysical Response[2]	Certainty of Outcome[3]
where existing programs are inadequate	activity	BPA (NPCC)		further degradation	sediment supply processes	
Wind 7. Review and adjust operations to ensure compliance with the Endangered Species Act; examples include roads, parks, and weed management	Expansion of existing program or activity	Skamania County	1, 4, 5 & 6	Low: Applies to public lands under county jurisdiction	Medium: Protection of water quality; greater streambank stability; reduction in road-related fine sediment delivery; restoration and preservation of fish access to habitats	High
Wind 8. Increase technical assistance to landowners and increase landowner participation in conservation programs that protect and restore habitat and habitat-forming processes. Includes increasing the incentives (financial or otherwise) and increasing program marketing and outreach	Expansion of existing program or activity	NRCS, UCD, WDNR, WDFW, Skamania County	All measures	Low: Private lands. Applies to lands in rural residential and forestland uses	High: Increased landowner stewardship of habitat. Potential improvement in all factors	Medium
Wind 9. Fully implement and enforce the Forest Practices Rules (FPRs) on private timber lands in order to afford protections to riparian areas, sediment processes, runoff processes, water quality, and access to habitats	Activity is currently in place	WDNR	1, 2, 4, 5, 6 & 7	Low: Private commercial timber lands	High: Increase in instream LWD; reduced stream temperature extremes; greater streambank stability; reduction in road-related fine sediment delivery; decreased peak flow volumes; restoration and preservation of fish access to habitats	Medium
Wind 10. Address instream flow setting through the WRIA 29 Planning Unit and/or through WDOE	Expansion of existing program or activity	WDOE, WDFW, WRIA 29 Planning Unit	9	High: Entire basin	Medium: Adequate instream flows to support life stages of salmonids and other aquatic biota.	Medium
Wind 11. Increase the level of implementation of voluntary habitat enhancement projects in high priority reaches and subwatersheds. This includes building partnerships with landowners and agencies and increasing funding	Expansion of existing program or activity	LCFRB, BPA (NPCC), NGOs, WDFW, NRCS, UCD, LCFEG, WR Watershed Council	3, 4, 5, 6, 7, 8 & 10	High: Priority stream reaches and subwatersheds throughout the basin	Medium: Improved conditions related to water quality, LWD quantities, bank stability, key habitat availability, habitat diversity, riparian function, floodplain function, sediment availability, & channel migration processes	Medium
Wind 12. Address passage issues at Hemlock Dam and other barriers	Expansion of existing program or activity	USFS, WDFW, WDNR, Skamania County, WSDOT	7	Medium: There are few significant passage issues other than Hemlock Dam	Medium: Increased survival through Hemlock Dam and Lake Reach	Medium
Wind 13. Create and/or restore lost side-channel/off-channel habitat for chum spawning and coho overwintering	New program or activity	LCFRB, BPA (NPCC), NGOs, WDFW, NRCS, UCD, LCFEG	10	Low: Lower mainstem	Medium: Increased habitat availability for spawning and rearing	Low

Action	Status	Responsible Entity	Measures Addressed	Spatial Coverage of Target Area[1]	Expected Biophysical Response[2]	Certainty of Outcome[3]
Wind 14. Conduct forest practices on state lands in accordance with the Habitat Conservation Plan in order to afford protections to riparian areas, sediment processes, runoff processes, water quality, and access to habitats	Activity is currently in place	WDNR	1, 2, 4, 5, 6 & 7	Low: State timber lands in the Wind Basin (approximately 2% of the basin area)	Medium: Increase in instream LWD; reduced stream temperature extremes; greater streambank stability; reduction in road-related fine sediment delivery; decreased peak flow volumes; restoration and preservation of fish access to habitats. Response is medium because of location and quantity of state lands	Medium
Wind 15. Increase technical support and funding to small forest landowners faced with implementation of Forest Practices Rules to ensure full and timely compliance with regulations	Expansion of existing program or activity	WDNR	1, 2, 4, 5, 6 & 7	Low: Small private timberland owners	Medium: Increase in instream LWD; reduced stream temperature extremes; greater streambank stability; reduction in road-related fine sediment delivery; decreased peak flow volumes; restoration and preservation of fish access to habitats	Medium
Wind 16. Protect and restore native plant communities from the effects of invasive species	Expansion of existing program or activity	Weed Control Boards (local and state); NRCS, UCD, LCFEG	1 & 5	Medium: Greatest risk is in residential use areas	Medium: restoration and protection of native plant communities necessary to support watershed and riparian function	Low
Wind 17. Assess, upgrade, and replace on-site sewage systems that may be contributing to water quality impairment	Expansion of existing program or activity	Skamania County, UCD, LCFEG	6	Low: Private rural residential lands	Medium: Protection and restoration of water quality (bacteria)	Low

