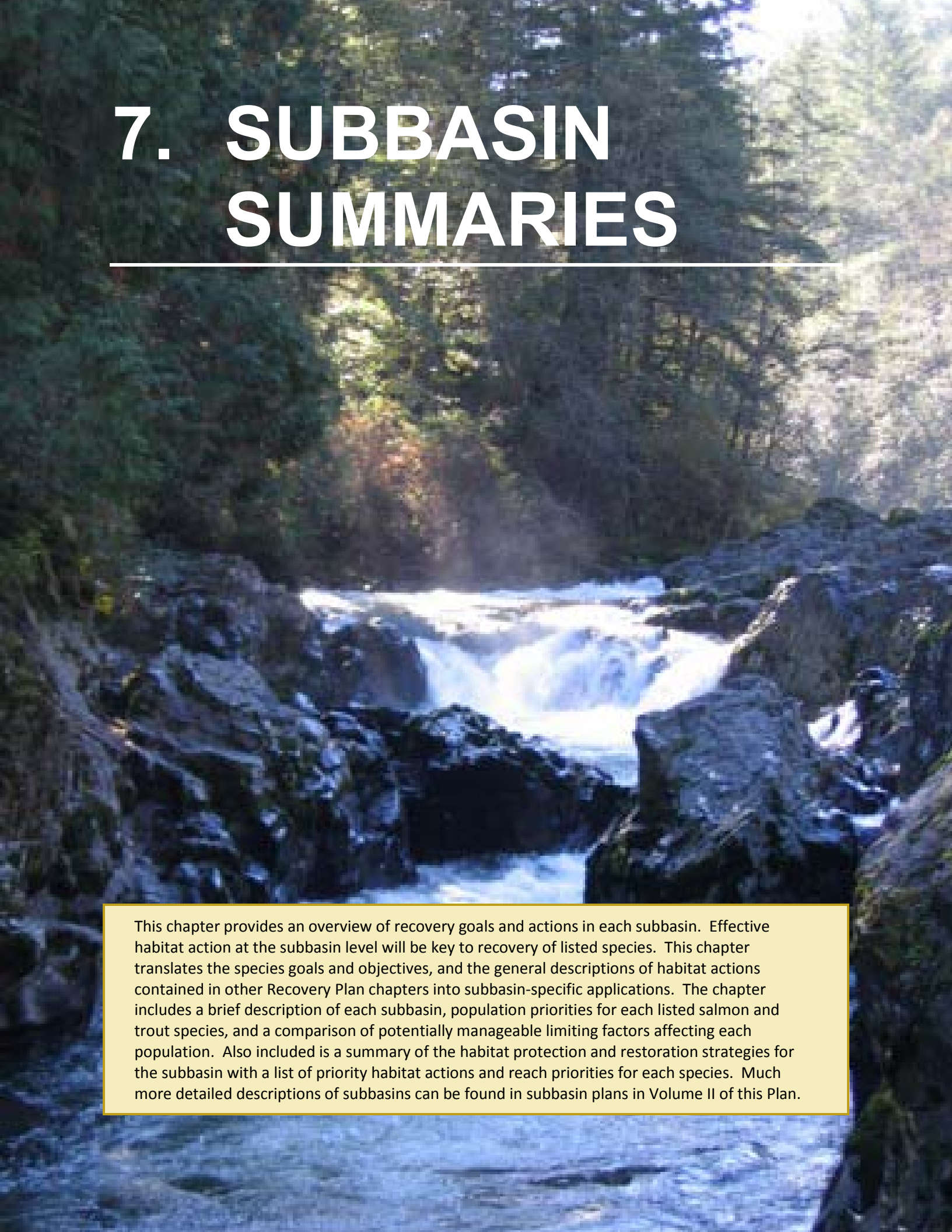
7. SUBBASIN SUMMARIES



This chapter provides an overview of recovery goals and actions in each subbasin. Effective habitat action at the subbasin level will be key to recovery of listed species. This chapter translates the species goals and objectives, and the general descriptions of habitat actions contained in other Recovery Plan chapters into subbasin-specific applications. The chapter includes a brief description of each subbasin, population priorities for each listed salmon and trout species, and a comparison of potentially manageable limiting factors affecting each population. Also included is a summary of the habitat protection and restoration strategies for the subbasin with a list of priority habitat actions and reach priorities for each species. Much more detailed descriptions of subbasins can be found in subbasin plans in Volume II of this Plan.

7. SUBBASIN SUMMARIES

Tables

Figures

7.1 Overview

The Lower Columbia Salmon Recovery & Fish and Wildlife Subbasin Plan encompasses multiple subbasins which extend from the mouth of the Columbia River to the White Salmon River in the heart of the Columbia Gorge. For the purposes of this Plan, this area has been separated into three strata which represent different ecological regions; the Coast Strata which includes rivers and streams originating in the Willapa Hills, the Cascade Strata which includes rivers originating in the mountains of the Cascade Range, and the Gorge Strata which includes subbasins whose headwaters are in the Cascades but which empty into the Columbia River Gorge (Table 7-1). The subbasins are further organized by focal fish populations as identified in the ESA Recovery Plan for the Willamette and Lower Columbia Basins and Northwest Power and Conservation Council Fish & Wildlife Plan.

This Recovery Plan includes an extensive analysis of the threats affecting each listed population including watershed and stream habitat conditions that have contributed to reductions in fish numbers and production in each subbasin. Subbasin habitat analyses were used in turn to establish habitat impact reduction targets, and to identify and prioritize habitat actions needed to achieve population objectives and targets established in this Plan. These analyses are the basis for subbasin-specific strategies and actions described in this chapter.

The relative significance of each category of threat was depicted for each population in every subbasin based on the impact analysis detailed in Chapter 3. “Impacts” are defined in this Plan as proportional reductions in population productivity due to potentially-manageable threats. Impacts are estimated for significant categories of threats including stream habitat, estuary/mainstem habitat, dams, fisheries, hatcheries, and ecological effects. The same impact analysis was used in this Plan to determine impact reduction targets for each threat. In this subbasin chapter, the relative significance of each threat impact is illustrated in a series of pie charts which express the total impacts for each population relative to a standardized scale of 100%.

Stream habitat restoration and preservation actions are identified in this Plan based on species-specific analyses of current fish productivity, potential fish productivity, and stream conditions that limit fish productivity in every reach of each subbasin. Stream habitat analyses were conducted using the Ecosystem Diagnosis & Treatment Model (EDT) including updated model runs that were completed in spring of 2007. EDT characterized fish population performance based on physical habitat conditions relative to habitat requirements for each species. EDT assessment methods are further detailed in Appendix E.

The current significance and potential of each stream reach for each species was determined by EDT comparisons of current and assumed historical conditions. This comparison was used to identify reach restoration and preservation values for each species. Restoration value is the relative improvement in fish numbers that would result by restoring stream conditions to the historical template. Preservation value is the relative reduction resulting from the loss of existing production. Current reach habitat quality can also be estimated as a percentage relative to historical production potential – these values are identified for priority stream reaches identified in this chapter for each subbasin.

Table 7-1. Description of Washington Lower Columbia subbasins.

Subbasin	Strata WRIA	County(s)	Watershed Area	Elevation (max)	Stream Miles[1]	Focal Species[3]
Chinook, Wallacut, Deep	Coast 24/25	Pacific, Wahkiakum	40 mi^2	1,100 ft	20	CHF,CHUM, COHO, STW[4]
Grays	Coast 25	Wahkiakum	170 mi^2	2,400 ft	160	CHF, CHUM, COHO,STW[4]
Elochoman, Skamokawa	Coast 25	Wahkiakum	160 mi^2	2,700 ft	130	CHF, CHUM, COHO, STW[4]
Mill, Abernathy, Germany	Coast 25	Cowlitz, Wahkiakum	100 mi^2	1300 ft	110	CHF, CHUM, COHO, STW[4]
Cowlitz (lower)	Cascade 26	Cowlitz, Lewis	440 mi^2	1,000 ft	360	CHF, CHUM, COHO, STW
Cowlitz (upper)	Cascade 26	Lewis, Pierce, Skamania	1,400 mi^2	14,000 ft	110	CHF, CHS, STW, COHO
Coweeman	Cascade 26	Cowlitz	200 mi^2	3,000 ft	90	CHF, STW, CHUM, COHO
Toutle	Cascade 26	Cowlitz	510 mi^2	8,000 ft	310	CHF,CHS,STW, COHO, CHUM
Kalama	Cascade 27	Cowlitz	210 mi^2	8,000 ft	120	CHF, CHS, CHUM, COHO, STW, STS
North Fork Lewis	Cascade 27	Clark, Cowlitz, Skamania	830 mi^2	12,000 ft	100	CHF, CHS, CHUM, COHO, STW, STS, BT
East Fork Lewis	Cascade 27/28	Clark, Skamania	240 mi^2	4,500 ft	180	CHF, CHUM, COHO, STW, STS
Lower Columbia Gorge Tributaries	Gorge 28/29	Clark, Skamania	n/a	3,000 ft	10[2]	CHF,STW, COHO, CHUM
Salmon Creek	Cascade 28	Clark	90 mi^2	2,000 ft	120	CHF, CHUM, COHO, STW
Washougal	Cascade 27/28	Clark, Skamania	240 mi^2	3,200 ft	130	CHUM, COHO, STW, STS, CHF
Wind	Gorge 29	Skamania	220 mi^2	3,900 ft	130	COHO, CHUM, CHF, STW, STS
Little White Salmon	Gorge 29	Skamania, Klickitat	140 mi^2	5,300 ft	0.25	CHUM, COHO[5] STW[5] STS[5] CHF
Upper Columbia Gorge Tributaries	Gorge 29	Skamania, Klickitat	n/a	3,000 ft	10[2]	CHUM, COHO, STS[5], STW CHF[5]
White Salmon River	Gorge 29	Skamania, Klickitat, Yakima	n/a	n/a	n/a	CHF, CHUM[5], COHO, CHS[5]

[1] Historic anadromous stream miles reflected in EDT model.
[2] Includes both upper and lower Columbia Gorge Tributaries.
[3] CHF= fall Chinook, CHS= spring Chinook, STW= winter steelhead, STS= summer steelhead, BT= bull trout
[4] Species present but not part of a listed population under ESA.
[5] This population is part of a larger recovery population and may not currently be present in basin.

Priorities at the reach scale are useful for identifying stream corridor recovery measures. Reach priorities for restoration or preservation were based on the significance of each reach to net production of a species in each subbasin. High, medium and low priority reaches were assigned for each species. Reaches were then 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. Actions with the potential to affect improvements were identified from EDT analyses based on habitat characteristics affecting species reach values.

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. 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)[1]. The tool uses landscape conditions 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. entire drainage). This subbasin chapter highlights priorities of subwatershed areas in each subbasin based on reach tiers.

A more-detailed description of each subbasin can be found in Chapters A-R of Volume II of this Plan (except for the White Salmon Subbasin which is addressed in a separate plan). Additional information detailing regional actions to recover local populations in each subbasin can be found in the following online documents (available at http://www.lcfrb.gen.wa.us).

- **6-year Habitat Work Schedules.** This Recovery Plan calls for the development of 6-Year Habitat Work Schedules (HWS) for each subbasins. Each HWS identifies reach level habitat protection and restoration measures and submeasures.
- **Site-specific Project Identification Reports**. Detailed habitat restoration reports have been completed for the Woodard, Abernathy and Germany Creeks, as well as the lower Cowlitz, lower East Fork Lewis, and lower Grays River subbasins. Each report details a prioritized list of site specific actions to restore or preserve habitat.
- **Water Resource Inventory Area (WRIA) 25-28 Watershed Plans.** Locally developed watershed plans for WRIAS 25-28 (Grays, Elochoman, Cowlitz, Salmon, Washougal, Lewis) adopted in 2006. The plans identify specific strategies and actions to manage watershed resources such as water quality and quantity, in-stream flows, and habitat.

[1] Each subbasin is composed of a number of subwatersheds.

7.2 Estuary Tributaries: Chinook, Wallacut, Deep

The Columbia Estuary Tributaries originate in the far southwest corner of the Willapa Hills and flow through wide valley bottoms made up of wetlands and floodplains, before emptying into the Columbia River (Figure 7-1). This is a rainfall dominated system which is also highly influenced by tidal processes. Lower elevation areas provide space for agriculture, and the higher elevations of the watershed provide some timber production. Much of the estuary habitat has been converted to agricultural use with significant diking and filling of off-channel habitats. Extensive road building and logging occurred in the upper Chinook Basin in the 1970s resulting in an increase in mass wasting events and sediment loads. The headwaters of Wallacut and Deep Rivers have also been impacted by timber harvest and road density, but to a lesser extent. The area is sparsely populated, with the fishing port of Ilwaco and the small rural communities of Chinook and Megler being the only population centers on the Washington side.

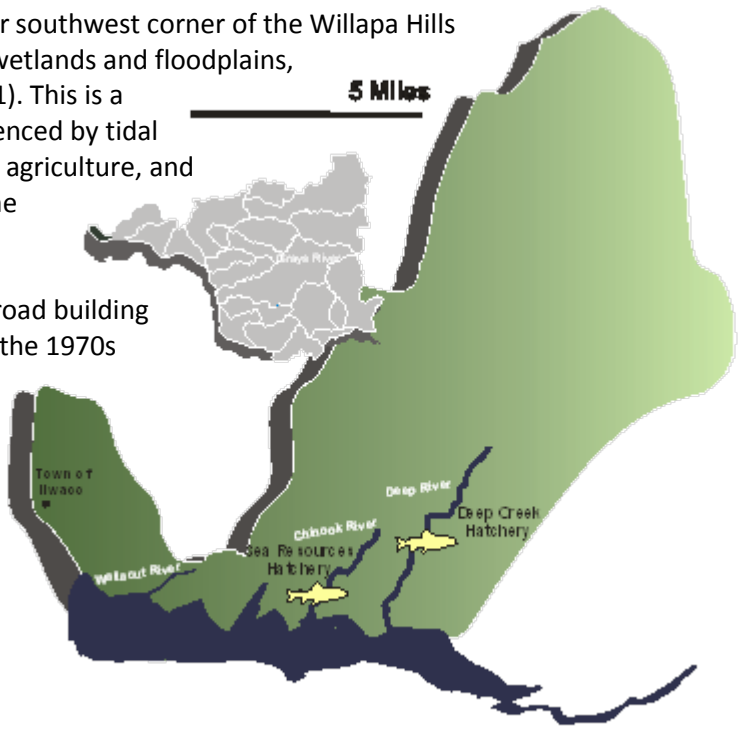


Figure 7-1. Map of the Estuary Tributaries

Fish Species

Focal salmonid species include fall Chinook, steelhead, chum and coho. Bull trout do not occur in the subbasin. Species-specific recovery goals are based on the Grays River population. When considering recovery objectives, the Estuary Tributary populations are combined with the Grays River to form Grays/Chinook populations. Salmon and steelhead numbers have declined to only a fraction of historical levels (Table 7-2). Extinction risks are significant for all focal species. Chum, coho and steelhead are considered Primary to population recovery while fall Chinook are considered Contributing. Returns of fall Chinook, chum, and coho include both natural and hatchery produced fish. Hatcheries present in the watershed include the Sea Resources Hatchery, Deep River Net Pens, and the Grays River Hatchery.

Table 7-2. Status and goals for salmon and steelhead populations in the lower Columbia Estuary Tributaries.

Species	Population	Recovery priority	Viability		Improve-ment	Abundance		
			Status	Obj.		Historical	Current	Target
Fall Chinook	Grays/Chinook	Contributing	VL	M+	500%	800	<50	1,000
Chum	Grays/Chinook	Primary	M	VH	0%[1]	10,000	1,600	1,600
Winter Steelhead	Grays/Chinook	Primary	M	H	0%[1]	1,600	800	800
Coho	Grays/Chinook	Primary	VL	H	370%	3,800	<50	2,400

[1] Improvement increments are based on abundance and productivity; however, this population will require improvements in spatial structure or diversity to meet recovery objectives.

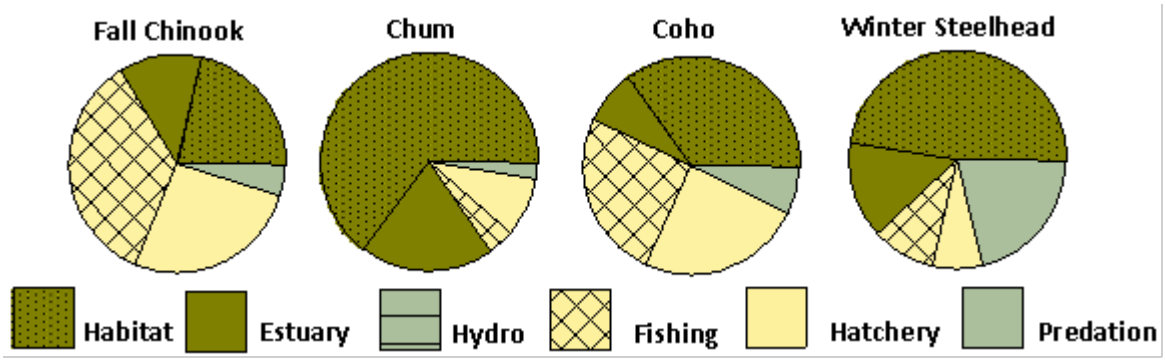


Figure 7-2. Relative significance of potentially manageable factors for Estuary Tributary fish populations.

Threats

The depleted status of subbasin fish populations is the combined effect of significant impacts of multiple factors (Figure 7-2). Loss of tributary habitat quality and quantity accounts for the large impacts in all species. Loss of estuary habitat quality and quantity is also relatively important for all species, but less so for coho. Fishing harvest has a sizeable effect on fall Chinook, but is relatively minor for chum and winter steelhead; harvest impact on coho is intermediate. Hatchery impacts are relatively substantial for fall Chinook, and moderate for coho. The main threats of the hatchery program are genetic effects of domestication on natural salmon by interbreeding with Grays River Hatchery and Deep River Net Pen salmon. Predation impacts are relatively moderate for all species but more so for winter steelhead. No dams are operated in the subbasin and hydrosystem impacts are relatively minor and limited to habitat effects in the Columbia River mainstem and estuary.

Habitat Strategy

Fish recovery will require significant subbasin habitat improvements in concert with reductions in out-of-subbasin impacts from other limiting factors (Box 7-1). Species-specific recovery goals are based on the Grays River population and will require an estimated 0-500% improvement in habitat conditions depending on the species (Table 7-2). Critical fish habitat problems include loss of habitat diversity, low summer flow, increased sediment, high summer temperature, and fish passage at tide gates. Underlying watershed issues include impaired hydraulic conditions, increased sediment supply, and degraded riparian conditions due to timber management in the upper subbasin and agriculture in the lower subbasin. The habitat restoration strategy emphasizes the need for process-related actions that provide long-term benefits over short term temporary fixes. High priority reaches for protection and improvement include: a) the reach between the estuary and the Sea Resources Hatchery on the Chinook River for chum and fall Chinook, and b) the upper mainstem and tributary reaches of the Chinook, Wallacut and Deep Rivers for coho and winter steelhead. Due to the small size of this subbasin, an in-depth stream habitat assessment was not conducted using EDT. Priority measures and actions were based on existing studies and a watershed process assessment (IWA).

Box 7-1. Key recovery priorities for the lower Columbia Estuary Tributaries.

- Restore lower river estuary, floodplain, and riparian habitats
- Manage forest lands to protect and restore watershed processes
- Address immediate risks with short-term habitat fixes
- Manage growth and development to protect watershed processes and habitat conditions
- Align hatchery priorities consistent with conservation objectives
- Manage fishery impacts to reduce near-term population risks and support progress toward recovery
- Reduce out-of-subbasin impact so that the benefits of in-basin actions can be realized

7.3 Grays River

This subbasin includes the Grays River and other tributaries to Grays Bay, including Deep River and Crooked Creek (Figure 7-3). The river originates in steep forested valleys of the Willapa Hills, and then flows through the relatively flat terrain of the plains of the Columbia Valley. It enters the Columbia River estuary at RM 21 and tidal influence extends upriver for 6 miles. Maximum elevation is 2,840 ft and most of the watershed is in the rain-dominated zone. Land ownership in the basin is predominantly private (90%) and most of the upper basin is in industrial timber production which has resulted in high road densities and a very young forest. Roads and timber harvest, combined with unstable sedimentary soils, result in a proliferation of mass wasting in the subbasin and other implications for watershed processes such as temperature and flow generation. Agricultural uses dominate the valley bottoms which suffer from non-forested riparian zones and disconnected floodplains.

Fish Species

Focal salmonid species in the Grays River include fall Chinook, winter steelhead, chum and coho. Bull trout do not occur in the subbasin. Salmon and steelhead numbers have declined to only a fraction of historical levels (Table 7-3). Extinction risks are significant for all focal species but chum, winter steelhead, and coho are considered Primary for population recovery. Returns of winter steelhead, chum, Chinook and coho include both natural and hatchery produced fish from the Grays River Hatchery and out of basin hatchery stocks.

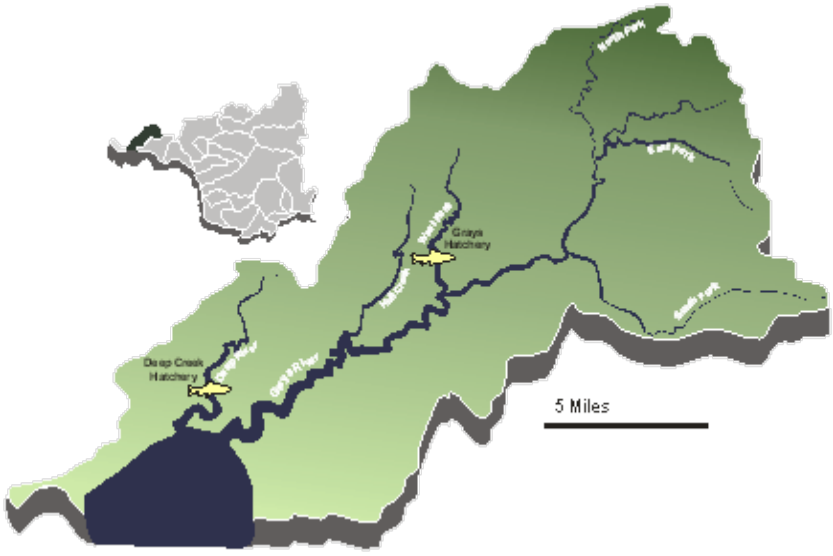


Figure 7-3. Map of the Grays River.

Table 7-3. Status and goals for salmon and steelhead populations in the Grays/Chinook River subbasin.

Species	Population	Recovery priority	Viability		Improve-ment	Abundance		
			Status	Obj.		Historical	Current	Target
Fall Chinook	Grays/Chinook	Contributing	VL	M+	500%	800	<50	1,000
Chum	Grays/Chinook	Primary	M	VH	0%[1]	10,000	1,600	1,600
Winter Steelhead	Grays/Chinook	Primary	M	H	0%[1]	1,600	800	800
Coho	Grays/Chinook	Primary	VL	H	370%	3,800	<50	2,400

[1] Improvement increments are based on abundance and productivity; however, this population will require improvements in spatial structure or diversity to meet recovery objectives.

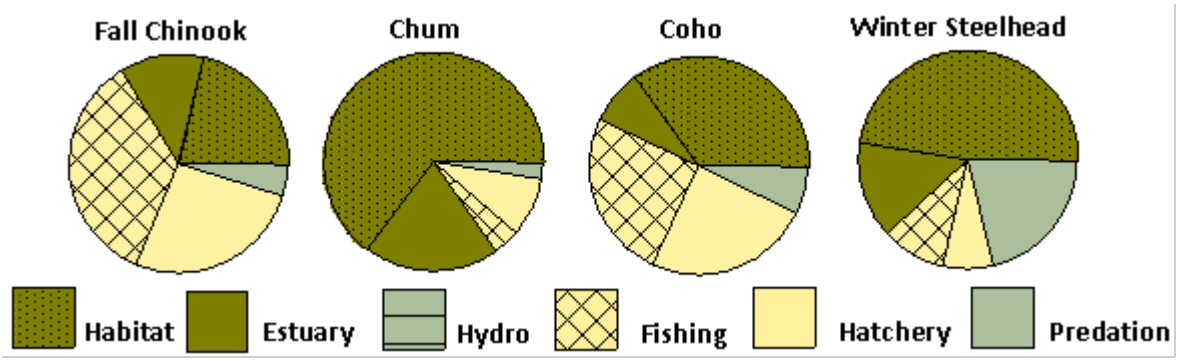


Figure 7-4. Relative significance of potentially manageable factors for Grays/Chinook River fish populations.

Threats

The depleted status of Grays River fish populations is the combined effect of significant impacts of multiple factors (Figure 7-4). Loss of tributary habitat quality and quantity accounts for the largest relative impact on all species except for fall Chinook. Loss of estuary habitat quality and quantity is also relatively important for all species. Fishing has the greatest effect on fall Chinook and coho, but is relatively minor for chum and winter steelhead. Hatchery impacts are moderate for fall Chinook and coho, and relatively low for chum. The main threats of the hatchery program are genetic effects of domestication on natural salmon by interbreeding with Grays River Hatchery and Deep River Net Pen salmon. Predation impacts are relatively moderate for all species except for winter steelhead for which they are significant. No dams are operated in the subbasin and hydro system impacts are relatively minor and limited to habitat effects in the Columbia River mainstem and estuary.

Habitat Strategy

Fish recovery will require significant subbasin habitat improvements in concert with reductions in out-of-subbasin impacts from other limiting factors (Box 7-2). Species-specific recovery goals will require an estimated 0-5000% improvement in habitat conditions (Table 7-3). Critical fish habitat problems include increased sediment, loss of habitat diversity, low summer flow, high summer temperature, and channel stability. Underlying watershed issues are primarily related to logging and agricultural lands uses and include impaired hydraulic conditions, increased sediment supply, channel alteration due to past splash-damming, stream bank hardening and flood control activities, and degraded riparian conditions. The habitat restoration strategy emphasizes the need for process-related actions that provide long-term benefits over short term temporary fixes. High priority reaches for restoration include: a) middle mainstem and lower portion of the tributaries for fall Chinook, chum and coho and; b) the upper mainstem, WF Grays, SF Grays, and NF Grays for steelhead (Figure 7-5, Table 7-4).

Box 7-2. Key recovery priorities for the Grays subbasin.

- Manage forest lands to protect and restore watershed processes
- Restore valley floodplain function, riparian function and stream habitat diversity
- Manage growth and development to protect watershed processes and habitat conditions
- Help address immediate risks with short-term habitat fixes
- Align hatchery priorities with conservation objectives
- Manage fishery impacts to reduce near-term population risks and support progress toward recovery
- Reduce out-of-subbasin impacts so that the benefits of in-basin actions can be realized

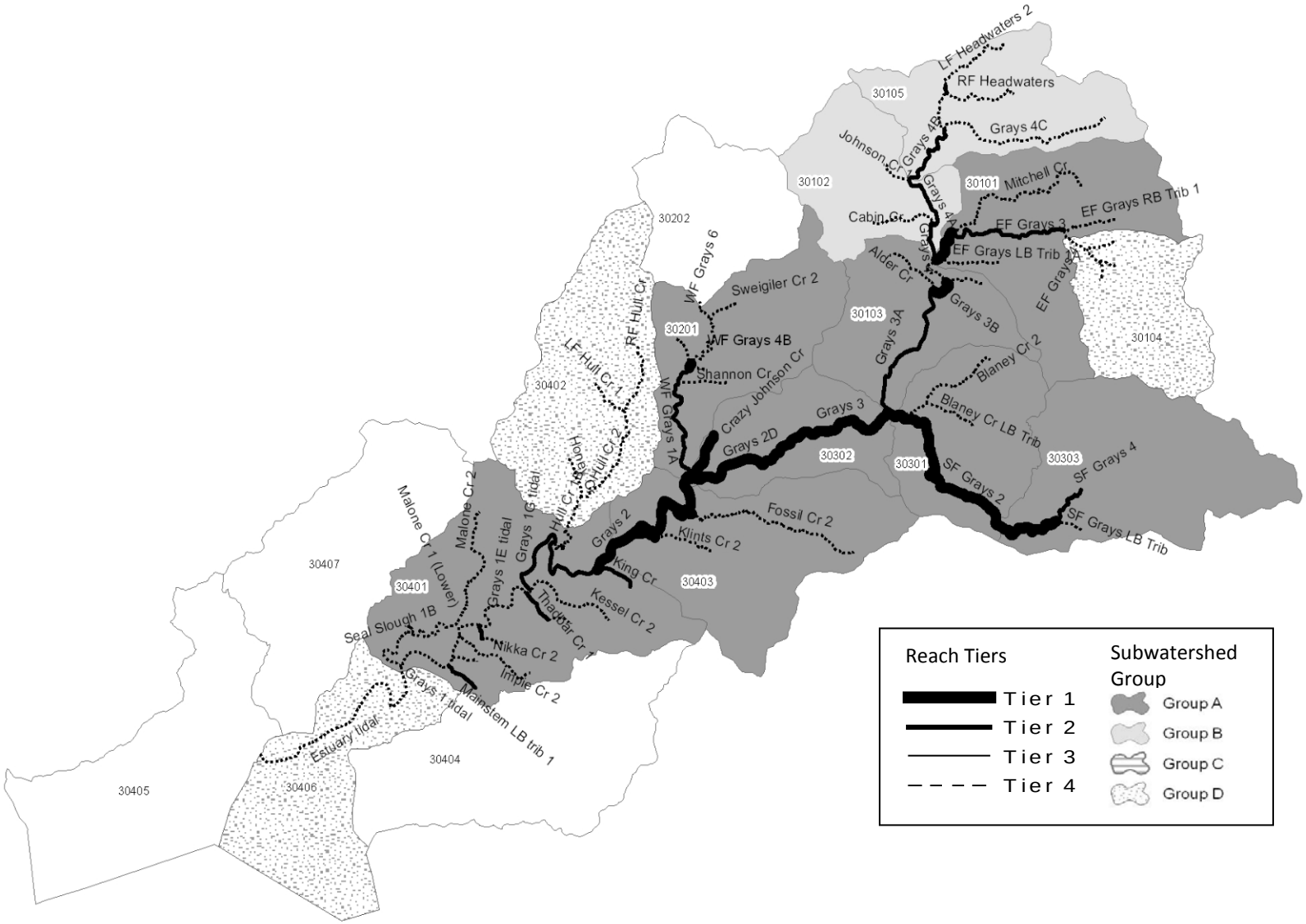


Figure 7-5. Reach tiers and subwatershed groups in the Grays River subbasin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives.

Table 7-4. High priority reaches identified for habitat protection and restoration actions in the Grays River subbasin and corresponding species priorities (High, Medium, Low) based on relative preservation and restoration value within the basin. Reach quality is the estimated proportion of historical fish production potential available for all species.

Reach	Habitat Quality	Priority (Tier)	Species Presence & Reach Priority					
			Chinook		Chum (Primary)	Coho (Primary)	Steelhead	
			Fall (Contrib.)	Spring (n/a)			Winter (Primary)	Summer (n/a)
Crazy Johnson Cr	72%	1	--	--	H	L	L	--
EF Grays 1	62%	1	--	--	--	--	H	--
EF Grays 2	50%	1	--	--	--	--	H	--
EF Grays 3	33%	2	--	--	--	--	M	--
Fossil Cr 1	26%	1	--	--	H	M	L	--
Grays 1H tidal	41%	2	M	--	M	M	L	--
Grays 2	44%	1	H	--	H	H	L	--
Grays 2A	47%	1	H	--	M	H	L	--
Grays 2B	44%	1	M	--	H	H	L	--
Grays 2C	41%	1	L	--	H	M	H	--
Grays 2D	35%	1	--	--	--	--	H	--
Grays 3	43%	1	--	--	--	--	H	--
Grays 3A	37%	2	--	--	--	--	M	--
Grays 3B	35%	1	--	--	--	--	H	--
Grays 4	47%	2	--	--	--	--	M	--
Grays 4A	30%	2	--	--	--	--	M	--
Grays 4B	34%	2	--	--	--	--	M	--
King Cr	52%	2	--	--	M	L	L	--
Klints Cr 1	53%	1	--	--	H	L	L	--
LF Headwaters 1	44%	2	--	--	--	--	M	--
Mainstem LB trib 1	53%	2	--	--	M	--	L	--
Nikka Cr 1 (lower)	47%	2	--	--	M	L	L	--
SF Grays 1	59%	1	--	--	--	--	H	--
SF Grays 2	44%	1	--	--	--	--	H	--
SF Grays 3	34%	2	--	--	--	--	M	--
Thadbar Cr 1	56%	2	--	--	M	L	L	--
WF Grays 1A	40%	2	--	--	M	M	M	--
WF Grays 1B	39%	2	--	--	--	M	M	--
WF Grays 2	31%	2	--	--	L	L	M	--
WF Grays 3	28%	1	--	--	--	L	H	--

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.

7.4 Elochoman River & Skamokawa Creek

Streams in the Elochoman & Skamokawa Subbasin originate in the Willapa Hills and flow south to the Columbia River. From west to east, the stream systems include Jim Crow Creek, Skamokawa Creek, Brooks Slough, the Elochoman River, and Birnie Creek (Figure 7-6). This is a rainfall dominated system with the highest elevation at 2,673 feet. The upper watershed is heavily-forested and largely managed for industrial timber production.

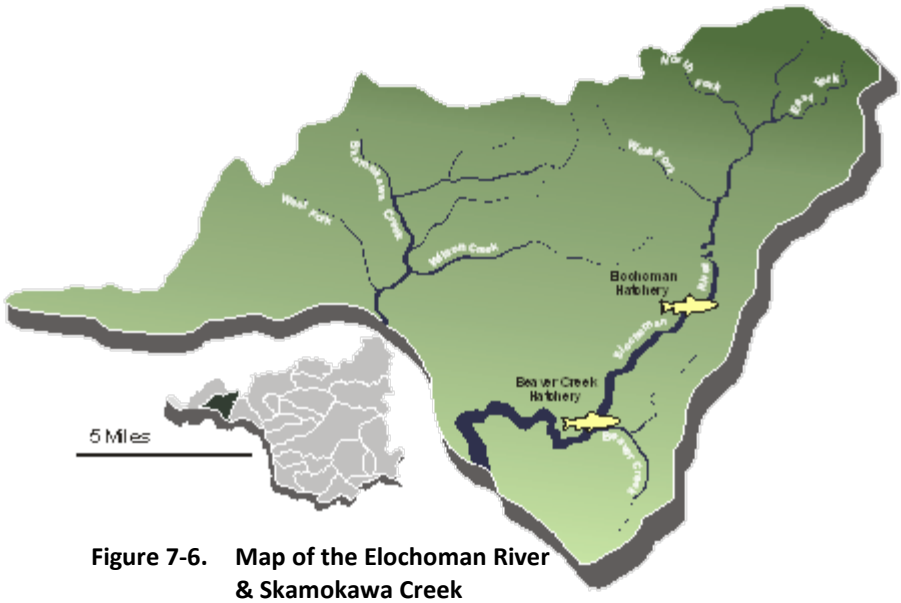


Figure 7-6. Map of the Elochoman River & Skamokawa Creek

Forest stands are young and road densities are high which has implications for watershed processes such as temperature, flow generation and sediment. Historic logging occurred without regard for riparian and channel habitat, resulting in loss of instream habitat. A broad agricultural valley extends up the mainstem Skamokawa Creek, Elochoman River, West Fork Skamokawa Creek, and Wilson Creek. There are considerable agricultural impacts to fish habitat in those areas, which suffer from non-forested riparian zones and disconnected floodplains. Continued population growth (37% by 2020) will increase pressures for conversion of forestry and agricultural land uses to residential uses, with potential impacts to habitat conditions.

Fish Species

Focal salmonid species include fall Chinook, winter steelhead, chum and coho. Bull trout do not occur in the subbasin. Salmon and steelhead numbers have declined to only a fraction of historical levels and extinction risks are significant (Table 7-5). Fall Chinook, chum, and coho are considered Primary for population recovery. Returns of winter steelhead, Chinook, and coho include both natural and hatchery produced fish from the Elochoman & Beaver Creek Hatcheries as well as out of basin hatchery stocks.

Table 7-5. Relative significance of potentially manageable factors for Elochoman/Skamokawa fish populations

Species	Population	Recovery priority	Viability		Improvement	Abundance		
			Status	Obj.		Historical	Current	Target
Fall Chinook	E/S	Primary	VL	H	150%	3,000	<50	1,500
Chum	E/S	Primary	M-	M+	>500%	16,000	<200	1,300
Winter Steelhead	E/S	Contributing	M	M+	0%[1]	1,100	600	600
Coho	E/S	Primary	VL	H	170%	6,500	<50	2,400

[1] Improvement increments are based on abundance and productivity; however, this population will require improvements in spatial structure or diversity to meet recovery objectives.

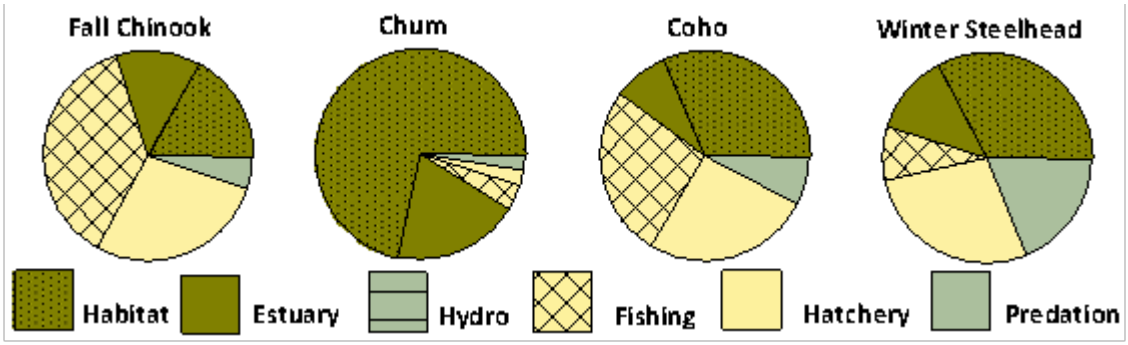


Figure 7-7. Status and goals for salmon and steelhead populations in the Elochoman/Skamokawa subbasin

Threats

The depleted status of subbasin fish populations is the combined effect of significant impacts of multiple factors (Figure 7-7). Loss of tributary habitat quality and quantity accounts for the largest relative impact on chum, coho, and winter steelhead. Loss of estuary habitat quantity and quality is relatively moderate for all species. Harvest has a relatively sizeable effect on fall Chinook, coho and winter steelhead. Hatchery impacts are substantial for coho, fall Chinook, and winter steelhead and relatively low for chum. The main threats from the Elochoman Hatchery are the potentially detrimental genetic effects of interbreeding of natural salmon with hatchery produced fish (especially Fall Chinook and coho) and ecological interactions (predation and competition) between hatchery and wild fish. There are no hatchery releases into Skamokawa Creek. Predation impacts are relatively moderate for coho, chum, and fall Chinook but higher for winter steelhead. No dams are operated in the subbasin and hydrosystem impacts are relatively minor and limited to habitat effects in the Columbia River mainstem and estuary.

Habitat Strategy

Fish recovery will require significant subbasin habitat improvements in concert with reductions in out-of-subbasin impacts from other limiting factors (Box 7-3). Species-specific recovery goals will require an estimated 0-170% improvement in habitat conditions (Table 7-5). Critical fish habitat problems include loss of habitat diversity, low summer flow, increased sediment, high summer temperature, and channel instability. Underlying watershed issues include impaired hydraulic conditions, increased sediment supply, and degraded riparian conditions due to timber management in the upper subbasin and agriculture in the lower subbasin. The habitat restoration strategy emphasizes the need for process-related actions that provide long-term benefits over short term temporary fixes. High priority reaches for protection and improvement include: a) the lower through middle reaches of Clear, Duck, Rock, McDonald, West Valley, and Wilson Creeks for coho and winter steelhead, b) lower mainstem reaches (above tidewater) of the Elochoman and Skamokawa for fall Chinook and chum, and c) the upper mainstem reaches of the Elochoman/Skamokawa for coho and winter steelhead (Figure 7-8, Table 7-6).

Box 7-3. Key recovery priorities for the Elochoman/Skamokawa subbasin.

- Manage forest lands to protect and restore watershed processes
- Restore lowland floodplain function, riparian function and stream habitat diversity
- Manage growth and development to protect watershed processes and habitat conditions
- Restore fish passage at culverts and other artificial barriers
- Address immediate risks with short-term habitat fixes
- Align hatchery priorities with conservation objectives
- Manage fishery impacts to reduce near-term population risks and support progress toward recovery
- Reduce out-of-subbasin impact so that the benefits of in-basin actions can be realized

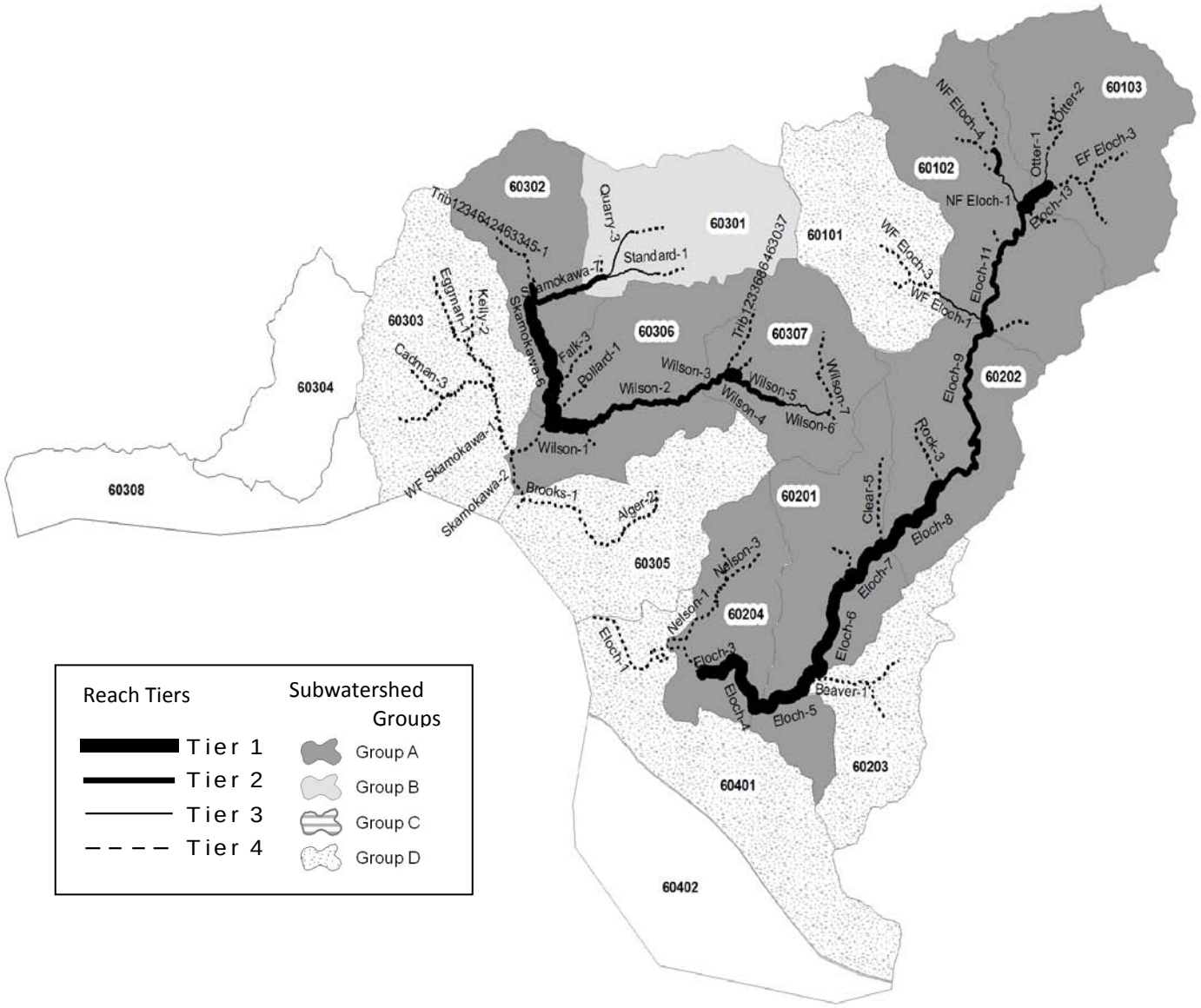


Figure 7-8. Reach tiers and subwatershed groups in the Elochoman/Skamokawa subbasin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives.

Table 7-6. High priority reaches identified for habitat protection and restoration actions in the Elochoman and Skamokawa subbasin and corresponding species priorities (High, Medium, Low) based on relative preservation and restoration value within the basin. Reach quality is the estimated proportion of historical fish production potential available for all species.

Reach	Habitat Quality	Priority (Tier)	Species Presence & Reach Priority					
			Chinook		Chum (Primary)	Coho (Primary)	Steelhead	
			Fall (Primary)	Spring (n/a)			Winter (Contrib.)	Summer (n/a)
Clear-1	70%	1	--	--	--	H	L	--
Clear-3	60%	2	--	--	--	M	L	--
Duck-1	50%	2	--	--	--	M	L	--
EF Eloch-1	63%	1	--	--	--	H	L	--
Eloch-10	61%	1	--	--	--	H	H	--
Eloch-11	49%	2	--	--	--	L	H	--
Eloch-12	50%	2	--	--	--	L	H	--
Eloch-13	61%	1	--	--	--	H	H	--
Eloch-3	58%	1	M	--	H	L	L	--
Eloch-4	54%	1	M	--	H	L	L	--
Eloch-5	56%	1	H	--	M	L	L	--
Eloch-6	46%	1	M	--	M	H	L	--
Eloch-7	42%	1	H	--	--	H	L	--
Eloch-8	49%	1	H	--	--	M	H	--
Eloch-9	60%	2	M	--	--	M	M	--
LF Skamokawa-1	50%	2	--	--	--	M	L	--
McDonald-1	51%	3	--	--	--	L	M	--
McDonald-2	61%	3	--	--	--	L	M	--
NF Eloch-1	48%	3	--	--	--	L	M	--
NF Eloch-2	40%	2	--	--	--	L	H	--
Otter-1	49%	3	--	--	--	L	M	--
Rock-1	64%	2	--	--	--	M	L	--
Skamokawa-5	55%	1	H	--	H	H	L	--
Skamokawa-6	59%	1	H	--	H	H	M	--
Skamokawa-7	48%	2	M	--	--	M	H	--
Skamokawa-8	65%	2	L	--	--	L	H	--
Standard-1	61%	3	--	--	--	L	M	--
Trib1233641463035-1	63%	1	--	--	--	H	L	--
WF Eloch-1	47%	3	--	--	--	L	M	--
Wilson-1	31%	1	--	--	M	H	L	--
Wilson-2	48%	2	--	--	M	M	M	--
Wilson-3	47%	1	--	--	--	H	H	--
Wilson-4	39%	2	--	--	--	L	H	--
Wilson-5	40%	2	--	--	--	L	H	--
Wilson-6	42%	3	--	--		L	M	--

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.