P.5.5.Hatcheries

This subbasin plan describes potential hatchery strategies and actions designed to address recovery objectives and hatchery risks detailed in Volume I and in hatchery program assessments described earlier in this Volume II chapter. These strategies and actions are largely based on assessments in the interim planning process that was completed in 2004. Strategies and actions are generally consistent with more recent plans based on HSRG analyses and WDFW's Conservation and Sustainable Fisheries Plan. However, in several cases, the ongoing hatchery reform and planning process has identified revisions to the alternatives presented herein.

Subbasin Hatchery Strategy

The desired future state of fish production within the Wind River Basin includes natural salmon and steelhead populations which are improving on a trajectory to recovery and hatchery programs that either enhance the natural fish recovery trajectory or are operated to not impede progress towards recovery. Carson National Fish Hatchery must also meet the requirements identified in Federal Court ordered Agreements reached through the *U.S. v, Oregon* Forum. Hatchery recovery measures specific to the ecological and biological circumstances in the Wind River basin will be implemented to attain the desired future state of hatchery operations. A summary of the types of natural production enhancement strategies and fishery enhancement strategies to be implemented in the Wind River Basin are displayed by species in Table P-32.

Table P-32. Summary of potential natural production and fishery enhancement strategies for the Wind River.

		Species					
		Fall Chinook	Spring Chinook	Coho	Chum	Winter Steelhead	Summer Steelhead
Natural Production Enhancement	Supplemetation						
	Hatch/Nat Conservation [1]						
	Isolation						
	Refuge						✓
Fishery Enhancement	Hatchery Production		✓				

[1] Hatchery and natural population management strategy coordinated to meet biological recovery objectives. Strategy may include integration and/or isolation strategy over time. Strategy will be unique to biological and ecological circumstances in each watershed.

Conservation-based hatchery programs include strategies and measures which are specifically intended to enhance production of a particular wild fish population within the basin. Hatchery conservation strategies employ four general approaches:

Hatchery Supplementation: This strategy utilizes hatchery production as a tool to assist in rebuilding depressed natural populations. Supplementation would occur in selected areas that are producing natural fish at levels significantly below current capacity or expected increases capacity as a result of immediate benefits of habitat or passage improvements. This strategy would not be included in near-term measures for the Wind Basin.

Hatchery/Natural Merged Conservation Strategy: A unique conservation strategy is developed for each watershed depending on the status of the natural population, the biological relationship between the hatchery and natural populations, ecological attributes of the watershed, and logistical opportunities to jointly manage the populations. This strategy may include integration or isolation, annual abundance driven distribution, and brood stock development. The strategies are expected to evolve over time dependent on changes in the populations and in the habitat productivity. This strategy is currently aimed at Chinook salmon in areas where harvest production occurs. There is not a spring Chinook harvest program in the Wind Basin but not a natural spring Chinook population to manage for. There is no fall Chinook hatchery program in the Wind basin.

Hatchery/Natural Isolation: This strategy is focused on separating hatchery adult fish from Natural produced adult fish to avoid or minimize spawning interactions. The strategy may be implemented in the entire watershed or more often in a section of the watershed upstream of a barrier or trap where the hatchery fish can be removed. This strategy is currently aimed at hatchery steelhead in watersheds with trapping capabilities. The strategy may also become part of spring and fall Chinook as well as coho strategy in certain watersheds in the future as unique wild runs develop. This strategy would not be included in near-term measures for the Wind Basin but could be considered in the future for coho.

Natural Refuge Watersheds: This strategy is species specific and requires certain sub-basins to be designated as wild fish only areas for a particular species. The refuge areas include watersheds where populations have persisted with minimum hatchery influence and areas that may have a history of hatchery production but would not be subjected to future hatchery influence as part of the recovery strategy. More refuge areas may be added over time as wild populations recover. The Wind River Basin would be a refuge area for natural summer steelhead

The majority of funding for lower Columbia basin hatchery operations is for producing salmon and steelhead for harvest to mitigate for lost harvest of natural production due to hydro development and habitat degradation. Programs for fishery enhancement will continue during the recovery period, but will be managed to minimize risks and ensure they do not compromise recovery objectives for natural populations. It is expected that the need to produce compensatory fish for harvest through artificial production will reduce in the future as natural populations recover and become harvestable. There are fishery enhancement programs for spring Chinook in the Wind Basin.