7.5 Mill, Abernathy & Germany Creeks

The Mill, Abernathy, Germany (MAG) subbasin is comprised of the eastern half of the Elochoman watershed as defined by the Northwest Power and Conservation Council and includes Fall, Coal, and Clark creeks as well as the Longview Ditch network (Figure 7-9). This is a low elevation, rain dominated system with tidal influences from the Columbia.

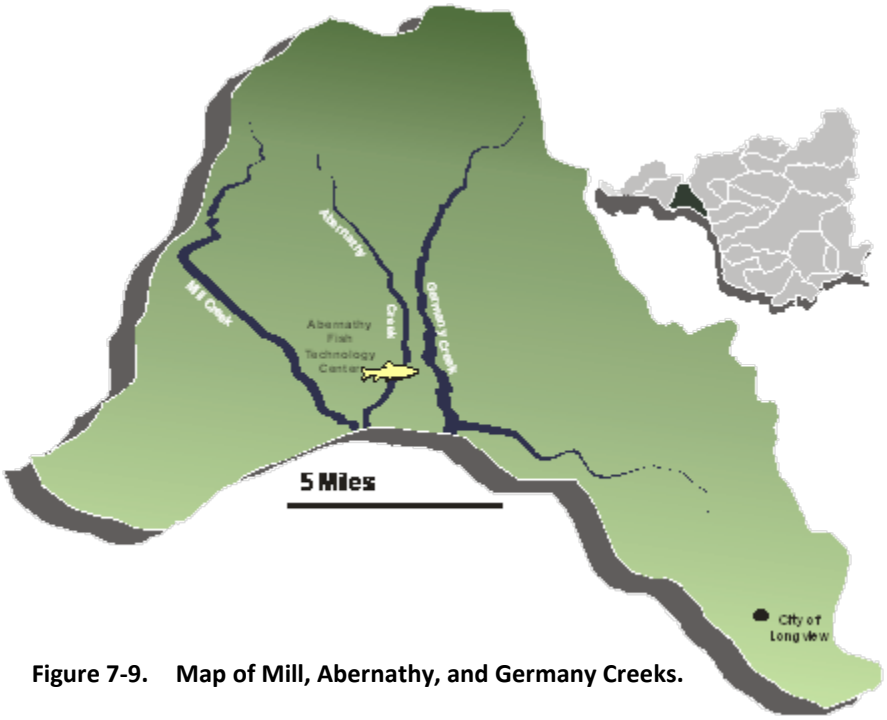


Figure 7-9. Map of Mill, Abernathy, and Germany Creeks.

The upper watershed is heavily-forested and largely managed for public and private industrial timber production. Forest stands are young and road densities are high which has implications for watershed processes such as temperature, flow generation and sediment. Historic logging occurred without regard for riparian and channel habitat, resulting in loss of instream habitat. However, as the forest matures, watershed conditions are recovering. Historically, some of the best habitat occurred in the higher reaches where low gradient, broad valleys resulted in complex channel meander and braiding. The middle reaches have considerable agricultural and development impacts to fish habitat, which suffer from non-forested riparian zones and disconnected floodplains.

Fish Species

Focal salmonid species include chum, coho, winter steelhead, and fall Chinook. Bull trout do not occur in the subbasin. Salmon and steelhead numbers have declined to only a fraction of historical levels (Table 7-7). Extinction risks are significant for all focal species. Fall Chinook, winter steelhead and chum are considered Primary for population recovery. Returns of winter steelhead and coho include both natural and hatchery produced fish. Natural fall Chinook spawning returns have been highly influenced by the release of Spring Creek Hatchery stock released at the Abernathy Creek NFH which was discontinued in 1995. Fall Chinook hatchery strays continue to be present in the subbasin.

Table 7-7. Status and goals for salmon and steelhead populations in the Mill, Abernathy and Germany creeks

Species	Population	Recovery priority	Viability		Improve-ment	Abundance		
			Status	Obj.		Historical	Current	Target
Fall Chinook	MAG	Primary	VL	H	155%	2,500	50	900
Chum	MAG	Primary	VL	H	>500%	7,000	<100	1,300
Winter Steelhead	MAG	Primary	M	H	0%[1]	900	600	600
Coho	MAG	Contributing	VL	M	>500%	2,800	<50	1,800

[1] Improvement increments are based on abundance and productivity; however, this population will require improvements in spatial structure or diversity to meet recovery objectives.

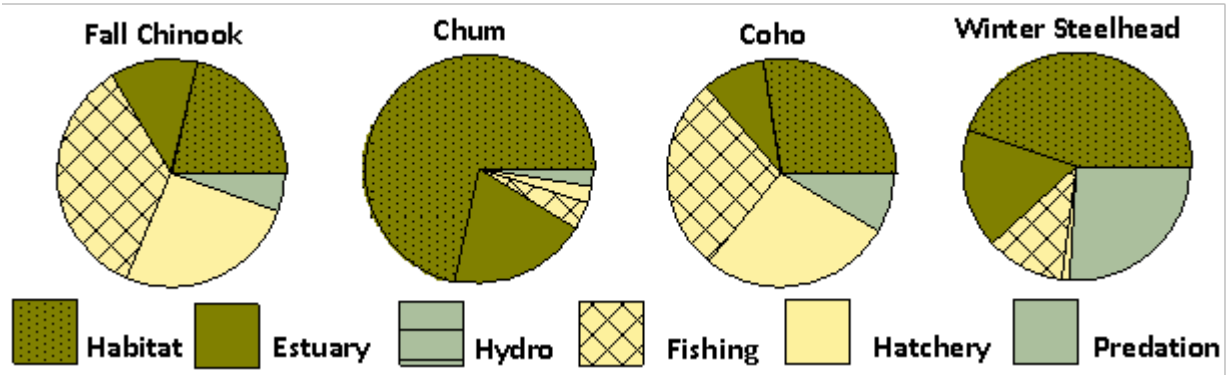


Figure 7-10. Relative significance of potentially manageable factors for MAG subbasin fish populations.

Threats

The depleted status of subbasin fish populations is the combined effect of significant impacts of multiple factors (Figure 7-10). Loss of tributary habitat quality and quantity accounts for large relative impacts on all species. Loss of estuary habitat quantity and quality is also relatively important for all species, but less so for coho. Harvest has a sizeable effect on fall Chinook, but is relatively minor for chum and winter steelhead; harvest impact on coho is intermediate. Hatchery impacts are relatively substantial for coho, moderate for fall Chinook, and relatively low for chum and winter steelhead. Predation impacts are variable. No dams are operated in the subbasin and hydrosystem impacts are relatively minor and limited to habitat effects in the Columbia River mainstem and estuary.

Habitat Strategy

Fish recovery will require significant subbasin habitat improvements in concert with reductions in out-of-subbasin impacts from other limiting factors (Box 7-4). Species-specific recovery goals will require an estimated 0-500% improvement in habitat conditions (Table 7-7). Critical fish habitat problems include loss of habitat diversity, flow, increased sediment, high summer temperature, channel stability, and predation. Underlying watershed issues include impaired hydraulic conditions, increased sediment supply, and degraded riparian and floodplain conditions due to timber management in the upper subbasin and agriculture in the lower subbasin. The habitat restoration strategy emphasizes the need for process-related actions that provide long-term benefits over short term temporary fixes. High priority reaches for preservation and restoration include: a) the upper reaches for coho and winter steelhead, b) lower reaches (including tidewater) for fall Chinook and chum (Figure 7-11, Table 7-8).

Box 7-4. Key recovery priorities for the MAG subbasin.

- Manage forest lands to protect and restore watershed processes
- Restore lowland floodplain function, riparian function and stream habitat diversity
- Manage growth and development to protect watershed processes and habitat conditions
- Restore fish passage at culverts and other artificial barriers
- Address immediate risks with short-term habitat fixes
- Align hatchery priorities with conservation objectives
- Manage fishery impacts to reduce near-term population risks and support progress toward recovery
- Reduce out-of-subbasin impact so that the benefits of in-basin actions can be realized

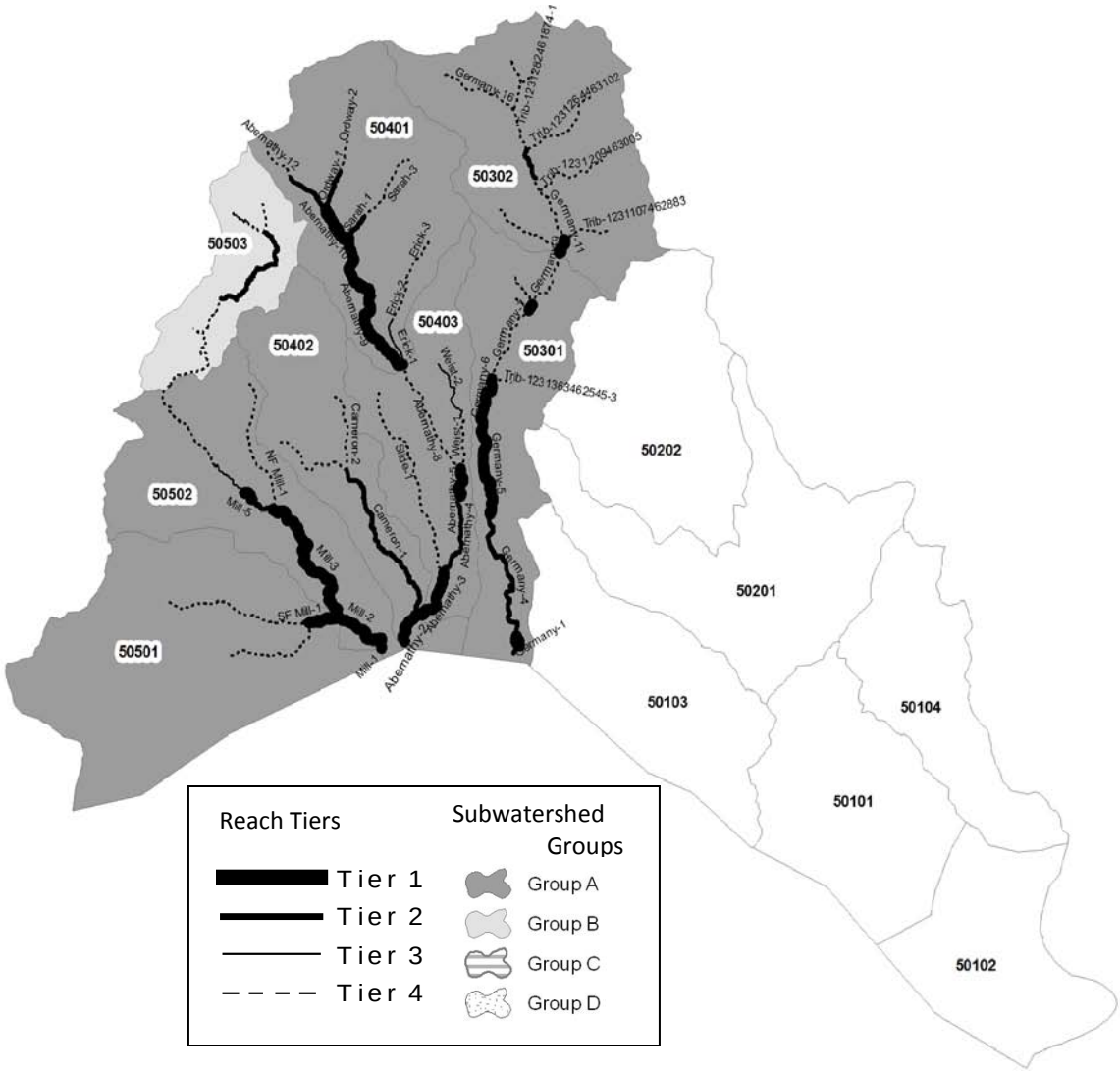


Figure 7-11. Reach tiers and subwatershed groups in the Mill, Abernathy, and Germany subbasin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives.

Table 7-8. High priority reaches identified for habitat protection and restoration actions in the Mill, Abernathy, and Germany subbasin and corresponding species priorities (High, Medium, Low) based on relative preservation and restoration value within the basin. Reach quality is the estimated proportion of historical fish production potential available for all species.

Reach	Habitat Quality	Priority (Tier)	Species Presence & Reach Priority					
			Chinook		Chum (Primary)	Coho (Contrib.)	Steelhead	
			Fall (Primary)	Spring (n/a)			Winter (Primary)	Summer (n/a)
Abernathy-1	52%	1	M	--	H	H	L	--
Abernathy-10	59%	1	--	--	--	H	H	--
Abernathy-11	48%	2	--	--	--	L	M	--
Abernathy-2	56%	1	H	--	H	H	H	--
Abernathy-3	46%	1	H	--	H	M	M	--
Abernathy-4	41%	2	M	--	L	M	M	--
Abernathy-5	48%	1	L	--	M	H	H	--
Abernathy-7	53%	1	L	--	--	H	H	--
Abernathy-9	31%	1	--	--	--	L	H	--
Cameron-1	49%	2	--	--	M	L	L	--
Germany-10	64%	1	--	--	--	L	H	--
Germany-13	36%	2	--	--	--	L	M	--
Germany-2	61%	1	H	--	H	L	H	--
Germany-3	52%	2	M	--	M	H	M	--
Germany-4	45%	2	L	--	--	H	M	--
Germany-5	46%	1	L	--	--	M	H	--
Germany-6	23%	1	--	--	--	L	H	--
Germany-8	50%	1	--	--	--	M	H	--
Mill-1	75%	1	M	--	L	L	H	--
Mill-10	35%	2	--	--	--	H	--	--
Mill-11	50%	2	--	--	--	H	--	--
Mill-12	47%	2	--	--	--	H	--	--
Mill-2	42%	1	H	--	M	M	M	--
Mill-3	51%	1	M	--	--	M	H	--
Mill-4	63%	2	L	--	--	H	M	--
Mill-5	54%	1	--	--	--	H	H	--
Ordway-1	28%	2	--	--	--	L	M	--
Sarah-1	39%	2	--	--	--	L	M	--
SF Mill-1	40%	1	--	--	H	M	L	--
Spruce-1	37%	2	--	--	--	H	--	--
Spruce-2	48%	2	--	--	--	H	--	--

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.

7.6 Cowlitz River – Upper

For the purposes of this assessment, the Cowlitz watershed has been divided into 4 subbasins; the lower Cowlitz, the upper Cowlitz, and the Toutle and Coweeman subbasins, which are the largest tributaries to the Cowlitz. The upper Cowlitz subbasin originates on the steep, heavily timbered mountains surrounding Mt. Rainier, Mt. Adams, Mt. St. Helens, and the Goat Rocks Wilderness. An upper alluvial valley extends from the junction of the Muddy Fork and Ohanapecosh Rivers (near Packwood) to Cowlitz Falls Reservoir (RM 99.5).

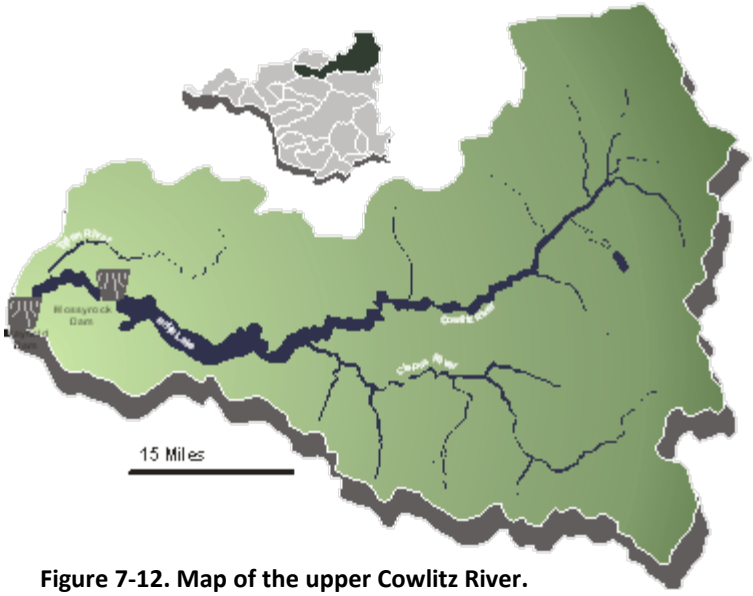


Figure 7-12. Map of the upper Cowlitz River.

Cowlitz Falls Dam (RM 88.5) was constructed in 1994, creating a long, narrow 11-mile reservoir. Below that, the river enters Riffe Lake, a 23.5 mile long reservoir created by the Mossyrock Dam (RM 66). Riffe Lake is operated as a storage reservoir by Tacoma Power for flood control and hydropower production. No fish passage facilities are present at Mossyrock Dam. A few miles below the dam, the river enters Mayfield Lake, a 13.5 mile long reservoir behind Mayfield Dam (RM 52). Historically, the portion of the stream inundated by the three reservoirs was made up of a series of deep canyons. Forestry is the dominant land use which has implications for watershed processes. Agricultural uses dominate the valley bottoms which suffer from non-forested riparian zones, disconnected floodplains and channelization.

Fish Species

Focal salmonid species in the Upper Cowlitz subbasin include fall Chinook, spring Chinook, winter steelhead, and coho. Bull trout do not occur in the subbasin. Salmon and steelhead numbers have declined to only a fraction of historical levels (Table 7-9). Extinction risks are significant for all focal species but winter steelhead, coho, and spring Chinook are considered Primary for population recovery. Spring Chinook, coho, and winter steelhead have been reintroduced into the upper Cowlitz in recent years, in an effort to reestablish natural production. Returns of spring Chinook, winter steelhead, and coho include both natural and hatchery produced fish.

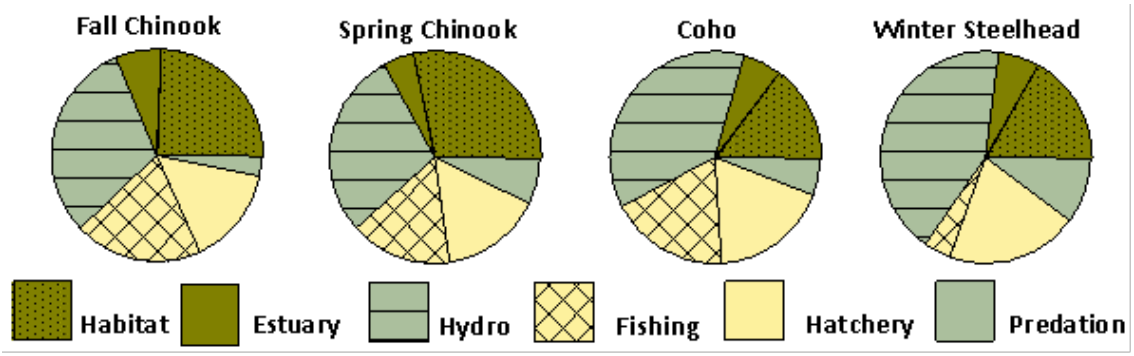


Figure 7-13. Relative significance of potentially manageable factors for upper Cowlitz River fish populations.

Table 7-9. Status and goals for salmon and steelhead populations in the Upper Cowlitz River subbasin.

Species	Population	Recovery priority	Viability		Improve-ment	Abundance		
			Status	Obj.		Historical	Current	Target
Fall Chinook	U. Cowlitz	Stabilizing	VL	VL	0%	28,000	0	--
Spring Chinook	U. Cowlitz	Primary	VL	H+	>500%	22,000	300	1,800
Winter Steelhead	U. Cowlitz	Primary	VL	H	>500%	1,400	<50	500
Coho	U. Cowlitz	Primary	VL	H	>500%	18,000	<50	2,000
Spring Chinook	Cispus	Primary	VL	H+	>500%	7,800	150	1,800
Winter Steelhead	Cispus	Primary	VL	H	>500%	1,500	<50	500
Coho	Cispus	Primary	VL	H	>500%	8,000	<50	2,000
Spring Chinook	Tilton	Stabilizing	VL	VL	0%	5,400	100	--
Winter Steelhead	Tilton	Contributing	VL	L	>500%	1,700	<50	200
Coho	Tilton	Stabilizing	VL	VL	0%	5,600	<50	--

Threats

The depleted status of subbasin fish populations is the combined effect of significant impacts of multiple factors (Figure 7-13). Hydrosystem impacts account for the largest relative impact on all species. Loss of tributary habitat quality and quantity is also relatively important for all species. Loss of estuary habitat quality and quantity has only moderate relative impact on all species. Harvest has a sizeable relative effect on all species, except winter steelhead. Hatchery impacts are relatively moderate for all species.

Habitat Strategy

Fish recovery will require significant subbasin habitat improvements in concert with reductions in out-of-subbasin impacts from other limiting factors (Box 7-5). Species-specific recovery goals will require an estimated 0->500% improvement in habitat conditions (Table 7-8). Critical fish habitat problems include increased sediment, loss of habitat diversity, flow, competition (hatchery), pathogens, food, and channel stability. The habitat restoration strategy emphasizes the need for process-related actions that provide long-term benefits over short term temporary fixes. High priority reaches for restoration include: a) upper mainstem & tributaries for fall/spring Chinook, coho, and winter steelhead; b) Cispus River and tributaries for coho, spring Chinook, and winter steelhead (Figure 7-14, Figure 7-10).

Box 7-5. Key recovery priorities for the Upper Cowlitz subbasin.

- Provide upstream and downstream passage through the Cowlitz basin hydrosystem
- Protect intact forests in headwater basins
- Manage forest lands to protect and restore watershed processes
- Manage growth and development to protect watershed processes and habitat conditions
- Restore valley floodplain function and stream habitat diversity
- Ensure hatchery priorities are consistent with conservation objectives
- Manage fishery impacts to reduce near-term population risks and support progress toward recovery
- Reduce out-of-subbasin impacts so that the benefits of in-basin actions can be realized

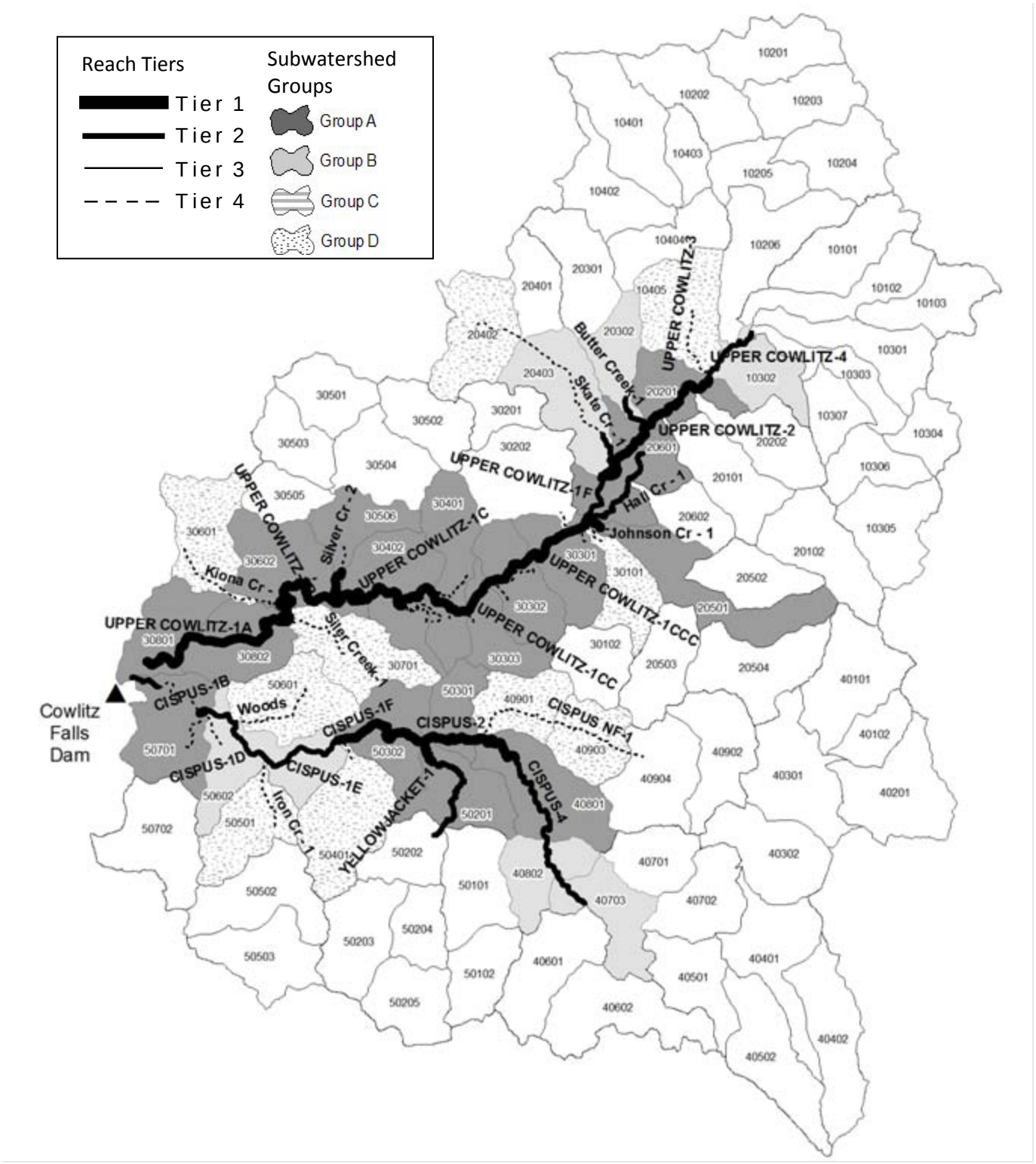


Figure 7-14. Reach tiers and subwatershed groups in the upper Cowlitz subbasin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives.