The Carson National Fish Hatchery will continue to support spring Chinook fisheries with hatchery releases in the Wind Basin. Fall Chinook, steelhead, or coho will not be included as a harvest program in the Wind Basin. (Table P-33)

Table P-33. A summary of conservation and harvest strategies to be implemented through Wind River Hatchery programs.

		Stock
Natural Production Enhancement	Supplementation	
	Hatch/Nat Conservation [1]	
	Isolation	
	Refuge	Summer Steelhead
	Broodstock development	
Fishery Enhancement	In-basin releases (final rearing at Wind)	Carson Spring Chinook
	Out of Basin Releases (final rearing at Wind)	

[1] May include integrated and/or isolated strategy over time.

Hatchery Measures and Actions

Hatchery strategies and measures are focused on evaluating and reducing biological risks consistent with the recovery strategies. Artificial production programs within the Wind River facilities have been evaluated in detail through the WDFW Benefit-Risk Assessment Procedure (BRAP) relative to risks to natural populations. The BRAP results were utilized to inform the development of these program actions specific to the Wind River Basin (Table P-34). The BRAP was completed prior to the 2004 adoption of the Interim Recovery Plan. Additional analyses of hatchery programs and reforms were subsequently completed based on reviews by a regional Hatchery Scientific Review Group (HSRG). The HSRG is the independent scientific review panel of the Pacific Northwest Hatchery Reform Project established by Congress in 2000 in recognition that while hatcheries play a legitimate role in meeting harvest and conservation goals for Pacific Northwest salmon and steelhead, the hatchery system was in need of comprehensive reform. The HSRG has reviewed all state, tribal and federal hatchery programs in Puget Sound, Coastal Washington, and the Columbia River Basin. Results of the HSRG review may be found in their 2009 final report (http://www.hatcheryreform.us/mfs/welcome_show.action).

The Sub-Basin plan hatchery recovery actions were developed in coordination with WDFW and at the same time as the Hatchery and Genetic Management Plans (HGMP) were developed by WDFW for each hatchery program. As a result, the hatchery actions represented in this document will provide direction for specific actions which will be detailed in the HGMPs submitted by WDFW for public review and for NMFS approval. It is expected that the HGMPs and these recovery actions will be complementary and provide a coordinated strategy for the Wind River Basin hatchery programs. Further explanation of specific strategies and actions for hatcheries can be found in the Lower Columbia Salmon and Steelhead Recovery and SubBasin Plan, Volume I, Chapter 5 under Regional Strategies and Measures.

Table P-34. Potential hatchery Program actions to be implemented in the Wind River Basin.

Action	Description	Comments
	Evaluate Carson NFH facility and operations.	Evaluate through HGMP and APRE processes to assess need for facility and operational changes to reduce impacts to wild salmonids.
	Juvenile release strategies to minimize impacts to naturally-spawning populations.	Release strategies would be aimed at minimizing interactions between hatchery released spring Chinook smolts and wild steelhead, fall Chinook, chum, and coho.
	Adaptively manage hatchery programs to further protect and enhance natural populations and improve operational efficiencies.	Appropriate research, monitoring, and evaluation programs along with guidance from regional hatchery evaluations will be utilized to improve the survival and contribution of hatchery fish, reduce impacts to natural fish, and increase benefits to natural fish.

The Carson Hatchery is a large-scale Mitchell Act Facility which is operated to meet subbasin and out-of-subbasin goals. Operations will be cooredinated with other habitat strategies in this Plan. Coordination will be addressed in the Mitchell Act EIS process being initiated by NMFS. NMFS is in the process of preparing an Environmental Impact Statement (EIS) for the funding an operation of Columbia River hatcheries under the Mitchell Act (Public Law 75-502). The EIS will evaluate the environmental impacts of a full range of alternatives for funding and operation of Columbia River Hatchery programs consistent with the Mitchell Act, Endangered Species Act (ESA), Tribal trust responsibilities, and broader NMFS objectives for sustainable fisheries under the Magnuson-Stevens Fisheries Conservation and Management Act.

P.5.6.Harvest

Fisheries are both an impact that reduces fish numbers and an objective of recovery. The long-term vision is to restore healthy, harvestable natural salmonid populations in many areas of the lower Columbia basin. The near-term strategy involves reducing fishery impacts on natural populations to ameliorate extinction risks until a combination of actions can restore natural population productivity to levels where increased fishing may resume. The regional strategy for interim reductions in fishery impacts involves: 1) elimination of directed fisheries on weak natural populations, 2) regulation of mixed stock fisheries for healthy hatchery and natural populations to limit and minimize indirect impacts on natural populations, 3) scaling of allowable indirect impacts for consistency with recovery, 4) annual abundance-based management to provide added protection in years of low abundance while allowing greater fishing opportunity consistent with recovery in years with much higher abundance, and 5) mass marking of hatchery fish for identification and selective fisheries.

Actions to address harvest impacts are generally focused at a regional level to cover fishery impacts accrued to lower Columbia salmon as they migrate along the Pacific Coast and through the mainstem Columbia River. Fisheries are no longer directed at weak natural populations but incidentally catch these fish while targeting healthy wild and hatchery stocks. Subbasin fisheries affecting natural populations have been largely eliminated. Fishery management has shifted from a focus on maximum sustainable harvest of the strong stocks to ensuring protection of the weak stocks. Weak stock protections often preclude access to large numbers of otherwise harvestable fish in strong stocks.

Fishery impact limits to protect lESA-isted weak populations are generally based on risk assessments that identify points where fisheries do not pose jeopardy to the continued persistence of a listed group of fish. In many cases, these assessments identify the point where additional fishery reductions provide little reduction in extinction risks. A population may continue to be at significant risk of extinction but those risks are no longer substantially affected by the specified fishing levels. Often, no level of fishery reduction will be adequate to meet naturally-spawning population escapement goals related to population viability. The elimination of harvest will not in itself lead to the recovery of a population. However, prudent and careful management of harvest can help close the gap in a coordinated effort to achieve recovery.

Fishery actions specific to the subbasins are addressed through the Washington State Fish and Wildlife sport fishing regulatory process. This public process includes an annual review focused on emergency type regulatory changes and a comprehensive review of sport fishing regulations which occurs every two years. This regulatory process includes development of fishing rules through the Washington Administrative Code (WAC) which are focused on protecting weak stock populations while providing appropriate access to harvestable populations. The actions consider the specific circumstances in each area of each subbasin and respond with rules that fit the relative risk to the weak populations in a given time and area of the subbasin. Following is a general summary of the fishery actions specific to the Wind River (Table P-35). More complete details can be found in the WDFW Sport Fishing Rules Pamphlet.

Actions to address harvest impacts are generally focused at a regional level to cover fishery impacts accrued to lower Columbia salmon as they migrate along the Pacific Coast and through the mainstem Columbia River. The regional actions cover species from multiple watersheds which share the same migration routes and timing, resulting in similar fishery exposure. Regional strategies and measures for harvest are detailed in Volume I, Chapter 5. A number of regional strategies for harvest involve implementation of actions within specific subbasins. In-basin fishery management is applicable to steelhead and salmon while regional management is more applicable to salmon. Harvest actions with significant application to the Wind River Subbasin populations are summarized in Table P-36.

Table P-35. Summary of sport fishing regulatory and protective fishery actions in the Wind River basin

Species	General Fishing Actions	Explanation	Other Protective Fishing Actions	Explanation
Fall Chinook	Open for fall Chinook	No hatchery fall Chinook produced in the Wind. Catch is primarily fall Chinook produced from Spring Creek Hatchery and URB stock	Night closures, gear restrictions, and closure near Shipperd Falls	Protects fall Chinook in areas of high concentration and while spawning
Spring Chinook	Open for spring Chinook	Fishery targets hatchery spring Chinook produced in the Wind. Wild spring Chinook are not native to the Wind River	Smolts released into the Wind River are now mass marked. Future adult returns will be identifiable with an adipose fin-clip.	Wind River selective fisheries in the future could offer further protection for wild spring that may temporarily stray into the lower Wind
chum	Closed to retention	Protects natural chum. Hatchery chum are not produced for harvest	Seasons for other salmon close before late fall	Further protection for wild chum returns
coho	Open for coho	No hatchery coho produced in the Wind. Coho catch not a focus but some harvest of hatchery coho from other basins	Little Wind is closed to salmon fishing.	Protects wild spawners in this lower river tributary.
Winter steelhead	Closed season	No winter fishing open for any species. Protects wild winter steelhead		
Summer Steelhead	Retain only adipose fin-clip marked steelhead during spring Chinook season	Selective fishery for hatchery steelhead, unmarked wild steelhead must be released. No hatchery steelhead released in the Wind	Summer closures, upper watershed closures, and minimum size rules	Protects returning adult summer steelhead, spawners in upper watershed and tributaries, and juveniles