Table 7-10. High priority reaches identified for habitat protection and restoration actions in the upper Cowlitz River subbasin and corresponding species priorities (High, Medium, Low) based on relative preservation and restoration value within the basin. Reach quality is the estimated proportion of historical fish production potential available for all species.

Reach	Habitat Quality	Priority (Tier)	Species Presence & Reach Priority					
			Chinook		Chum (n/a)	Coho (Primary)	Steelhead	
			Fall (Stabil.)	Spring (Primary)			Winter (Primary)	Summer (n/a)
CISPUS-1A	13%	2	M	M	--	M	L	--
CISPUS-1C	57%	1	H	H	--	M	M	--
CISPUS-1F	56%	1	M	M	--	M	H	--
CISPUS-2	50%	1	M	M	--	H	H	--
CISPUS-3	47%	1	M	M	--	H	H	--
Hall Cr - 1	60%	2	--	M	--	M	L	--
Johnson Cr - 1	37%	1	L	M	--	L	H	--
MID COWLITZ-6	50%	2	M	M	--	L	L	--
MID COWLITZ-7	40%	1	M	M	--	H	L	--
Silver Cr - 1	30%	2	M	M	--	M	H	--
UPPER COWLITZ-1A	61%	1	H	M	--	H	L	--
UPPER COWLITZ-1AA	57%	1	M	H	--	H	M	--
UPPER COWLITZ-1B	51%	1	H	H	--	H	M	--
UPPER COWLITZ-1C	59%	1	H	H	--	M	H	--
UPPER COWLITZ-1CC	58%	1	H	H	--	M	H	--
UPPER COWLITZ-1CCC	58%	1	H	H	--	M	M	--
UPPER COWLITZ-1D	59%	1	H	M	--	M	H	--
UPPER COWLITZ-1E	62%	1	H	H	--	H	H	--
UPPER COWLITZ-1F	60%	2	M	M	--	M	M	--
UPPER COWLITZ-2	61%	1	M	M	--	L	H	--
YELLOWJACKET-1	48%	1	M	L	--	M	H	--

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.

7.7 Cowlitz River - Lower

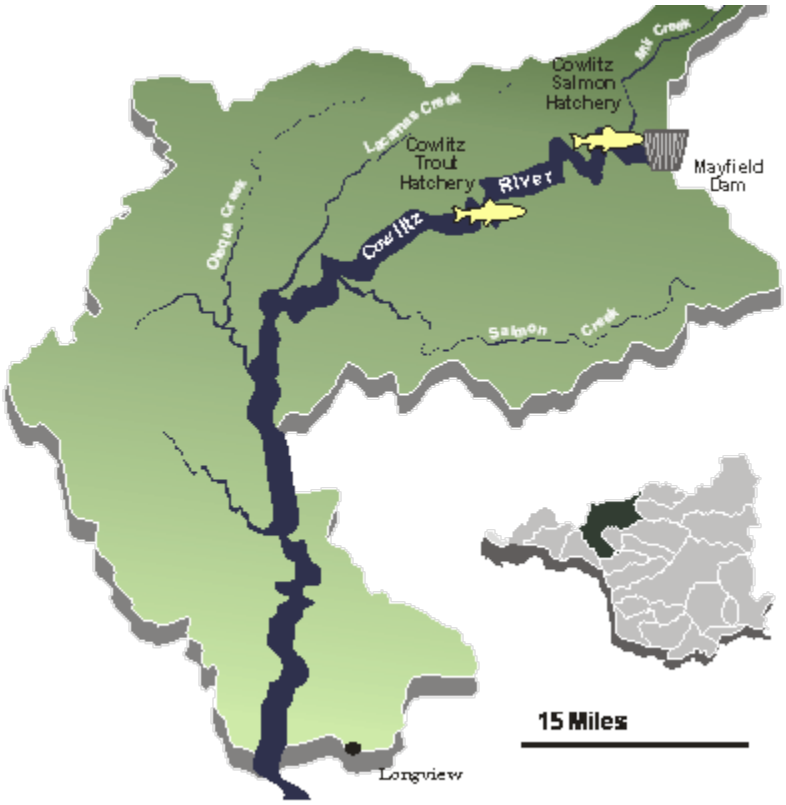


Figure 7-15. Map of the lower Cowlitz River.

For the purposes of this assessment, the Cowlitz watershed has been divided into 4 subbasins; the lower Cowlitz, the upper Cowlitz, and the Toutle and Coweeman subbasins which are the largest tributaries to the Cowlitz. The lower Cowlitz subbasin begins below Mayfield Dam (RM 52), travels south through a broad valley until it meets the Columbia at RM 68, (Figure 7-15). Principal tributaries include Salmon, Lacamas, Olequa, Delameter, and Ostrander Creeks. Forestry is the dominant land use below Mayfield Dam which has implications for watershed processes such as temperature and flow generation.

Agricultural uses dominate the valley bottoms which suffer from non-forested riparian zones, disconnected floodplains and channelization. Mayfield Dam, constructed in 1962, blocks all natural passage of anadromous fish to the upper basin. The Cowlitz Salmon Hatchery Barrier Dam (RM 49.5) is a collection facility for trapping and hauling fish into the upper basin. Major population centers include Kelso and Longview as well as a number of smaller towns, all of which are expected to increase in population substantially by 2020.

Fish Species

Focal salmonid species in the lower Cowlitz subbasin include fall Chinook, winter steelhead, chum and coho. Bull trout do not occur in the subbasin. Salmon and steelhead numbers have declined to only a fraction of historical levels (Table 7-11). Extinction risks are significant for all focal species but coho are considered Primary for population recovery. Lower Cowlitz chum are a subset of a larger population which includes the Coweeman and Toutle Rivers. Returns of fall Chinook, winter steelhead, and coho include both natural and hatchery produced fish from the Grays River Hatchery and out of basin hatchery stocks.

Table 7-11. Status and goals for salmon and steelhead populations in the lower Cowlitz River subbasin.

		Recovery	Viability		Improve-	Abundance		
Species	Population	Priority	Status	Obj.	ment	Historical	Current	Target
Fall Chinook	L. Cowlitz	Contributing	VL	M+	50%	24,000	500	3,000
Chum (Fall)	L. Cowlitz	Contributing	VL	M	>500%	195,000	<300	900
Chum (Summer)	L. Cowlitz	Contributing	VL	M	>500%	n/a	n/a	900
Winter Steelhead	L. Cowlitz	Contributing	L	M	5%	1,400	350	400
Coho	L. Cowlitz	Primary	VL	H	100%	18,000	500	3,700

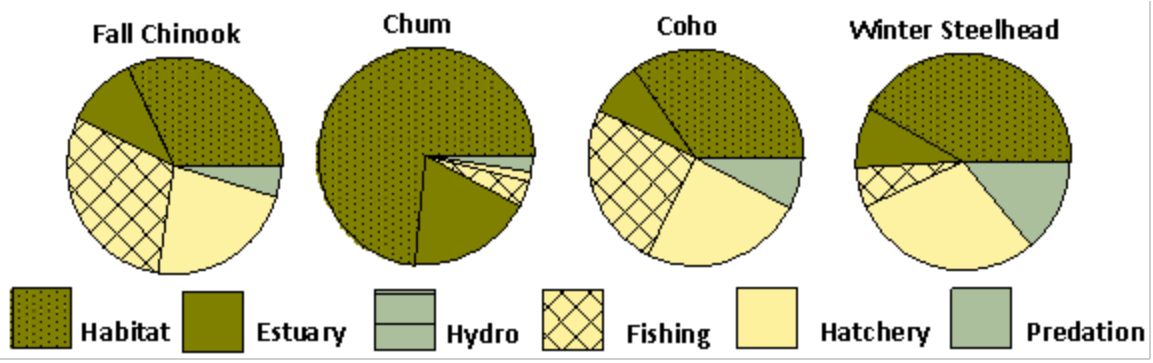


Figure 7-16. Relative significance of potentially manageable factors for lower Cowlitz River fish populations

Threats

The depleted status of subbasin fish populations is the combined effect of significant impacts of multiple factors (Figure 7-16). Loss of tributary habitat quality and quantity accounts for the largest relative impact on all species except for fall Chinook where fishing harvest impacts dominate. Loss of estuary habitat quality and quantity are substantial for chum, and moderate for all other species. Harvest has a sizeable effect on fall Chinook and coho but is relatively minor for chum and winter steelhead. Hatchery impacts are significant for coho, fall Chinook and winter steelhead. Predation impacts are significant for winter steelhead, and moderate for fall Chinook and coho. Hydrosystem impacts appear to be relatively minor for all species.

Habitat Strategy

Fish recovery will require significant subbasin habitat improvements in concert with reductions in out-of-subbasin impacts from other limiting factors (Box 7-6). Species-specific recovery goals will require an estimated 0->500% improvement in habitat conditions (Table 7-11). Critical fish habitat problems include increased sediment, loss of habitat diversity, flow, high summer temperature, pathogens, food, and channel stability. Underlying watershed issues are primarily related to logging and agricultural lands uses, and include impaired hydraulic conditions, increased sediment supply, channel alteration, streambank hardening and flood control activities, and degraded riparian conditions. The habitat restoration strategy emphasizes the need for process-related actions that provide long-term benefits over short term temporary fixes. High priority reaches for restoration include: a) lower mainstem & tributaries for fall Chinook, coho, and chum; b) middle mainstem and Mill Creek for chum, fall Chinook, coho, and winter steelhead, and c) Olequa, Lacamas, and Salmon creeks for coho and winter steelhead (Figure 7-17, Table 7-12).

Box 7-6. Key recovery priorities for the lower Cowlitz subbasin.

- Manage regulated stream flows through the hydropower system
- Restore floodplain function, riparian function and stream habitat diversity
- Protect intact forest in headwater basins
- Manage growth and development to protect watershed processes and habitat conditions
- Address immediate risks with short-term habitat fixes
- Manage forest lands to protect and restore watershed processes
- Restore passage at culverts and other artificial barriers
- Align hatchery priorities consistent with conservation objectives
- Manage fishery impacts to reduce near-term population risks and support progress toward recovery
- Reduce out-of-subbasin impacts so that the benefits of in-basin actions can be realized

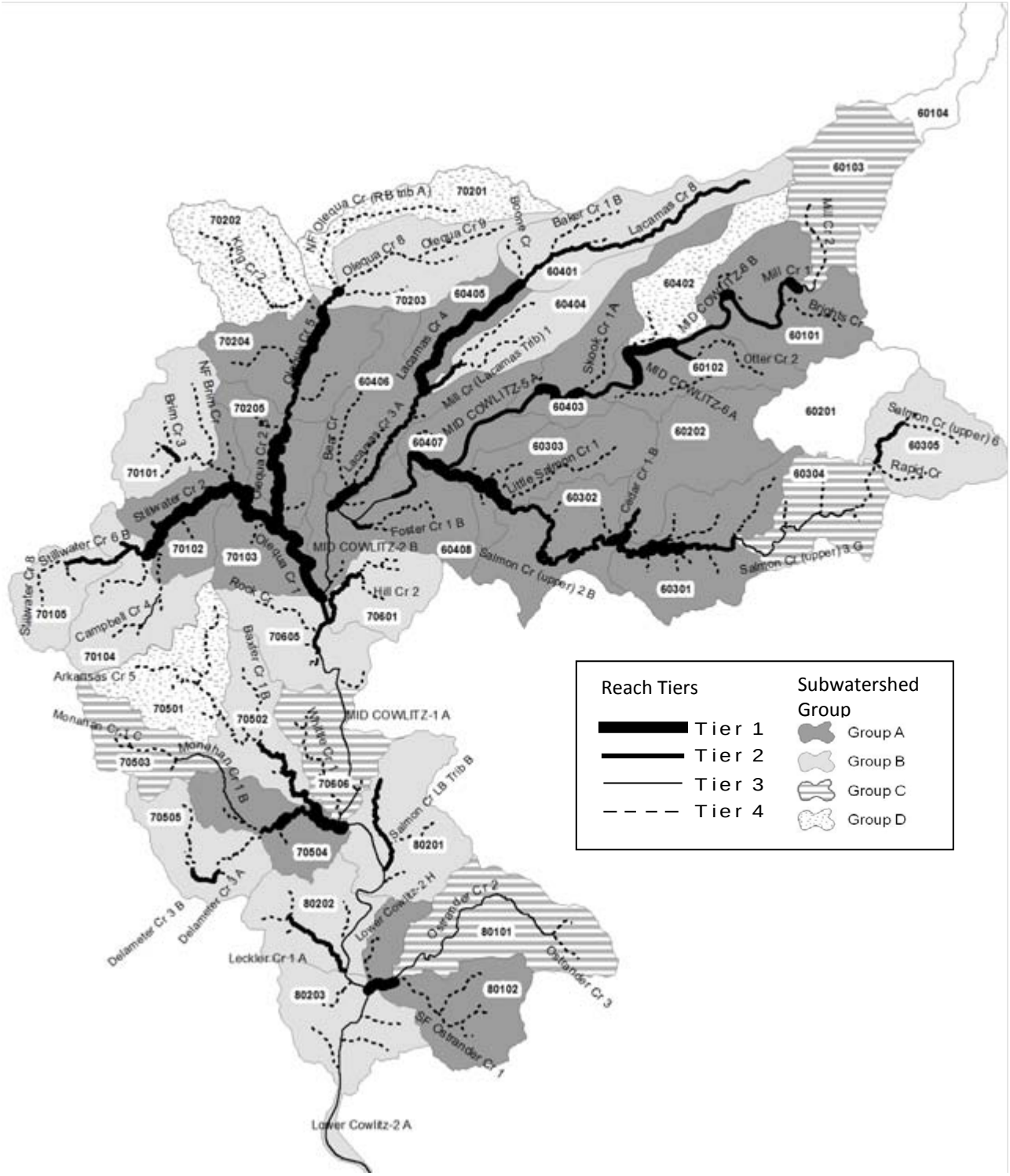


Figure 7-17. Reach tiers and subwatershed groups in the lower Cowlitz River Basin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives.

Table 7-12. High priority reaches identified for habitat protection and restoration actions in the lower Cowlitz River subbasin and corresponding species priorities (High, Medium, Low) based on relative preservation and restoration value within the basin. Reach quality is the estimated proportion of historical fish production potential available for all species.

Reach	Habitat Quality	Priority (Tier)	Species Presence & Reach Priority					
			Chinook		Chum (Contrib.)	Coho (Primary)	Steelhead	
			Fall (Contrib.)	Spring (n/a)			Winter (Contrib.)	Summer (n/a)
Arkansas Cr 1 A	31%	1	--	--	L	H	M	--
Arkansas Cr 1 B	3%	1	--	--	--	H	M	--
Arkansas Cr 2 A	22%	2	--	--	--	M	L	--
Arkansas Cr 2 B	26%	2	--	--	--	M	L	--
Brim Cr 1 A	36%	2	--	--	--	M	L	--
Brim Cr 2	31%	2	--	--	--	M	L	--
Brim Cr RB Trib 2 A	31%	2	--	--	--	M		--
Cedar Cr 1 A	11%	1	--	--	--	H	L	--
Cedar Cr 1 B	9%	2	--	--	--	M	L	--
Delameter Cr 1	23%	2	--	--	L	M	L	--
Delameter Cr 2 A	56%	1	--	--	L	H	L	--
Delameter Cr 2 B	48%	2	--	--	L	M	L	--
Delameter Cr 3 B	31%	2	--	--	--	M	L	--
Foster Cr 1 A	44%	2	--	--	--	M	L	--
Hill Cr 1	35%	2	--	--	--	M	L	--
Lacamas Cr 1 A	34%	1	--	--	H	H	H	--
Lacamas Cr 1 B	36%	1	--	--	H	H	M	--
Lacamas Cr 2	21%	1	--	--	--	H	H	--
Lacamas Cr 3 A	17%	2	--	--	--	M	H	--
Lacamas Cr 3 B	21%	2	--	--	--	M	M	--
Lacamas Cr 4	23%	1	--	--	--	H	L	--
Lacamas Cr 5	28%	1	--	--	--	H	L	--
Lacamas Cr 6	27%	2	--	--	--	M	L	--
Lacamas Cr 7	31%	2	--	--	--	M	L	--
Lacamas Cr 8	29%	2	--	--	--	M	L	--
Leckler Cr 1 A	13%	2	--	--	--	M	L	--
Leckler Cr 1 B	18%	2	--	--	--	M	L	--
Lower Cowlitz-1	6%	2	L	--	H	L	L	--
MID COWLITZ-1 C	61%	2	H	--	L	L	L	--
MID COWLITZ-1 D	46%	2	H	--	L	L	L	--
MID COWLITZ-1 E	50%	2	H	--	L	L	L	--
MID COWLITZ-1 F	44%	2	H	--	L	L	L	--
MID COWLITZ-4 A	36%	2	L	--	M	M	L	--
MID COWLITZ-4 B	38%	1	M	--	M	H	H	--
MID COWLITZ-5 A	33%	2	L	--	L	M	H	--
MID COWLITZ-5 B	35%	1	L	--	L	H	H	--
MID COWLITZ-5 C	35%	2	L	--	L	M	H	--
MID COWLITZ-5 D	31%	1	L	--	L	H	H	--
MID COWLITZ-6 A	45%	1	L	--	H	H	H	--
MID COWLITZ-6 B	43%	2	L	--	H	M	H	--
MID COWLITZ-6 C	50%	1	L	--	H	H	L	--
MID COWLITZ-6 D	44%	2	L	--	H	M	H	--
MID COWLITZ-6 E	44%	2	L	--	H	M	H	--
MID COWLITZ-7	33%	1	L	--	H	H	L	--

Reach	Habitat Quality	Priority (Tier)	Species Presence & Reach Priority					
			Chinook		Chum (Contrib.)	Coho (Primary)	Steelhead	
			Fall (Contrib.)	Spring (n/a)			Winter (Contrib.)	Summer (n/a)
Mill Cr (Lacamas Trib) 1	41%	2	--	--	--	M	L	--
Olequa Cr 1	36%	1	--	--	H	H	M	--
Olequa Cr 2 A	20%	1	--	--	--	H	L	--
Olequa Cr 2 B	13%	1	--	--	--	H	M	--
Olequa Cr 3	9%	2	--	--	--	M	M	--
Olequa Cr 4	11%	2	--	--	--	M	H	--
Olequa Cr 5	6%	1	--	--	--	H	H	--
Olequa Cr 6	21%	2	--	--	--	M	M	--
Olequa Cr 7	31%	1	--	--	--	H	L	--
Ostrander Cr 1 A	33%	1	--	--	L	H	M	--
Ostrander Cr 1 B	28%	1	--	--	L	H	L	--
Otter Cr 1	42%	2	--	--	--	M	L	--
Owens Cr	58%	2	--	--	--	M	L	--
Salmon Cr (upper) 1 A	29%	1	--	--	H	H	M	--
Salmon Cr (upper) 1 B	30%	1	--	--	H	H	M	--
Salmon Cr (upper) 1 C	36%	1	--	--	H	H	L	--
Salmon Cr (upper) 1 D	27%	1	--	--	H	H	M	--
Salmon Cr (upper) 1 E	41%	1	--	--	H	H	L	--
Salmon Cr (upper) 2 A	25%	2	--	--	L	M	L	--
Salmon Cr (upper) 2 B	26%	2	--	--	L	M	L	--
Salmon Cr (upper) 2 C	47%	1	--	--	L	H	L	--
Salmon Cr (upper) 3 A	23%	2	--	--	--	M	L	--
Salmon Cr (upper) 3 B	21%	1	--	--	--	H	M	--
Salmon Cr (upper) 3 C	27%	1	--	--	--	H	L	--
Salmon Cr (upper) 3 D	17%	1	--	--	--	H	M	--
Salmon Cr (upper) 3 E	28%	2	--	--	--	M	M	--
Salmon Cr (upper) 3 F	34%	2	--	--	--	M	M	--
Salmon Cr (upper) 5	44%	2	--	--	--	M	L	--
Salmon Cr Trib 6 A	37%	2	--	--	--	M	L	--
Salmon Cr 1	9%	2	--	--	L	M	L	--
Salmon Cr 2 thru 5	3%	2	--	--	H	L	L	--
Stillwater Cr 1 A	20%	1	--	--	--	H	H	--
Stillwater Cr 1 B	24%	1	--	--	--	H	M	--
Stillwater Cr 2	29%	1	--	--	--	H	L	--
Stillwater Cr 3	25%	1	--	--	--	H	M	--
Stillwater Cr 4	35%	1	--	--	--	H	M	--
Stillwater Cr 5	35%	1	--	--	--	H	H	--
Stillwater Cr 6 A	28%	2	--	--	--	M	M	--
Stillwater Cr 6 B	26%	2	--	--	--	M	L	--
Stillwater Cr LB Trib	47%	2	--	--	--	M	L	--

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.