Table P-36. Regional harvest actions from Volume I, Chapter 10 with significant application to the Wind River Subbasin populations.

Action	Description	Responsible Parties	Programs	Comments
	Monitor and evaluate commercial and sport impacts to naturally-spawning steelhead in salmon and hatchery steelhead target fisheries.	WDFW, ODFW	Columbia Compact, BPA Fish and Wildlife Program	Includes monitoring of naturally-spawning steelhead encounter rates in fisheries and refinement of long-term catch and release handling mortality estimates. Would include assessment of the current monitoring programs and determine their adequacy in formulating naturally-spawning steelhead incidental mortality estimates.
	Continue to improve gear and regulations to minimize incidental impacts to naturally-spawning steelhead.	WDFW, ODFW	Columbia Compact, BPA Fish and Wildlife Program	Regulatory agencies should continue to refine gear, handle and release methods, and seasonal options to minimize mortality of naturally-spawning steelhead in commercial and sport fisheries.

Action	Description	Responsible Parties	Programs	Comments
	Maintain selective sport fisheries in ocean, Columbia River, and tributaries and monitor naturally-spawning stock impacts.	WDFW, NMFS, ODFW, USFWS	PFMC, Columbia Compact, BPA Fish and Wildlife Program, WDFW Creel	Mass marking of lower Columbia River coho and steelhead has enabled successful ocean and freshwater selective fisheries to be implemented since 1998. Marking programs should be continued and fisheries monitored to provide improved estimates of naturally-spawning salmon and steelhead release mortality.

P.5.7.Hydropower

No hydropower facilities exist in the Wind River subbasin, however the anadromous fish populations in the Wind River are affected by Bonneville Dam operations with reservoir conditions now present in the lower Wind River and by dam passage effects

The configuration and operation of Bonneville Dam affects juvenile and adult salmon migration and passage. Hydropower operations reduce the resiliency and inhibit the recovery of anadromous salmonid populations in the Wind River Subbasin. Upstream and downstream fish passage facilities are operated at Bonneville Dam in the mainstem Columbia River but significant mortality and migration delay occurs. No bypass system is 100% effective. Adults are typically delayed in the tailrace but most eventually find and use fish ladders. A varying percentage of adults do not pass successfully or pass but fall back over the spillway. Juvenile passage mortality results primarily from passage through dam turbines rather than spillway or fish bypass systems. Anadromous fish populations will benefit from regional recovery actions and actions identified for operations of Bonneville Dam relative to fish passage and for habitat conditions in the mainstem and estuary (Table P-37).

Table P-37. Regional hydropower operation measures from Volume I, Chapter 10 with significant application to the Wind River Subbasin populations

Measure	Description	Responsible Parties	Programs	Comments
D.M2	Maintain and operate effective juvenile and adult passage facilities (including facilities, flow, and spill) at Bonneville Dam.	BPA; NMFS; ACOE	ESA Section 7, FPAC, TMT	Effective flow, spill, and facilities are crucial for dam passage.

P.5.8.Mainstem and Estuary Habitat

Wind River anadromous fish populations will also benefit from regional recovery strategies and measures identified to address habitat conditions and threats in the Columbia River mainstem and estuary. Regional recovery plan strategies involve: 1) avoiding large scale habitat changes where risks are known or uncertain, 2) mitigating small-scale local habitat impacts to ensure no net loss, 3) protecting functioning habitats while restoring impaired habitats to functional conditions, 4) striving to understand, protect, and restore habitat-forming processes, 5) moving habitat conditions in the direction of the historical template which is presumed to be more consistent with restoring viable populations, and 6) improving understanding of salmonid habitat use in the Columbia River mainstem and estuary and their response to habitat changes. A series of specific measures are detailed in the regional plan for each of these strategies.