7.8 Coweeman River

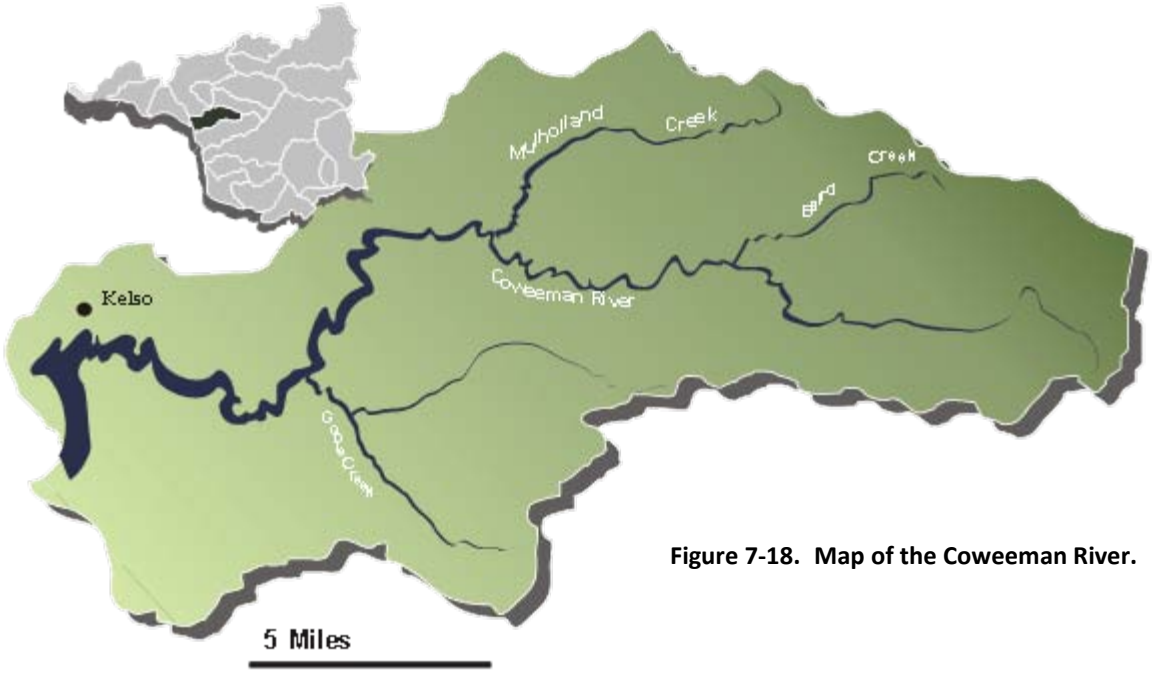


Figure 7-18. Map of the Coweeman River.

The Coweeman River originates in the cascade foothills. Elevations range from sea level at the mouth to 3,000 feet. Principal tributaries include Goble, Mulholland, Baird, O'Neill, and Butler Creeks (Figure 7-18). The Coweeman River joins the mainstem Cowlitz at RM 1.7. It is a rainfall dominated system with some portions in the rain-on-snow zone. Forestry is the dominant land use which has implications for watershed processes. Agricultural uses dominate the valley bottoms which suffer from non-forested riparian zones, channelization and disconnected floodplains. The largest population center in the basin is Kelso, WA, located near the river mouth. Population growth is expected to increase by 42% by 2020, which will increase pressures for conversion of forestry and agricultural land uses to residential uses, with potential impacts to habitat conditions.

Fish Species

Focal salmonid species in the Coweeman subbasin include fall Chinook, chum, winter steelhead, and coho. Bull trout do not occur in the subbasin. Salmon and steelhead numbers have declined to only a fraction of historical levels (Table 7-13). Extinction risks are significant for all focal species but fall Chinook, winter steelhead, and coho are considered Primary for population recovery. Chum, in this subbasin, are a subset of a larger population which includes the Cowlitz and Toutle Rivers.

Table 7-13. Status and goals for salmon and steelhead populations in the Coweeman River subbasin.

Species	Population	Recovery priority	Viability		Improve-ment	Abundance		
			Status	Obj.		Historical	Current	Target
Fall Chinook	Coweeman	Primary	VL	H+	80%	3,500	100	900
Chum	L. Cowlitz	Contributing	VL	M	>500%	195,000	<300	900
Winter Steelhead	Coweeman	Primary	L	H	25%	900	350	500
Coho	Coweeman	Primary	VL	H	170%	5,000	<50	1,200

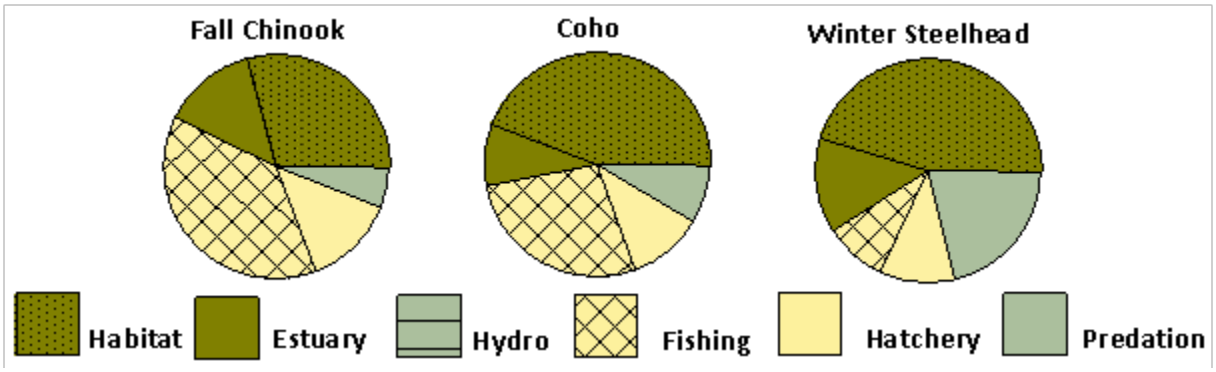


Figure 7-19. Relative significance of potentially manageable factors for Coweeman River fish populations.

Threats

The depleted status of subbasin fish populations is the combined effect of significant impacts of multiple factors (Figure 7-19). Loss of tributary habitat quality and quantity accounts for the largest relative impact on all species, except fall Chinook where harvest is most significant. Predation is relatively important for all species. Loss of estuary habitat quality and quantity are relatively important for all species. Harvest has a relatively sizeable effect on fall Chinook and coho. Hatchery impacts are assumed to be relatively low for all species. Hydrosystem impacts appear to be relatively minor for all species.

Habitat Strategy

Fish recovery will require significant subbasin habitat improvements in concert with reductions in out-of-subbasin impacts from other limiting factors (Box 7-7). Species-specific recovery goals will require an estimated 25-500% improvement in habitat conditions (Table 7-13). Critical fish habitat problems include channel stability, loss of habitat diversity, flow, high summer temperature, pathogens, and food. Underlying watershed issues are primarily related to logging and agricultural land-uses and include impaired hydraulic conditions, increased sediment supply, channel alteration, streambank hardening, flood control activities, and degraded riparian conditions. The habitat restoration strategy emphasizes the need for process-related actions that provide long-term benefits over short term temporary fixes. High priority reaches for restoration include: a) lower mainstem and canyon reach for fall Chinook, coho, and chum; b) middle mainstem and Goble Creek for fall Chinook, coho, and winter steelhead, and c) upper Coweeman reaches (including Mulholland and Baird Creeks) for fall Chinook, coho and winter steelhead (Figure 7-20, Table 7-14).

Box 7-7. Key recovery priorities for the Coweeman River subbasin.

- Manage subbasin forests to restore watershed processes
- Manage growth and development to protect watershed processes and habitat conditions
- Restore lower mainstem valley floodplain function and stream habitat diversity
- Address immediate risks with short-term habitat fixes
- Align hatchery priorities consistent with conservation objectives
- Manage fishery impacts to reduce near-term population risks and support progress toward recovery
- Reduce out-of-subbasin impacts so that the benefits of in-basin actions can be realized

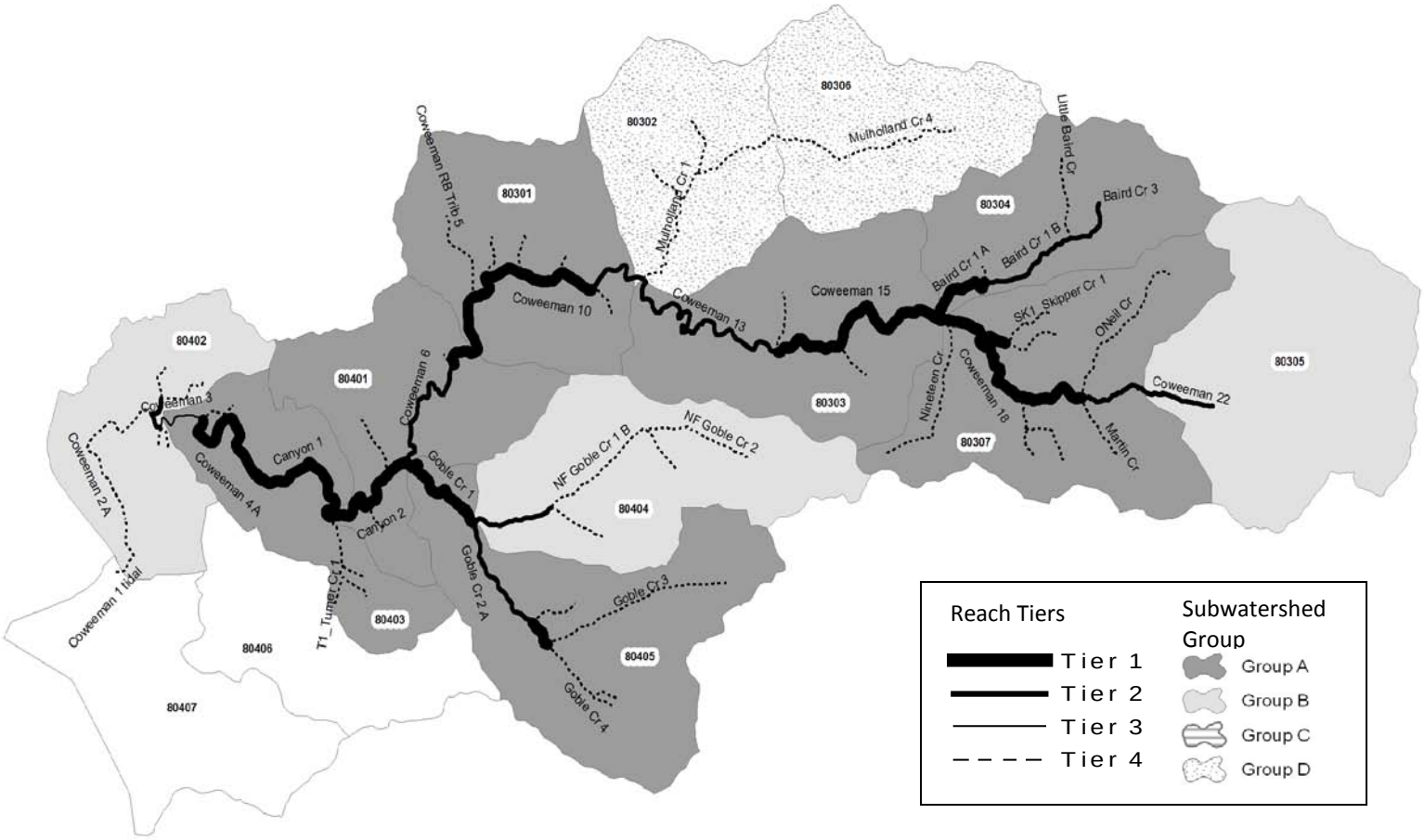


Figure 7-20. Reach tiers and subwatershed groups in the Coweeman River subbasin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives.

Table 7-14. High priority reaches identified for habitat protection and restoration actions in the Coweeman River subbasin and corresponding species priorities (High, Medium, Low) based on relative preservation and restoration value within the basin. Reach quality is the estimated proportion of historical fish production potential available for all species.

Reach	Habitat Quality	Priority (Tier)	Species Presence & Reach Priority					
			Chinook		Chum (Contributing)	Coho (Primary)	Steelhead	
			Fall (Primary)	Spring (n/a)			Winter (Primary)	Summer (n/a)
Baird Cr 1 A	58%	1	--	--	--	L	H	--
Baird Cr 1 B	51%	2	--	--	--	L	M	--
Baird Cr 2	65%	2	--	--	--	L	M	--
Canyon 1	47%	1	H	--	--	M	L	--
Canyon 2	49%	1	H	--	--	M	L	--
Canyon 3	53%	1	H	--	--	L	M	--
Coweeman 10	34%	1	H	--	--	H	M	--
Coweeman 11	39%	1	M	--	--	H	M	--
Coweeman 12	39%	2	M	--	--	M	M	--
Coweeman 13	50%	2	L	--	--	L	M	--
Coweeman 14	44%	1	M	--	--	M	H	--
Coweeman 15	47%	1	L	--	--	M	H	--
Coweeman 16	55%	1	M	--	--	H	H	--
Coweeman 17	54%	1	M	--	--	H	H	--
Coweeman 18	47%	1	L	--	--	H	H	--
Coweeman 19	41%	1	--	--	--	L	H	--
Coweeman 2 B	26%	2	L	--	L	M	L	--
Coweeman 20	45%	1	--	--	--	M	H	--
Coweeman 21	19%	2	--	--	--	L	M	--
Coweeman 22	20%	2	--	--	--	L	M	--
Coweeman 3	63%	3	L	--	M	L	L	--
Coweeman 4 A	45%	1	H	--	H	L	L	--
Coweeman 4 B	36%	1	H	--	H	L	L	--
Coweeman 5	46%	1	H	--	--	H	M	--
Coweeman 6	34%	2	M	--	--	M	M	--
Coweeman 7 & 8	38%	1	M	--	--	H	L	--
Coweeman 9 A	43%	1	M	--	--	H	L	--
Coweeman 9 B	35%	1	M	--	--	H	M	--
Coweeman RB 1 A	54%	2	--	--	--	M	L	--
Goble Cr 1	31%	1	L	--	--	L	H	--
Goble Cr 2 A	38%	2	--	--	--	L	M	--
Goble Cr 2 B	45%	1	--	--	--	L	H	--
NF Goble Cr 1 A	16%	2	--	--	--	L	M	--
SK1_Skipper Cr 1	36%	1	--	--	--	L	H	--

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.

7.9 Toutle River

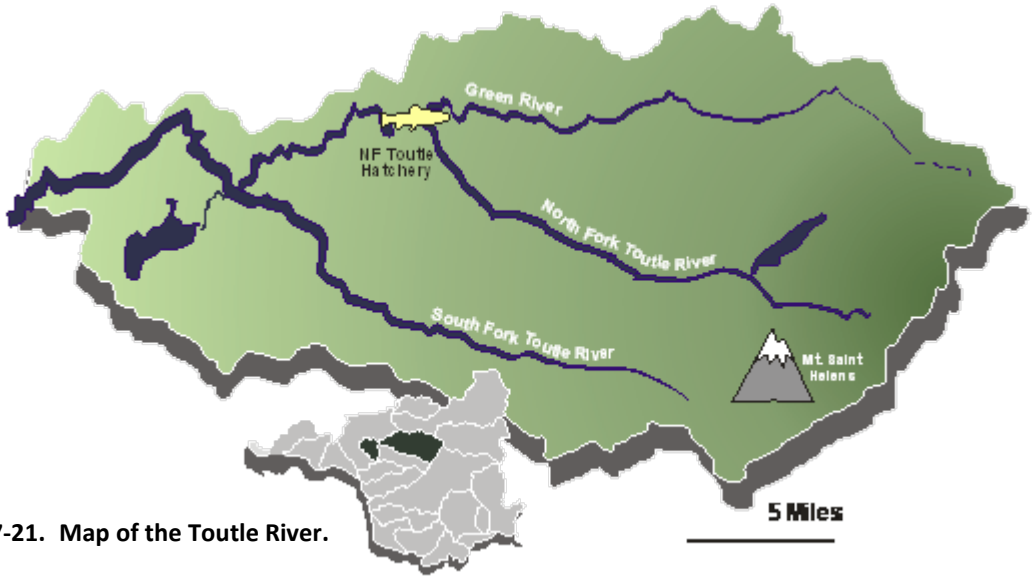


Figure 7-21. Map of the Toutle River.

The Toutle originates on Mt. St. Helens and drains the north and west sides of the mountain, flowing westward until it joins the Cowlitz River at RM 20. Elevation ranges from near sea level to 8,000 feet at the summit of St. Helens. The watershed contains three main drainages, the North Fork Toutle, the South fork Toutle, and the Green River (Figure 7-21). Much of the upper basin is within the Mt. St. Helens National Volcanic Monument. Most of the North and South Fork were severely impacted by the 1980 eruption of St. Helens and the resulting debris torrents and mudflows. Forestry is the dominant land use and significant portions of the forests to the north and west were decimated by the 1980 eruption and are now in early seral, or young vegetative conditions, which has significant implications for watershed processes such as sedimentation.

Fish Species

Focal salmonid species in the Toutle subbasin include fall and spring Chinook, chum, winter steelhead, and coho. Bull trout do not occur in the subbasin. Salmon and steelhead numbers have declined to only a fraction of historical levels (Table 7-15). Extinction risks are significant for all focal species but fall Chinook, winter steelhead and coho are considered Primary for population recovery. Chum are a subset of a larger population which includes the Cowlitz and Coweeman Rivers. Returns of fall Chinook, coho, and winter steelhead include both natural and hatchery produced fish.

Table 7-15. Status and goals for salmon and steelhead populations in the Toutle River.

Species	Population	Recovery priority	Viability		Improve-ment	Abundance		
			Status	Obj.		Historical	Current	Target
Fall Chinook	NF Toutle	Primary	VL	H+	265%	11,000	<50	3,000
Spring Chinook	SF Toutle	Contributing	VL	M	>500%	3,100	100	1,100
Winter Steelhead	NF Toutle	Primary	VL	H	125%	3,600	120	600
Winter Steelhead	SF Toutle	Primary	M	H+	35%	--[1]	350	600
Coho	NF Toutle	Primary	VL	H	180%	27,000	<50	3,800
Coho	SF Toutle	Primary	VL	H	180%	--[2]	<50	3,800
Chum	L. Cowlitz	Contributing	VL	M	>500%	195,000	<300	900

[1] The estimated historical abundance for both the NF and SF Toutle winter steelhead population is 3,600
[2] The estimated historical abundance for both the NF and SF Toutle coho population is 27,000

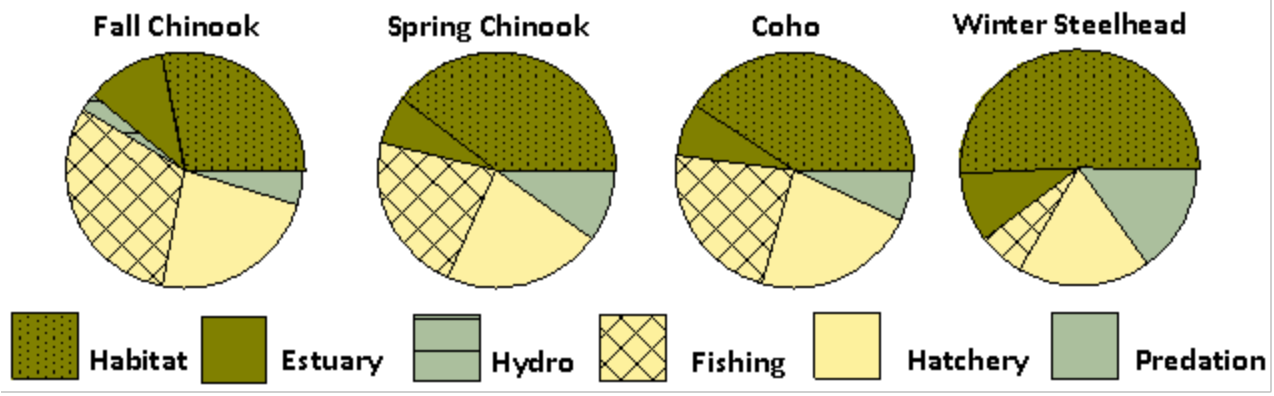


Figure 7-22. Relative significance of potentially manageable factors for Toutle River fish populations.

Threats

The depleted status of subbasin fish populations is the combined effect of significant impacts of multiple factors (Figure 7-22). Loss of tributary habitat quality and quantity accounts for the largest relative impact on all species except for fall Chinook for which harvest dominates. Predation impacts are moderate for all species but higher for winter steelhead. Harvest has significant impacts to fall and spring Chinook and coho. Hatchery impacts are moderate for all fish species. Loss of estuary habitat quality and quantity has moderate impacts on all species. Out of basin hydrosystem impacts appear to be relatively minor for all species but more so for fall Chinook.

Habitat Strategy

Fish recovery will require significant subbasin habitat improvements in concert with reductions in out-of-subbasin impacts from other limiting factors (Box 7-8). Species-specific recovery goals will require an estimated 35-500% improvement in habitat conditions (Table 7-14). Critical fish habitat problems include increased sediment, loss of habitat diversity, flow, temperature, and channel stability. The habitat restoration strategy emphasizes the need for process-related actions that provide long-term benefits over short term temporary fixes. High priority reaches for restoration include: a) lower mainstem for fall Chinook, coho, and chum; b) North Fork & South Fork Toutle for fall Chinook and coho, c) upper South Fork Toutle for fall Chinook and winter steelhead and, d) Middle Reach of the North Fork Toutle for winter steelhead, spring Chinook, and coho (Figure 7-23, Table 7-16).

Box 7-8. Key recovery priorities for the Toutle River.

- Address passage and sedimentation issues associated with the sediment retention structure on the North Fork Toutle
- Manage forest lands to protect and restore watershed processes
- Restore valley floodplain function and stream habitat diversity
- Help address immediate risks with short-term habitat fixes
- Manage growth and development to protect watershed processes and habitat conditions
- Align hatchery priorities consistent with conservation objectives
- Manage fishery impacts to reduce near-term population risks and support progress toward recovery
- Reduce out-of-subbasin impacts so that the benefits of in-basin actions can be realized

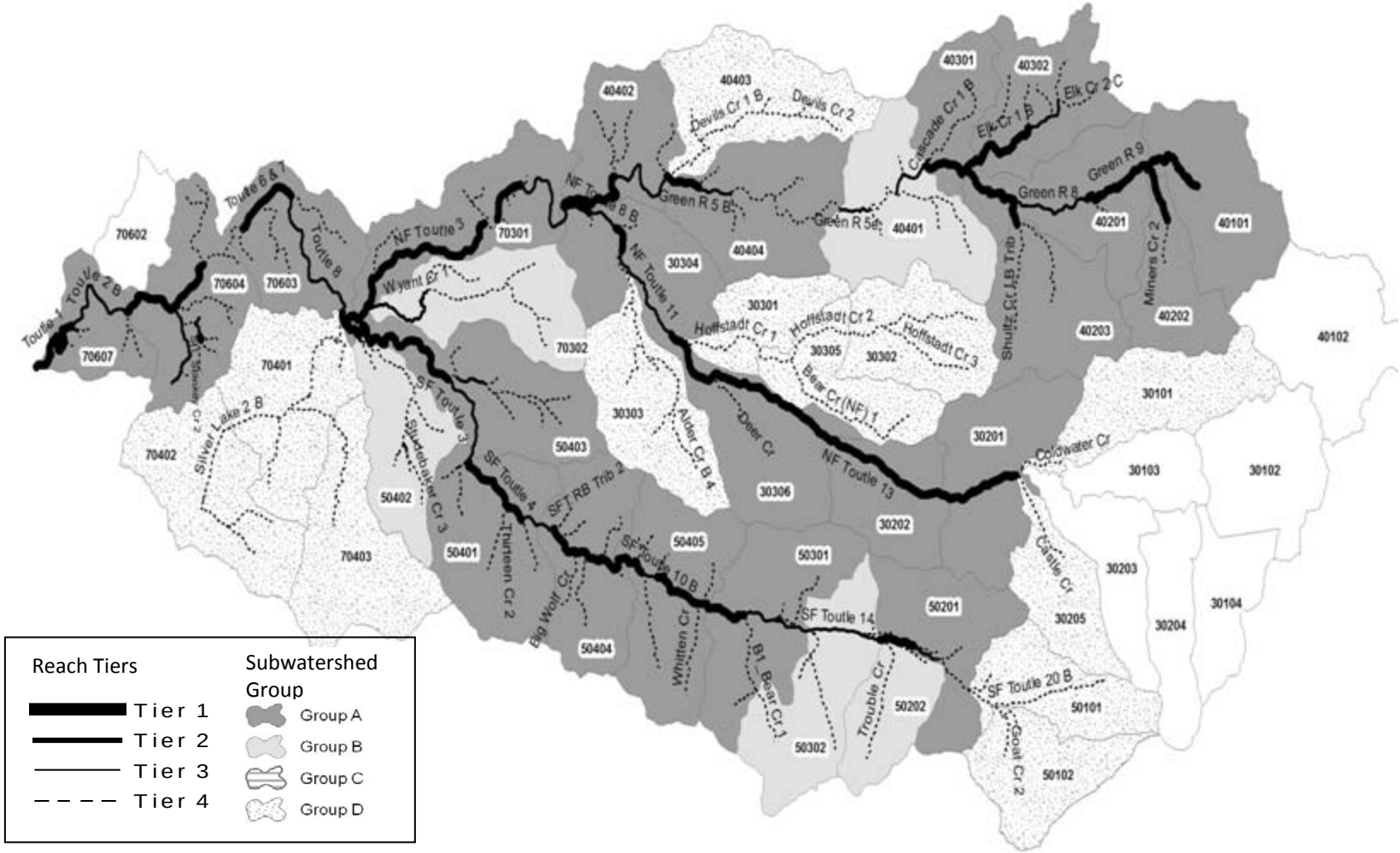


Figure 7-23. Reach tiers and subwatershed groups in the Toutle River subbasin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives.

Table 7-16. High priority reaches identified for habitat protection and restoration actions in the Toutle River subbasin and corresponding species priorities (High, Medium, Low) based on relative preservation and restoration value within the basin. Reach quality is the estimated proportion of historical fish production potential available for all species.

Reach	Habitat Quality	Priority (Tier)	Species Presence & Reach Priority					
			Chinook		Chum (Primary)	Coho (Primary)	Steelhead	
			Fall (Contributing)	Spring (n/a)			Winter (Primary)	Summer (n/a)
Elk Cr 1 A	41%	1	--	--	--	L	H	--
Elk Cr 1 B	21%	1	--	--	--	L	H	--
Green R 1	33%	1	M	--	--	H	M	--
Green R 10	58%	1	--	--	--	L	H	--
Green R 4	71%	1	H	--	--	L	H	--
Green R 5 A	52%	1	H	--	--	H	H	--
Green R 6	39%	1	L	--	--	M	H	--
Green R 7	31%	1	--	--	--	M	H	--
Green R 9	16%	1	--	--	--	L	H	--
Miners Cr 1	45%	1	--	--	--	L	H	--
NF Toutle 1	8%	1	L	L	--	H	L	--
NF Toutle 10	0%	1	--	H	--	H	H	--
NF Toutle 12	1%	1	--	H	--	H	H	--
NF Toutle 13	1%	1	--	M	--	L	H	--
NF Toutle 2	7%	1	L	L	--	H	L	--
NF Toutle 3	4%	1	L	L	--	H	M	--
NF Toutle 5 A	11%	1	L	L	--	L	H	--
NF Toutle 5 B	7%	1	L	L	--	H	L	--
NF Toutle 5 C	5%	1	M	L	--	H	M	--
NF Toutle 7	8%	1	L	L	--	H	L	--
NF Toutle 8 A	5%	1	L	L	--	H	L	--
NF Toutle 9	2%	1	L	L	--	H	H	--
SF Toutle 1	44%	1	H	--	--	H	L	--
SF Toutle 11 A	36%	1	H	--	--	H		--
SF Toutle 2	24%	1	H	--	--	H	L	--
SF Toutle 4	38%	1	H	--	--	H		--
SF Toutle 8 B	35%	1	H	--	--	H		--
Shultz Cr 1	34%	1	--	--	--	L	H	--
St1_Stankey Cr	100%	1	--	--	--	H		--
Toutle 1	31%	1	M	L	H	H	L	--
Toutle 2 A	35%	1	H	L	L	H	H	--
Toutle 3	35%	1	M	L	H	H	M	--
Toutle 4	34%	1	H	L	H	L	H	--
Toutle 5	13%	2	M	L	H	M	L	--
Toutle 6 & 7	34%	2	L	L	H	M	M	--
Toutle 9	18%	1	H	L	--	H	H	--

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.

7.10 Kalama River

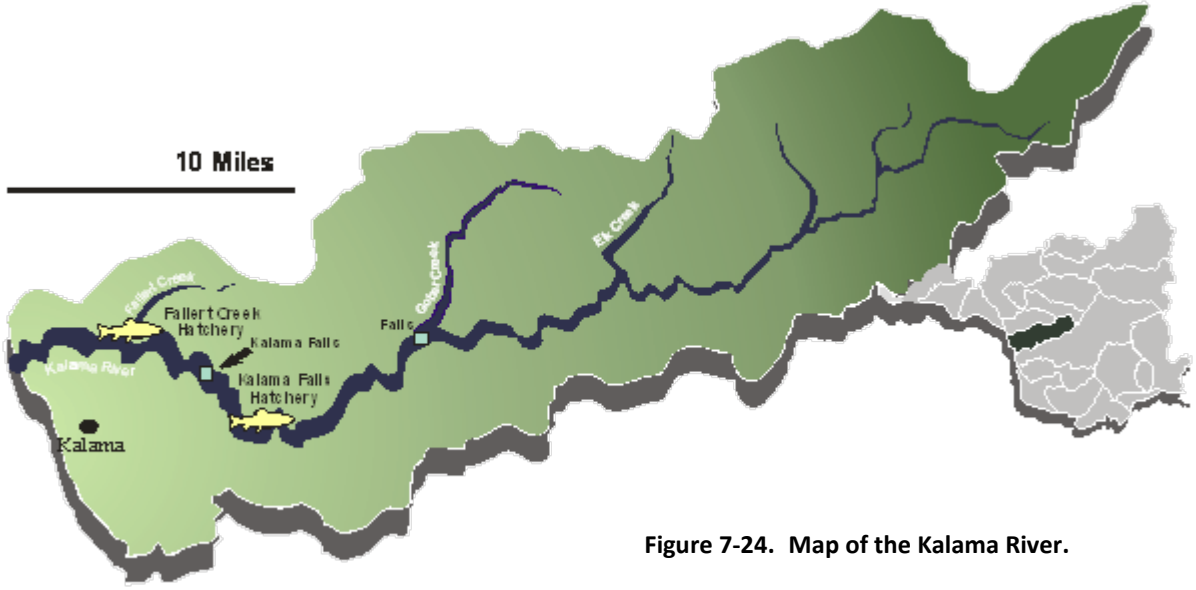


Figure 7-24. Map of the Kalama River.

The Kalama subbasin originates on the southwest slopes of Mt. St. Helens and enters the Columbia at RM 73.1 (Figure 7-24). Hydrology is driven by rainfall from fall through spring as only a small portion of the basin is above the snowline. The lower basin is low gradient, with tidal influence extending up to RM 2.8. Lower Kalama Falls, at RM 10, blocked most anadromous passage except for summer steelhead until it was laddered in 1936 and now passes steelhead and some spring Chinook. Above RM 10, the river flows through narrow V-shaped valley. Upper tributaries are steep and only the lowest reaches are accessible to anadromous fish. Passage to all anadromous fish is blocked by falls at RM 35. The watershed is heavily-forested and largely managed for public and private industrial timber production. A portion of the upper basin is within the Mt. St. Helens National Volcanic Monument and is managed primarily for natural resource protection and research. The subbasin forest stands are young and road densities are high which has implications for watershed processes such as temperature, flow generation and sediment. The lower reaches suffer from non-forested riparian zones and disconnected floodplains.

Fish Species

Focal salmonid species include fall and spring Chinook, chum, coho, winter steelhead, and summer steelhead. Bull trout do not occur in the subbasin. Salmon and steelhead numbers have declined to only a fraction of historical levels (Table 7-17). Extinction risks are significant for all focal species but winter and summer steelhead are considered Primary for population recovery. Returns of fall Chinook, winter steelhead, summer steelhead, and coho include both natural and hatchery produced fish.

Table 7-17. Status and goals for salmon and steelhead populations in the Kalama River subbasin.

Species	Population	Recovery priority	Viability		Improve-ment	Abundance		
			Status	Obj.		Historical	Current	Target
Fall Chinook	Kalama	Contributing	VL	M	110%	2,700	<50	500
Spring Chinook	Kalama	Contributing	VL	L	>500%	4,900	100	300
Chum	Kalama	Contributing	VL	M	>500%	20,000	<100	900
Winter Steelhead	Kalama	Primary	L	H+	45%	800	300	600
Summer Steelhead	Kalama	Primary	M	H	0%	1,000	500	500
Coho	Kalama	Contributing	VL	L	>500%	800	<50	500

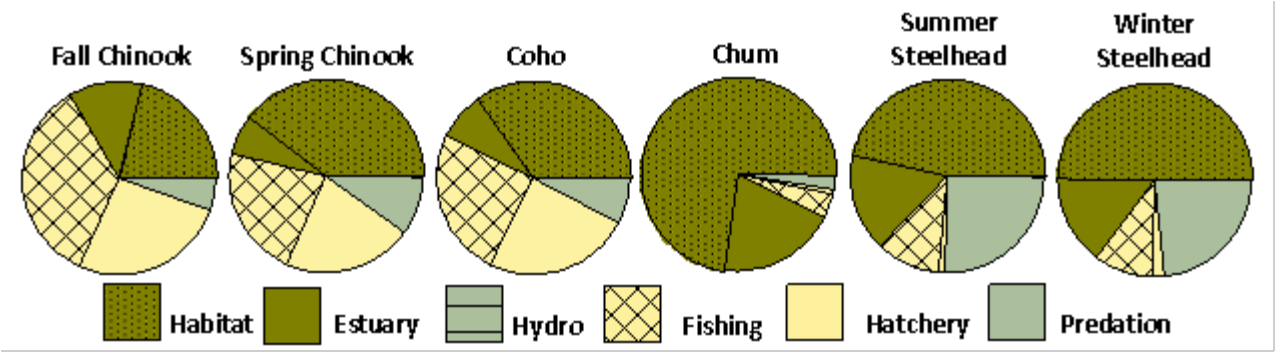


Figure 7-25. Relative significance of potentially manageable factors for Kalama River fish populations.

Threats

The depleted status of subbasin fish populations is the combined effect of significant impacts of multiple factors (Figure 7-25). Loss of tributary habitat quality and quantity accounts for the largest relative impact on all species, except for fall Chinook where harvest dominates. Harvest is also relatively important for all other species but least for chum. Loss of estuary habitat quantity and quality are moderate for all species. The main threats from the Fallert Creek Hatchery and Kalama Falls Hatchery are the potentially detrimental genetic effects of interbreeding of natural salmon with hatchery produced Chinook and coho. No dams are operated in the subbasin and hydrosystem impacts are relatively minor and limited to habitat effects in the Columbia River mainstem and estuary. Predation is most significant for summer and winter steelhead.

Habitat Strategy

Fish recovery will require significant subbasin habitat improvements in concert with reductions in out-of-subbasin impacts from other limiting factors (Box 7-9). Species-specific recovery goals will require an estimated 45-500% improvement in habitat conditions (Table 7-16). Critical fish habitat problems include loss of habitat diversity, summer low flow, increased sediment, high summer temperature, and channel stability. Underlying watershed issues include impaired hydraulic conditions, increased sediment supply, and degraded riparian and floodplain conditions due to timber management in the upper subbasin and agriculture in the lower subbasin. The habitat restoration strategy emphasizes the need for process-related actions that provide long-term benefits over short term temporary fixes. High priority reaches for preservation and restoration include: a) the lower mainstem reaches from Dee Creek for fall Chinook, coho, and chum b) the middle Kalama and major tributaries for steelhead and spring Chinook and, c) the upper Kalama mainstem and tributaries for summer steelhead (Figure 7-26, Table 7-18)

Box 7-9. Key recovery priorities for the Kalama River subbasin.

- Manage subbasin forests to restore watershed processes
- Manage growth and development to protect watershed processes and habitat conditions
- Restore passage at culverts and other artificial barriers
- Align hatchery priorities consistent with conservation objectives
- Manage fishery impacts to reduce near-term population risks and support progress toward recovery
- Reduce out-of-subbasin impacts so that the benefits of in-basin actions can be realized

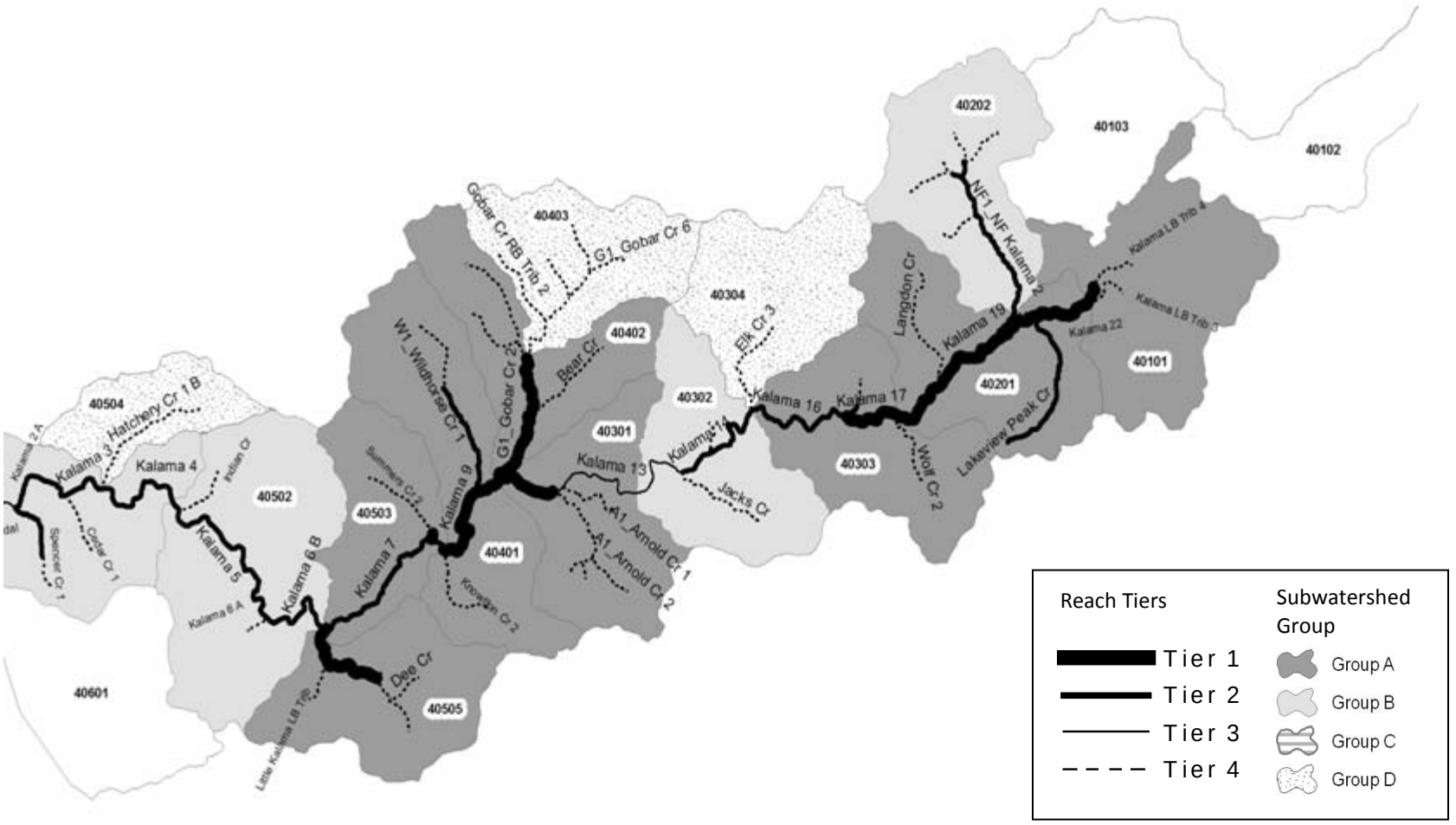


Figure 7-26. Reach tiers and subwatershed groups in the Kalama River subbasin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives.

Table 7-18. High priority reaches identified for habitat protection and restoration actions in the Kalama River subbasin and corresponding species priorities (High, Medium, Low) based on relative preservation and restoration value within the basin. Reach quality is the estimated proportion of historical fish production potential available for all species.

Reach	Habitat Quality	Priority (Tier)	Species Presence & Reach Priority					
			Chinook		Chum (Contrib.)	Coho (Contrib.)	Steelhead	
			Fall (Contrib.)	Spring (Contrib.)			Winter (Primary)	Summer (Primary)
Bush Cr 1 A	76%	2	--	--	--	--		M
G1_Gobar Cr 1	60%	1	--	--	--	--	H	L
G1_Gobar Cr 2	64%	1	--	--	--	--	H	L
Kalama 10	73%	1	--	H	--	--	H	L
Kalama 11	70%	2	--	H	--	--	L	L
Kalama 12	73%	3	--	M	--	--	L	L
Kalama 13	64%	3	--	M	--	--	L	L
Kalama 14	62%	2	--	H	--	--	--	L
Kalama 15	67%	2	--	M	--	--	--	M
Kalama 16	68%	2	--	L	--	--	--	M
Kalama 17	67%	1	--	L	--	--	--	H
Kalama 18	58%	1	--	M	--	--	--	H
Kalama 19	58%	1	--	L	--	--	--	H
Kalama 2 A	62%	2	H	L	H	L	L	L
Kalama 2 B	49%	2	M	--	H	L	L	L
Kalama 20	55%	1	--	L	--	--	--	H
Kalama 21	48%	1	--	L	--	--	--	H
Kalama 22	41%	1	--	M	--	--	--	H
Kalama 23	47%	1	--	H	--	--	--	H
Kalama 3	33%	2	H	L	M	H	L	L
Kalama 4	44%	2	H	L	M	M	L	L
Kalama 5	64%	2	M	L	H	M	M	L
Kalama 6 A	64%	2	--	H	--	--	M	L
Kalama 6 B	68%	2	--	M	--	--	M	L
Kalama 7	73%	2	--	H	--	--	M	L
Kalama 8	74%	2	--	H	--	--	M	L
Kalama 9	72%	1	--	H	--	--	H	L
Lakeview Peak Cr	45%	2	--	--	--	--	--	M
LK1_Little Kalama 1	69%	1	--	--	--	--	H	L
LK1_Little Kalama 2	40%	1	--	--	--	--	H	--
LK1_Little Kalama 3	50%	1	--	--	--	--	H	--
Lost Cr 1	81%	2	--	--	--	--	--	M
NF1_NF Kalama 1	69%	2	--	--	--	--	--	M
NF1_NF Kalama 2	56%	2	--	--	--	--	--	M
NF1_NF Kalama 3	64%	2	--	--	--	--	--	M
NF1_NF Kalama 4	70%	2	--	--	--	--	--	M
NF1_NF Kal Trib 2 A	79%	2	--	--	--	--	--	M
Spencer Cr 1	67%	2	--	--	L	H	L	L
Summers Cr 1	73%	1	--	--	--	--	H	L
W1_Wildhorse Cr 1	56%	2	--	--	--	--	M	L

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.

7.11 Lewis River - North Fork

The North Fork Lewis subbasin originates high in the Cascades on the slopes of Mt. Adams and Mt. St. Helens and enters the Columbia at RM 87. The North Fork is a snow dominated system which contributes streamflow from melt water in the summer. For purposes of this assessment, the upper North Fork Lewis and the lower North Fork Lewis are separated into two geographic units (Figure 7-27). The upper Lewis begins at Lake Merwin (RM 19.5) and extends up to the headwaters.

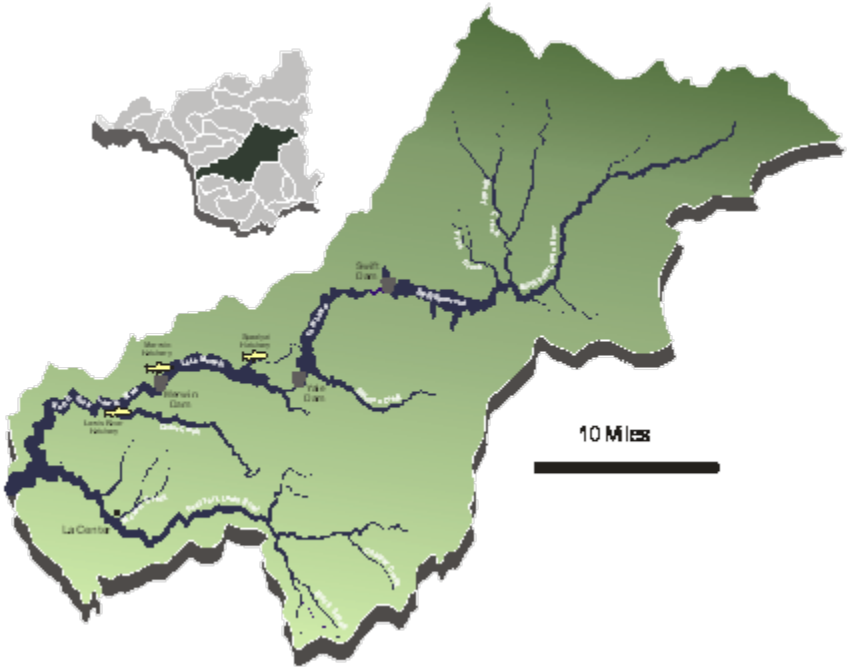


Figure 7-27. Map of the North Fork Lewis River.

Three dams and their respective reservoirs are situated on the mainstem; the Swift Dam #1 (RM 47.9), Yale Dam (RM 34.2), and Merwin Dam (RM 19.5) which is a complete barrier to all anadromous fish, blocking up to 80% of the historically available habitat. Below Merwin Dam, the lower North Fork flows through a deep canyon until it opens to a broad alluvial valley at RM 12. Tidal influence extends up to RM 11. Agriculture and residential uses dominate the lower valley. The balance of the watershed is heavily-forested and largely managed for public and private industrial timber production. Most of the Upper North Fork is within the Gifford Pinchot National Forest or the Mt. St. Helens National Volcanic Monument. Stand replacing fires, which burned large portions of the basin between 1902 and 1952, have had lasting effects on basin hydrology, sediment transport, soil conditions, and riparian function.

Fish Species

Focal salmonid species include fall and spring Chinook, chum, coho, and winter and summer steelhead. Bull trout currently occur above Merwin Dam. Salmon and steelhead numbers have declined to only a fraction of historical levels (Table 7-19). Extinction risks are significant for all focal species and Chinook and chum are considered Primary for population recovery. Returns of spring Chinook, coho, and winter and summer steelhead include both natural and hatchery produced fish.

Table 7-19. Status and goals for salmon and steelhead populations in the North Fork Lewis River subbasin.