P.5.9. Ecological Interactions

For the purposes of this Plan, ecological interactions refer to the relationships of salmon anadromous steelhead with other elements of the ecosystem. Regional strategies and measures pertaining to exotic or non-native species, effects of salmon on system productivity, and native predators of salmon are detailed and discussed at length in Volume I and are not reprised at length in each subbasin plan. Strategies include 1) avoiding, eliminating introductions of new exotic species and managing effects of existing exotic species, 2) recognizing the significance of salmon to the productivity of other species and the salmon themselves, and 3) managing predation by selected species while also maintaining a viable balance of predator populations. A series of specific measures are detailed in the regional plan for each of these strategies. Implementation will occur at the regional and subbasin scale.

P.5.10. Limiting Factors, Biological Objectives, and Strategies

At present, there are numerous recovery plans, status reports, and management recommendations available for habitats and wildlife in the Wind River subbasin; this subbasin management plan is intended to supplement these existing plans. Wind River focal wildlife species with existing recovery plans or status reports include the western pond turtle (Hays et al. 1999); Wind River wildlife species of interest with existing recovery plans or status reports include the fisher (Lewis and Stinson 1998), the bald eagle (Stinson et al. 2001), and the Oregon spotted frog (McAllister and Leonard 1997). Only management recommendations for focal species are provided in the subsequent sections; species of interest are not included. Additionally, WDFW has produced management recommendations for priority species groups (amphibians and reptiles – Larsen 1997; birds – Larsen et al. 2004; mammals – Azerrad 2004) and priority habitats (riparian – Knutson and Naef 1997).

Some general goals, objectives, and strategies were developed by various stakeholders in the Wind River subbasin (Rawding 2000). However, at the time of publication of the draft subbasin summary, the subbasin summary was not complete and there was a lack of consensus regarding the desired future condition of fish and wildlife habitats and populations. Thus, the subbasin summary presented goals, objectives, and strategies specific to each stakeholder group and not a unified set of goals, objectives, and strategies for the subbasin. Additionally, many of the goals, objectives, and strategies, as well as identified limiting factors and ongoing restoration projects, addressed fish populations and habitats and placed less priority on wildlife populations and their habitat.

Western Gray Squirrel

The western gray squirrel (*Sciurus griseus*) is a Washington state threatened species and a Federal species of concern. Within the Wind River subbasin, western gray squirrels may be found in mesic lowland conifer-hardwood forest in close proximity to westside white oak – dry Douglas fir forest. Table P-38 provides a summary of western gray squirrel limiting factors, biological objectives, and restoration strategies.

Table P-38. Western gray squirrel limiting factors, biological objectives, and restoration strategies.

Limiting Factors	Biological Objectives	Restoration Strategies	Geographical Area
Loss of Large Tracts of Old Growth or Late Seral Forests. Loss of Columbia River lowland riparian vegetation.	Increase quantity of habitat for western gray squirrel.	Increase compliance with forest guidelines for western gray squirrels. Retain remaining large, unfragmented tracts of western gray squirrel habitat.	Lower Wind River drainage and Columbia River Shoreline
Increased Stand Density and Decreased Average Tree Diameter Reduction of Large Diameter Trees and Snags Loss of Native Understory Vegetation and Composition	Increase quality of western gray squirrel habitat. Protect all stands of Oregon White Oak.	Use site-specific fire prescriptions to enhance potential and used western gray squirrel habitat. Create / retain optimal habitat (see assessment).	Lower Wind River drainage Columbia River Shoreline
Loss of Individual, Late Seral Trees (i.e. woodcutting)	Retain decadent and other important wildlife trees. Leave all Oak and Oak snags.	Encourage woodcutting to be used as a tool for thinning overstocked areas. Create public education programs.	Lower Wind River
Increased Competition to Western Gray Squirrels	Reduce pressure to western gray squirrels from California ground squirrels and eastern gray squirrels.	Create programs to control non-native wildlife and other non-historical species. Create public education programs.	Lower Wind River drainage and Columbia River Shoreline

Yellow Warbler

Yellow warblers are an indicator species for riparian habitat; possible habitats in the Wind River subbasin that may provide suitable riparian areas for yellow warblers include open water and montane coniferous wetlands, as well as riparian microhabitats within the forest habitats. Historically, westside riparian-wetland habitat was present in the Wind River subbasin, but this habitat was not present during recent mapping efforts. Table P-39 provides a summary of yellow warbler limiting factors, biological objectives, and restoration strategies.

Table P-39. Yellow warbler limiting factors, biological objectives, and restoration strategies.

Limiting Factors	Biological Objectives	Restoration Strategies	Geographical Area
Reduction in Floodplain Acreage Overall Habitat Loss Habitat Fragmentation	Increase riparian habitat which will provide quality and quantity habitat for yellow warblers.	Inventory existing and potential yellow warbler habitat. Create / retain optimal habitat (see assessment).	Lower elevations
Reduced Food Base	Reduce mortality of food base (insects) needed by yellow warblers, from chemical applications.	Use alternative control measures for undesirable insect species in riparian buffers, especially in areas used by yellow warbler.	Lower elevations

Pileated Woodpecker

Pileated woodpeckers are currently candidates for endangered species listing by the Washington Department of Fish and Wildlife. Any forest type (broadleaved, coniferous, or mixed) can sustain pileated woodpeckers as long as there are trees large enough for roosting and nesting. Pileated woodpeckers are often associated with mature and old-growth forests but can breed in younger forests if they contain some large trees. In western Washington, they typically roost in western hemlock and western red cedar. Although generally resident, pileated woodpeckers sometimes wander from their breeding areas and many move down-slope or into streamside forests or suburban areas in winter.

Pileated woodpeckers play an important role within their ecosystems by excavating nesting and roosting cavities that are subsequently used by many other birds and by many small mammals, reptiles, amphibians, and invertebrates. Clear-cutting of old-growth and other forests currently has the most significant impact on pileated woodpecker habitat, but pileated woodpeckers are fairly adaptable, which offsets some of the impact from habitat loss. Table P- 40 provides a summary of pileated woodpecker limiting factors, biological objectives, and restoration strategies.

Table P- 40. Pileated woodpecker limiting factors, biological objectives, and restoration strategies.

Limiting Factors	Biological Objectives	Restoration Strategies	Geographical Area
Loss of Large Tracts of Old Growth or Late Seral Forests	Increase quantity of habitat for pileated woodpecker.	Encourage landowner incentives through compensation and land easements. Retain reserves and identify and protect important habitats.	Entire subbasin
Reduction of Large Diameter Trees and Snags	Increase quality of pileated woodpecker habitat.	Increase number of snags and snag recruitment in pileated woodpecker habitat. Retain 2 snags per acre that are >30 in dbh, in stands 60 years and older and >70% canopy closure. In nesting areas, retain 7 large snags and 3 decaying large trees per acre. Trees >90 ft in height should be retained. Create site-specific fire prescriptions to enhance potential and used pileated woodpecker habitat.	Entire subbasin

Band-Tailed Pigeon

The band-tailed pigeon breeds throughout much of Western Washington. The band-tailed pigeon requires mineral springs as a source of calcium for egg-laying and the production of crop-milk for its young (March and Sadleir 1975, Jarvis and Passmore 1992, Braun 1994). The proximity of these mineral springs to suitable foraging habitats is an important factor for band-tailed pigeons (Jarvis and Passmore 1992). A mineral spring located in the lower reach of the Wind River has one of the highest concentrations of pigeon use in the state. Management of band-tailed pigeons has been addressed in Larson et al. (2004). Table P-41 provides a summary of band-tailed pigeon limiting factors, biological objectives, and restoration strategies.

Table P-41. Band-tailed pigeon limiting factors, biological objectives, and restoration strategies.

Limiting Factors	Biological Objectives	Restoration Strategies	Geographical Area
Reduction in Mineral Springs and Mineral Sources Overall Habitat Loss Habitat Fragmentation	Increase quality and quantity of habitat for band-tailed pigeons.	Inventory existing and potential band-tailed pigeon habitat. Create / retain optimal habitat (see assessment). Avoid removal of perch trees surrounding mineral springs. Enhance access to mineral sources via dense vegetation removal. Maintain and enhance growth of berry/mast-producing shrubs and trees. Avoid large clearcuts in band-tailed pigeon habitat; if cut, replant with a variety of species, especially near mineral sources. Manage human foot traffic along key portions of Wind River near mineral springs.	Lower half of sub-basin, especially Carson/St Martins hotspring area.
Reduced Food Base	Reduce mortality of food-producing shrubs and trees needed by band-tailed pigeons, from chemical applications.	Use alternative control measures for undesirable shrub and tree species in areas used by band-tailed pigeons so that food producing species are maintained.	Lower half of sub-basin, especially Carson/St Martins hotspring area.
Mortality from Disease Outbreaks	Minimize disease (protozoan Trichomoniasis) transmission from urban feeders.	Create public education programs to encourage regular cleaning of bird feeders and establish reporting requirements for sick/dead birds.	Lower half of sub-basin, especially Carson/St Martins hotspring area.