Species	Population	Recovery priority	Viability		Improve-ment	Abundance		
			Status	Obj.		Historical	Current	Target
Fall Chinook	Lewis	Primary	VL	H+	280%	2,600	<50	1,500
Late Fall Chinook	NF Lewis	Primary	VH	VH	0%	23,000	7,300	7,300
Spring Chinook	NF Lewis	Primary	VL	H	>500%	15,700	300	1,500
Chum	Lewis	Primary	VL	H	>500%	125,000	<100	1,300
Winter Steelhead	NF Lewis	Contributing	VL	M	>500%	8,300	150	400
Summer Steelhead	NF Lewis	Stabilizing	VL	VL	0%	Na[1]	150	--
Coho	NF Lewis	Contributing	VL	L	50%	40,000	200	500

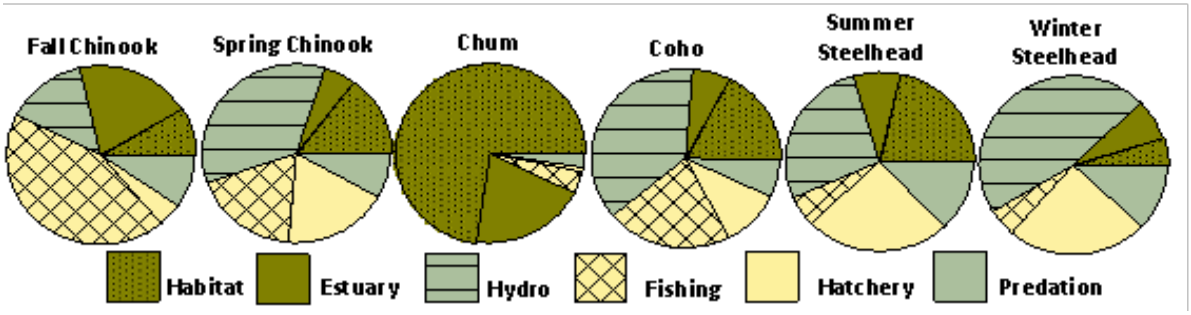


Figure 7-28. Relative significance of potentially manageable factors for North Fork Lewis River fish populations.

Threats

The depleted status of subbasin fish populations is the combined effect of significant impacts of multiple factors (Figure 7-28). Hydrosystem access and passage impacts are the most influential factor for spring Chinook, coho, and steelhead. Loss of tributary habitat quality and quantity is important for chum in the lower basin, and moderate for spring Chinook, coho and summer steelhead in the upper basin. Harvest has sizeable impact on fall Chinook and moderate impacts on spring Chinook and coho. Hatchery impacts include the potentially detrimental genetic effects of interbreeding of natural salmon with hatchery produced fish (especially spring Chinook and coho) and ecological interactions (predation and competition) between hatchery and wild fish. Loss of estuary habitat quality and quantity has a moderate impact on all species, but more so for chum and fall Chinook. Predation impacts are moderate for all species.

Habitat Strategy

Fish recovery will require significant subbasin habitat improvements in concert with reductions in out-of-subbasin impacts from other limiting factors (Box 7-10). Species-specific recovery goals will require an estimated 50-500% improvement in habitat conditions (Table 7-18). Critical fish habitat problems include loss of habitat diversity, flow, increased sediment, channel stability, food, competition (hatchery), and predation. Underlying watershed issues include impaired hydraulic conditions, increased sediment supply, and degraded riparian and floodplain conditions due to timber management in the upper subbasin and agriculture in the lower subbasin. The habitat restoration strategy emphasizes the need for process-related actions that provide long-term benefits over short term temporary fixes. High priority reaches for preservation and restoration include: a) the upper North Fork for spring Chinook, b) the upper and lower North Fork for coho and winter steelhead, c) the lower North Fork for fall Chinook and chum (which are a subset of a larger population which includes the EF Lewis River) (Figure 7-29, Figure 7-30, Table 7-20, Table 7-21).

Box 7-10. Key recovery priorities for the Upper North Fork Lewis River subbasin.

- Manage regulated stream flows through the hydropower system
- Provide upstream and downstream passage through the Lewis river hydrosystem
- Protect intact forests in headwater basins
- Manage forest lands to protect and restore watershed processes
- Restore floodplain function, riparian function and stream habitat diversity
- Restore passage at culverts and other artificial barriers
- Address immediate risks with short-term habitat fixes
- Manage growth and development to protect watershed processes and habitat conditions
- Align hatchery priorities consistent with conservation objectives
- Manage fishery impacts to reduce near-term population risks and support progress toward recovery
- Reduce out-of-subbasin impacts so that the benefits of in-basin actions can be realized

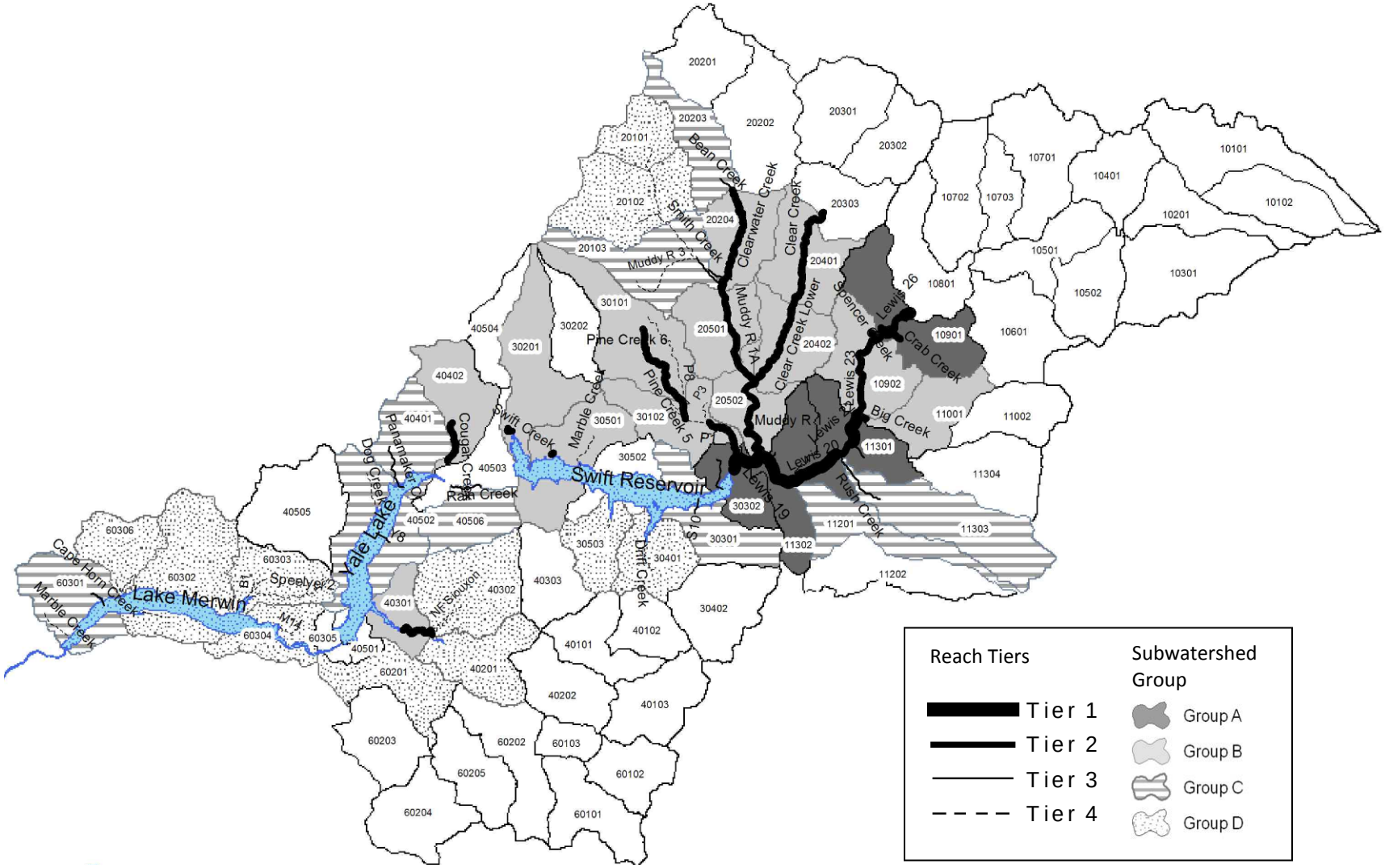


Figure 7-29. Reach tiers and subwatershed groups in the upper North Fork Lewis River subbasin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives.

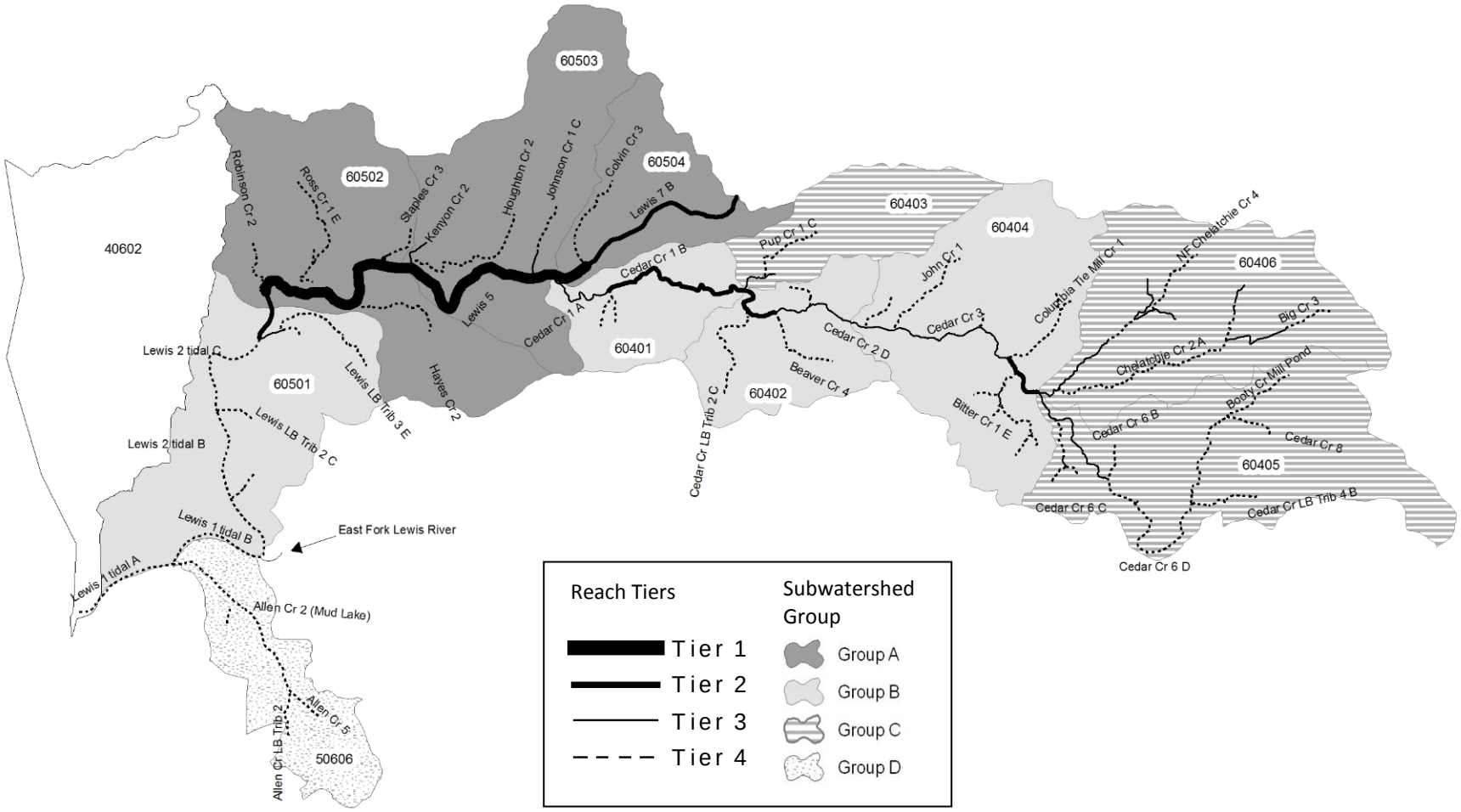


Figure 7-30. Reach tiers and subwatershed groups in the lower North Fork Lewis River subbasin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives.

Table 7-20. High priority reaches identified for habitat protection and restoration actions in the upper North Fork Lewis River subbasin and corresponding species priorities (High, Medium, Low) based on relative preservation and restoration value within the basin. Reach quality is the estimated proportion of historical fish production potential available for all species.

Reach	Habitat Quality	Priority (Tier)	Species Presence & Reach Priority					
			Chinook		Chum (Primary)	Coho (Contrib.)	Steelhead	
			Fall (Primary)	Spring (Primary)			Winter (Contrib.)	Summer (Stabilizing)
Big Creek Mid	69%	2	--		--	M	H	--
Clear Creek	48%	2	--	M	--	M	M	--
Clear Creek Lower	56%	2	--	M	--	H	L	--
Clearwater Creek	43%	2	--	M	--	H	M	--
Cougar Creek	91%	2	--	M	--	L	L	--
Crab Creek	58%	2	--	--	--	M	H	--
Cussed Hollow	80%	2	--	L	--	L	H	--
Diamond Creek	91%	2	--		--	H	L	--
Lewis 18	48%	1	--	H	--	H	H	--
Lewis 19	65%	1	--	H	--	M	H	--
Lewis 20	55%	1	--	H	--	M	M	--
Lewis 21	55%	2	--	L	--	M	H	--
Lewis 22	60%	1	--	H	--	M	H	--
Lewis 23	56%	2	--	M	--	L	H	--
Lewis 24	65%	2	--	M	--	L	H	--
Lewis 25	63%	1	--	H	--	L	H	--
Lewis 26	53%	2	--	M	--	L	H	--
Lewis 27	52%	1	--	H	--	M	H	--
Muddy R 1	45%	2	--	L	--	H	M	--
Muddy R 1A	36%	2	--	L	--	H	M	--
Pine Creek 1	59%	2	--	L	--	L	H	--
Pine Creek 2	48%	2	--	M	--	L	H	--
Pine Creek 4	55%	2	--	L	--	L	H	--
Pine Creek 5	56%	2	--	L	--	L	H	--
Pine Creek 6	44%	2	--	L	--	L	H	--
Siouxon 1	66%	2	--	M	--	L	L	--
Spencer Creek	75%	2	--	--	--	L	H	--
Swift Creek	67%	2	--	M	--	L	L	--

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.

Table 7-21. High priority reaches identified for habitat protection and restoration actions in the lower North Fork Lewis River subbasin and corresponding species priorities (High, Medium, Low) based on relative preservation and restoration value within the basin. Reach quality is the estimated proportion of historical fish production potential available for all species.

Reach	Habitat Quality	Priority (Tier)	Species Presence & Reach Priority					
			Chinook		Chum (Primary)	Coho (Contrib.)	Steelhead	
			Fall (Primary)	Spring (Primary)			Winter (Contrib.)	Summer (Stabilizing)
Cedar Cr 1 B	41%	2	--	--	--	L	H	--
Cedar Cr 1 C	36%	2	--	--	--	M	H	--
Cedar Cr 2 A	34%	2	--	--	--	M	H	--
Cedar Cr 2 B	31%	2	--	--	--	H	L	--
Cedar Cr 4 B	41%	2	--	--	--	H	M	--
Cedar Cr 5	37%	2	--	--	--	M	H	--
Hayes Cr 1	75%	2	--	--	--	H	L	--
Lewis 2 tidal D	68%	2	M	--	L	L	L	--
Lewis 3	47%	1	H	--	M	H	L	--
Lewis 4 A	64%	1	M	--	H	H	L	--
Lewis 4 B	56%	1	H	--	H	H	H	--
Lewis 4 C	58%	1	H	--	H	H	L	--
Lewis 5	60%	1	M	--	H	H	L	--
Lewis 6	73%	1	H	--	H	M	L	--
Lewis 7 A	74%	1	H	--	M	M	L	--
Lewis 7 B	60%	2	L	--	M	L	L	--
Robinson Cr 1 A	38%	2	--	--	--	H	M	--
Staples Cr 1	54%	2	--	--	--	H	L	--

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.

7.12 Lewis River - East Fork

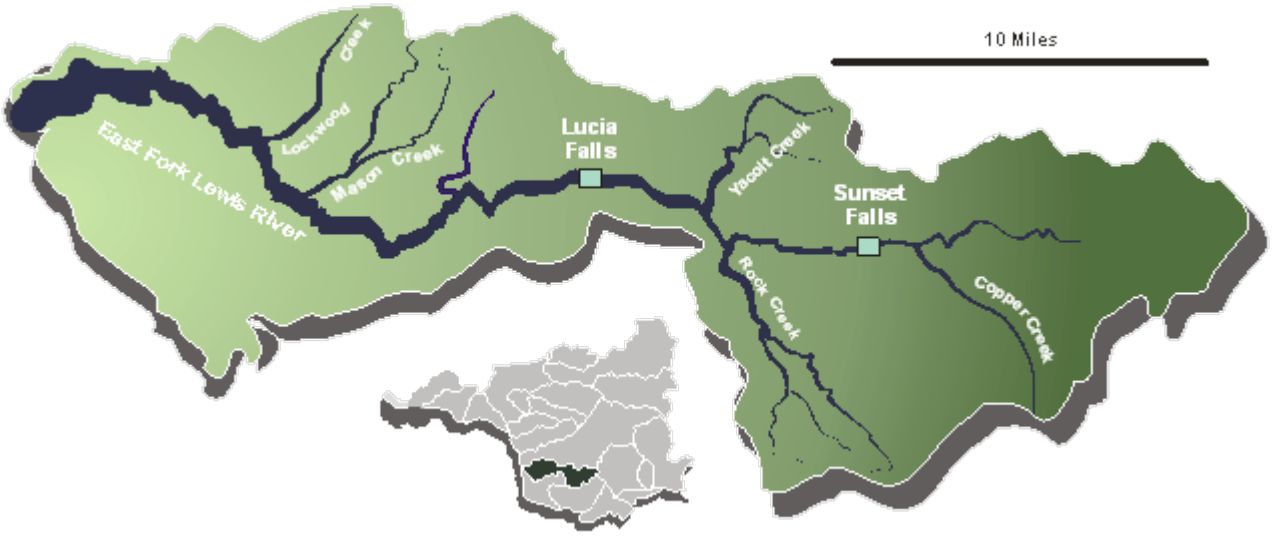


Figure 7-31. Map of the East Fork Lewis River.

This river originates in the steep headwaters of the Gifford Pinchot National Forest on the eastern slope of the Cascade foothills. This is a rainfall dominated system with a significant portion of the upper basin in the rain-on-snow zone. Principal tributaries include Yacolt, Copper, Rock, Mason, and Lockwood Creeks (Figure 7-31). The upper and middle watershed is heavily-forested and largely managed as commercial forest. Lucia Falls at mile 12.3 blocks passage of anadromous fish except for steelhead and an occasional Chinook and coho. Below Lucia Falls, the river runs through narrow valleys or canyons until it opens up around RM 14 into a broad alluvial valley where stream gradient drops off and large amounts of sediment are deposited. Extensive meandering, braiding, and channel shifting occurs in the lower river, particularly between RM 6 and RM 10. The East Fork joins the North Fork 3.5 miles upstream from the Columbia River and backwater effects from the Columbia extend up to RM 6 on the East Fork. Rural residential development and agriculture is widespread in the lower basin where the population is expected to double by 2020.

Fish Species

The East Fork Lewis subbasin has been identified as critical to salmon recovery. Fall Chinook, chum, coho, and summer and winter steelhead numbers have declined to only a fraction of historical levels and populations are all currently at very high risk of extinction (Table 7-22). Each of these species is designated as a Primary population for recovery to high or very high levels of viability. Bull trout are not present in the basin but may have occurred there historically. Returns of summer steelhead include both natural and hatchery produced fish.

Table 7-22. Status and goals for salmon and steelhead populations in the East Fork Lewis River subbasin.

		Recovery	Viability		Improve-	Abundance		
Species	Population	priority	Status	Obj.	ment	Historical	Current	Target
Fall Chinook	Lewis	Primary	VL	H+	280%	2,600	<50	1,500
Chum	Lewis	Primary	VL	H	500%	125,000	<100	1,300
Winter Steelhead	EF Lewis	Primary	M	H	25%	900	350	500
Summer Steelhead	EF Lewis	Primary	VL	H	>500%	600	<50	500
Coho	EF Lewis	Primary	VL	H	>500%	3,000	<50	2,000

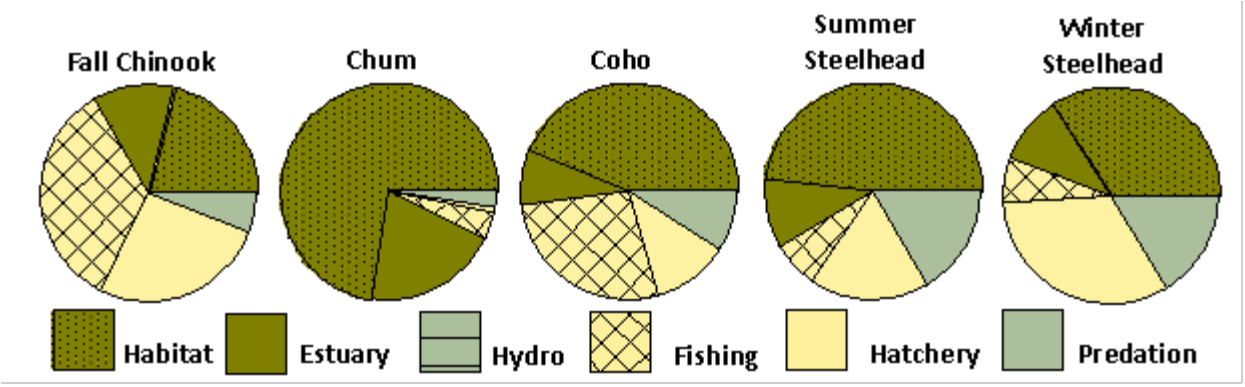


Figure 7-32. Relative significance of potentially manageable factors for East Fork Lewis River fish populations.

Threats

The depleted status of subbasin fish populations is the combined effect of significant impacts of multiple factors (Figure 7-32). Loss of subbasin habitat quality and quantity for spawning and rearing accounts for the largest relative impact across all species except for fall Chinook where harvest dominates. Loss of estuary habitat has affected all species. Fishery impacts in the ocean, Columbia River, and subbasin have been reduced to a relatively small share of the impacts except for fall Chinook and coho. No hatcheries are operated in the basin, however, releases of hatchery summer and winter steelhead in the basin have some affect on wild steelhead populations. Hatchery impacts to fall Chinook are from out-of-basin straying. No dams are operated in the subbasin and hydrosystem impacts are limited to habitat effects in the Columbia River mainstem and estuary. Subbasin fish populations are subject to predation impacts on juveniles and adults by fish, pinniped, and bird predators in the Columbia River and estuary.

Habitat Strategy

Fish recovery will require significant subbasin habitat improvements in concert with reductions in out-of-subbasin impacts from other limiting factors (Box 7-11). Species-specific recovery goals will require an estimated 25-500% improvement in habitat conditions (Table 7-21). Critical fish habitat problems include loss of habitat diversity, low summer flow, increased sediment, high summer temperature, and channel instability due to extensive historical gravel mining activities in the lower river. Underlying watershed issues include impaired hydraulic conditions, increased sediment supply, and degraded riparian conditions particularly in the lower watershed due to extensive development pressure, high road density, lack of mature forest cover, and loss of floodplain forest. The habitat restoration strategy emphasizes the need for process-related actions that provide long-term benefits over short term temporary fixes. High priority reaches for protection and improvement include: a) the lower mainstem for fall Chinook, chum and coho, b) the middle mainstem and Rock Creek for winter steelhead and, c) the upper mainstem for summer steelhead (Figure 7-33, Table 7-23).

Box 7-11. Key recovery priorities for the East Fork Lewis subbasin.

- Protect intact forest in headwater basins
- Restore lowland floodplain function, riparian function and stream habitat diversity
- Manage growth and development to protect watershed processes and habitat conditions
- Manage forest lands to protect and restore watershed processes
- Restore fish passage at culverts and other barriers
- Address immediate risks with short-term habitat fixes
- Align hatchery priorities with conservation objectives
- Manage fishery impacts to reduce near-term population risks and support progress toward recovery
- Reduce out-of-subbasin impacts so that the benefits of in-basin actions can be realized.