Western Pond Turtle

The western pond turtle is listed as endangered in the State of Washington and is considered a federal species of concern. The western pond turtle is closely associated with open water habitats in close proximity to appropriate soil for nesting and vegetation for nesting and cover. Wildlife habitats in the Wind River subbasin that may provide these attributes include open water and mesic lowland conifer-hardwood forest. Historically, westside riparian-wetland habitat was present in the Wind River subbasin, but this habitat was not present during recent mapping efforts. Western pond turtle recovery was discussed in detail in Hays et al. (1999); a synopsis of the recovery strategies is provided in Table P-42.

Table P-42. Western pond turtle limiting factors, biological objectives, and restoration strategies.

Limiting Factors	Biological Objectives	Restoration Strategies	Geographical Area
Reduction in Floodplain Acreage Habitat Fragmentation	Increase quality and quantity of habitat for western pond turtles.	Utilize purchase easements, leases or agreements, for landowners to restore or protect riparian vegetation (e.g. Farm Program partner, etc.).	Columbia River shoreline and adjacent uplands (low elevation).
Loss of Riparian Habitat and Function	Restore western pond turtle population numbers to historical levels.	Create / retain optimal habitat (see assessment).	Collins Slide
Native Riparian Vegetation Displacement with Non-native Vegetation		Inventory roads near occupied or potential western pond turtle habitat and assess impacts to determine problem areas in need of resolution.	
Overall Loss of Riparian Vegetation		Augment or support shoreline and adjacent uplands non-native vegetation control programs.	
		Promote silviculture practices that retain buffer of shoreline trees (basking log recruitments) within western pond turtle habitat.	
		Provide incentives through easements, leases or agreements, for landowners to manage livestock in such a way to provide for riparian vegetation restoration (e.g., farm programs).	
Predation by Non-native Species	Eliminate predation from non-native species.	Remove bullfrog and non-native fish from occupied sites and control current bullfrog and non-native fish occupation in potential habitat.	Columbia River shoreline and adjacent uplands (low elevation). Collins Slide
Increased Human Disturbance	Decrease disturbance to western pond turtles.	Restrict access to known western pond turtle sites.	Columbia River shoreline and adjacent uplands (low elevation). Collins Slide

Larch Mountain Salamander

Larch Mountain salamander distribution includes west-side habitats of the southern Cascades region in Washington and the Columbia Gorge area of Oregon and Washington, including the Wind River subbasin. Larch Mountain salamanders depend on cool, moist environments; they require a suitable combination of slope, rock size, shade, and organic debris. Populations of Larch Mountain salamanders are small, isolated, and occur in a limited geographic area. This salamander is sedentary and its very specific habitat requirements may hinder dispersal. Management of Larch Mountain salamanders has been addressed in Larsen (1997); Table P-43 provides a summary of Larch Mountain salamander limiting factors, biological objectives, and restoration strategies.

Table P-43. Larch Mountain salamander limiting factors, biological objectives, and restoration strategies.

Limiting Factors	Biological Objectives	Restoration Strategies	Geographical Area
Loss of Habitat	Increase quantity of habitat for Larch Mountain salamander.	Retain current suitable habitat. Avoid logging on talus slopes occupied by Larch Mountain salamander. If logging occurs, maintain a minimum 50m buffer around talus slopes, retain shade, and retain downed slash. Avoid disturbing talus slopes during building/ development; maintain minimum 50m buffer. Restrict gravel removal for road construction from known talus slopes supporting salamanders.	Entire subbasin
Decreased Shade, Moisture, and Detritus on Talus Slopes	Increase quality of Larch Mountain salamander habitat.	Encourage woody debris recruitment of all size and decay classes to talus slopes.	Entire subbasin
Increased Human Disturbance	Minimize human use of known Larch Mountain salamander habitat.	Restrict human access to caves known to support Larch Mountain salamanders.	Entire subbasin

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