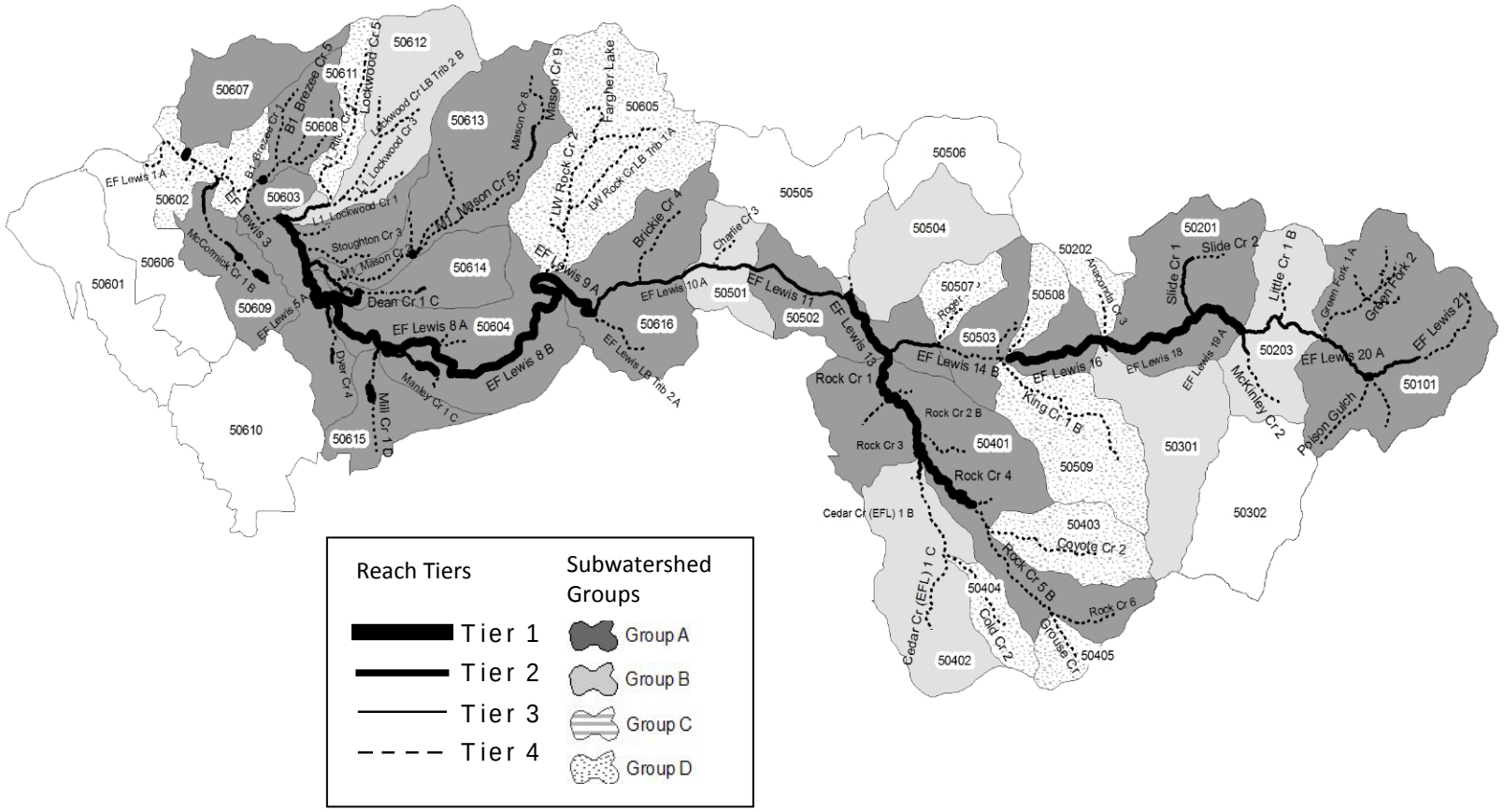


Figure 7-33. Reach tiers and subwatershed groups in the East Fork Lewis subbasin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives.

Table 7-23. High priority reaches identified for habitat protection and restoration actions in the East Fork Lewis River subbasin and corresponding species priorities (High, Medium, Low) based on relative preservation and restoration value within the basin. Reach quality is the estimated proportion of historical fish production potential available for all species.

Reach	Habitat Quality	Priority (Tier)	Species Presence & Reach Priority					
			Chinook		Chum (Primary)	Coho (Primary)	Steelhead	
			Fall (Primary)	Spring (n/a)			Winter (Primary)	Summer (Primary)
B1_Brezee Cr 2	47%	1	--	--	--	H	L	
Big Tree Cr 1 A	77%	2	--	--	--	--	M	L
Cedar Cr (EFL) 1 A	77%	2	--	--	--	--	M	--
Copper Cr 1 A	61%	2	--	--	--	--	--	M
Dean Cr 1 A	36%	1	--	--	L	H	L	--
Dean Cr 3	13%	2	--	--	--	M	--	--
Dyer Cr 1	63%	1	--	--	--	H	L	L
Dyer Cr 2	67%	2	--	--	--	M	L	L
Dyer Cr 4	10%	2	--	--	--	M	--	--
EF Lewis 10 A	45%	2	L	--	--	M	M	L
EF Lewis 10 B	43%	2	L	--	--	L	M	L
EF Lewis 11	69%	2	--	--	--	--	M	L
EF Lewis 12	86%	2	--	--	--	--	M	L
EF Lewis 13	66%	1	--	--	--	--	H	L
EF Lewis 14 A	73%	2	--	--	--	--	M	L
EF Lewis 15 B	58%	1	--	--	--	--	--	H
EF Lewis 16	62%	1	--	--	--	--	--	H
EF Lewis 17 A	72%	1	--	--	--	--	--	H
EF Lewis 17 B	62%	1	--	--	--	--	--	H
EF Lewis 18	61%	1	--	--	--	--	--	H
EF Lewis 19 A	49%	1	--	--	--	--	--	H
EF Lewis 19 B	40%	2	--	--	--	--	--	M
EF Lewis 19 C	38%	2	--	--	--	--	--	M
EF Lewis 20 A	40%	2	--	--	--	--	--	M
EF Lewis 20 B	65%	1	--	--	--	--	--	H
EF Lewis 20 C	46%	2	--	--	--	--	--	M
EF Lewis 4 A	42%	1	L	--	H	L	L	L
EF Lewis 4 B	50%	1	L	--	H	L	L	L
EF Lewis 4 C	47%	1	L	--	H	L	L	L
EF Lewis 5 A	56%	1	L	--	H	L	L	L
EF Lewis 5 B	43%	1	H	--	H	H	L	L
EF Lewis 6 A	45%	1	H	--	H	H	L	L
EF Lewis 6 B	46%	1	H	--	H	H	L	L
EF Lewis 6 C	43%	1	H	--	H	H	L	L
EF Lewis 7	54%	1	H	--	H	H	M	L
EF Lewis 8 A	48%	1	H	--	H	H	M	L
EF Lewis 8 B	44%	1	M	--	H	M	M	L
EF Lewis 9 A	44%	1	H	--	--	H	L	L
EF Lewis 9 B	48%	2	M	--	--	L	M	L
Jenny Cr	56%	1	--	--	--	H	L	--
L1_Lockwood Cr 1	38%	2	--	--	M	L	L	--
Little Cr 1 A	78%	2	--	--	--	--	--	M
M1_Mason Cr 1	28%	2	--	--	L	M	L	--
M1_Mason Cr 3	38%	2	--	--	--	M	L	--
M1_Mason RB Trib 1 A	63%	1	--	--	--	H	L	--
Manley Cr 1 A	32%	1	--	--	L	H	L	--

Reach	Habitat Quality	Priority (Tier)	Species Presence & Reach Priority					
			Chinook		Chum (Primary)	Coho (Primary)	Steelhead	
			Fall (Primary)	Spring (n/a)			Winter (Primary)	Summer (Primary)
Manley Cr 1 B	36%	2	--	--	L	M	L	--
Manley Cr 1 C	36%	2	--	--	L	M	L	--
Manley Cr 1 D	28%	1	--	--	L	H	L	--
Manley Cr 1 E	27%	1	--	--	L	H	L	--
Manley Cr 1 F	26%	1	--	--	L	H	L	--
Manley Cr 1 G	35%	1	--	--	L	H	L	--
Mason Cr 8	16%	2	--	--	--	M	--	--
McCormick Cr 1 A	44%	2	--	--	M	L	L	--
McCormick Cr 1 C	41%	2	--	--	--	M	L	--
McCormick Cr 1 D	71%	1	--	--	--	H	L	--
McCormick Cr 1 G (pond)	24%	1	--	--	--	H	--	--
McCormick Cr 1 H (pond)	15%	1	--	--	--	H	--	--
McCormick Cr 1 I	26%	2	--	--	--	M	--	--
McKinley Cr 1	64%	2	--	--	--	--	--	M
Mill Cr 1 A	56%	2	--	--	M	L	L	L
Mill Cr 1 C	58%	1	--	--	--	H	L	--
Rock Cr 1	65%	1	--	--	--	--	H	L
Rock Cr 2 A	74%	1	--	--	--	--	H	--
Rock Cr 2 B	69%	1	--	--	--	--	H	--
Rock Cr 3	68%	1	--	--	--	--	H	--
Rock Cr 4	61%	1	--	--	--	--	H	--
Slide Cr 1	58%	2	--	--	--	--	--	M
Swanson Cr	55%	2	--	--	--	M	L	--

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.

7.13 Salmon Creek

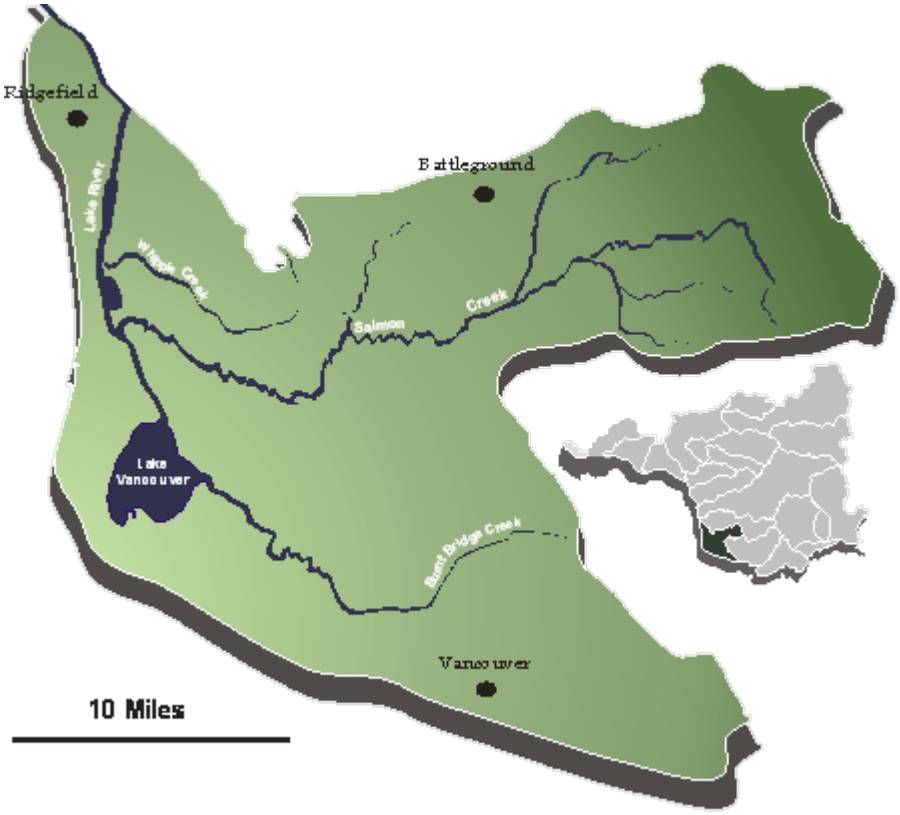


Figure 7-34. Map of Salmon Creek.

Salmon Creek originates in the low foothills of the southwest Washington Cascades. Salmon Creek flows into Lake River, which drains north from Vancouver Lake. Major tributaries entering Lake River are Salmon, Flume, and Whipple Creeks. Burnt Bridge Creek flows into Vancouver Lake and its watershed is located in the heart of the city of Vancouver (Figure 7-34). This is a rain dominated system with a peak elevation at 1,998 feet.

Most streams are low gradient, meandering systems located within Clark County's flat alluvial plain. Vancouver Lake and Lake River are within the historical Columbia River floodplain and are tidally-influenced. Land use in the subbasin is predominantly urban and rural development and most of the historic wetland and floodplain habitat has been converted to urban uses. The upper forested watersheds are also being influenced by development and timber harvest. Population growth in this subbasin has been substantial in recent decades and is estimated to double by 2020 which will increase pressures for conversion of forest and rural land uses to high density suburban and urban uses, with potential impacts to habitat conditions.

Fish Species

Focal salmonid species include chum, coho, winter steelhead, and fall Chinook. Bull trout do not occur in Salmon Creek. Salmon and steelhead numbers have declined to only a fraction of historical levels (Table 7-24). Extinction risks are significant for all focal species but none are considered primary for population recovery. Returns of Salmon Creek winter steelhead include both natural and hatchery produced fish.

Table 7-24. Status and goals for salmon and steelhead populations in the Salmon Creek subbasin.

Species	Population	Recovery priority	Viability		Improve-ment	Abundance		
			Status	Obj.		Historical	Current	Target
Fall Chinook	Salmon	Stabilizing	VL	VL	0%	n/a	<50	--
Chum	Salmon	Stabilizing	VL	VL	0%	n/a	<100	--
Winter Steelhead	Salmon	Stabilizing	VL	VL	0%	n/a	<50	--
Coho	Salmon	Stabilizing	VL	VL	0%	n/a	<50	--

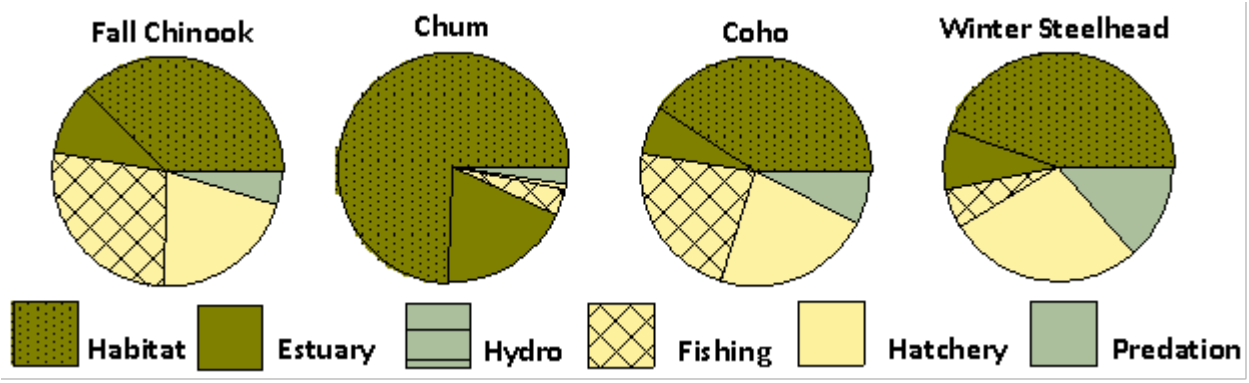


Figure 7-35. Relative significance of potentially manageable factors for Salmon Creek fish populations.

Threats

The depleted status of subbasin fish populations is the combined effect of significant impacts of multiple factors (Figure 7-35). Loss of tributary habitat quality and quantity accounts for the largest relative impact on all species. Loss of estuary habitat quantity and quality is also relatively important for all species, but more so for chum. Fishing harvest has a relatively sizeable effect on fall Chinook and coho, but is relatively minor for chum and winter steelhead. Coho, fall Chinook and winter steelhead are the species moderately impacted by hatcheries in the subbasin. Predation impacts are particularly important for winter steelhead. Hydrosystem access and passage impacts are relatively minor for all species.

Habitat Strategy

Fish recovery will require significant subbasin habitat improvements in concert with reductions in out-of-subbasin impacts from other limiting factors (Box 7-12). Because populations are designated as Stabilizing, species-specific recovery goals will require an estimated no improvement in habitat conditions (Table 7-23). However, habitat protection and restorations actions will be required to avoid further declines. Critical fish habitat problems include loss of habitat diversity, flow, increased sediment, high summer temperature, and channel stability. Underlying watershed issues include impaired hydraulic conditions, increased sediment supply, and degraded riparian and floodplain conditions primarily related to urban and rural development throughout the subbasin. The habitat restoration strategy emphasizes the need for process-related actions that provide long-term benefits over short term temporary fixes. High priority reaches for preservation and restoration include: a) the lower and middle reaches of Salmon Creek for fall Chinook and chum, b) middle and upper mainstem Salmon Creek reaches as well as tributaries for coho and , c) middle and upper mainstem Salmon Creek reaches for winter steelhead (Figure 7-36, Table 7-25).

Box 7-12. Key recovery priorities for the Salmon Creek subbasin.

- Manage growth and development to protect watershed processes and habitat conditions
- Restore floodplain function, riparian function and stream habitat diversity
- Manage forest lands to protect and restore watershed processes
- Address immediate risks with short-term habitat fixes
- Align hatchery priorities consistent with conservation objectives
- Manage fishery impacts to reduce near-term population risks and support progress toward recovery
- Reduce out-of-subbasin impacts so that the benefits of in-basin actions can be realized

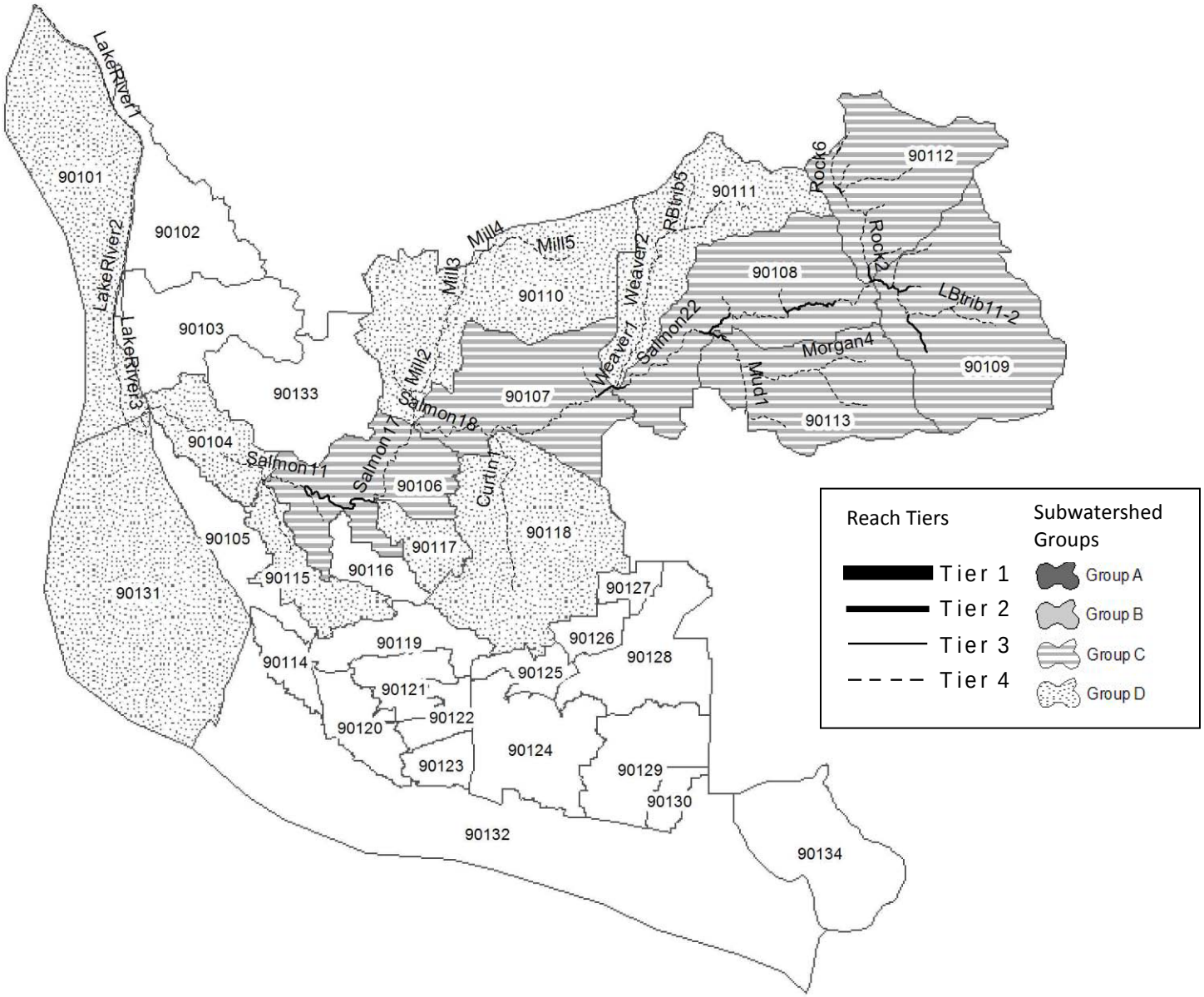


Figure 7-36. Reach tiers and subwatershed groups in the Salmon Creek subbasin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives.

Table 7-25. Priority reaches identified for habitat protection and restoration actions in the Salmon Creek subbasin and corresponding species priorities (High, Medium, Low) based on relative preservation and restoration value within the basin. No tier 1 or tier 2 reaches were identified and no Salmon Creek fish populations were designated as Primary or Contributing. Reach quality is the estimated proportion of historical fish production potential available for all species.

			Species Presence & Reach Priority					
	Habitat	Priority	Chinook		Chum	Coho	Steelhead	
Reach	Quality	(Tier)	Fall (Stabilizing)	Spring (n/a)	(Stabilizing)	(Stabilizing)	Winter (Stabilizing)	Summer (n/a)
Lalonde1	1%	3	--	--	--	H	--	--
LBtrib11-1	45%	3	--	--	--	H	--	--
Morgan1	6%	3	--	--	--	H	L	--
RBtrib11-1	15%	3	--	--	--	H	--	--
RBtrib9-1	16%	3	--	--	--	H	--	--
Rock1	13%	3	--	--	--	H	M	--
Rock5	12%	3	--	--	--	H	--	--
Rock7	26%	3	--	--	--	H	--	--
Salmon12	7%	3	M	--	M	H	M	--
Salmon13	3%	3	M	--	H	H	H	--
Salmon14_A	0%	3	H	--	H	H	H	--
Salmon14_B	1%	3	H	--	H	H	H	--
Salmon14_C	8%	3	H	--	M	M	H	--
Salmon16	6%	3	H	--	H	H	H	--
Salmon20	10%	3	--	--	--	H	H	--
Salmon21	9%	3	--	--	--	H	H	--
Salmon23	19%	3	--	--	--	H	H	--
Salmon24	29%	3	--	--	--	H	M	--
Salmon26	24%	3	--	--	--	H	L	--
Salmon28	15%	3	--	--	--	M	H	--
Salmon29	27%	3	--	--	--	H	H	--
Salmon31	45%	3	--	--	--	H	H	--
Salmon32	25%	3	--	--	--	L	H	--
SideChannel1	4%	3	--	--	--	H	--	--
Suds1	0%	3	--	--	--	H	--	--
Suds2	1%	3	--	--	--	H	--	--

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.

7.14 Washougal River

The Washougal subbasin originates on the southwest slopes of Mt. Adams and enters the Columbia near the town of Camas, Washington at RM 121. Principal tributaries include the West Fork Washougal, Little Washougal, and Lacamas Creek (Figure 7-37). The upper reaches of the Washougal flow through a narrow, deep canyon until it reaches Sunset Falls at RM 14.5.

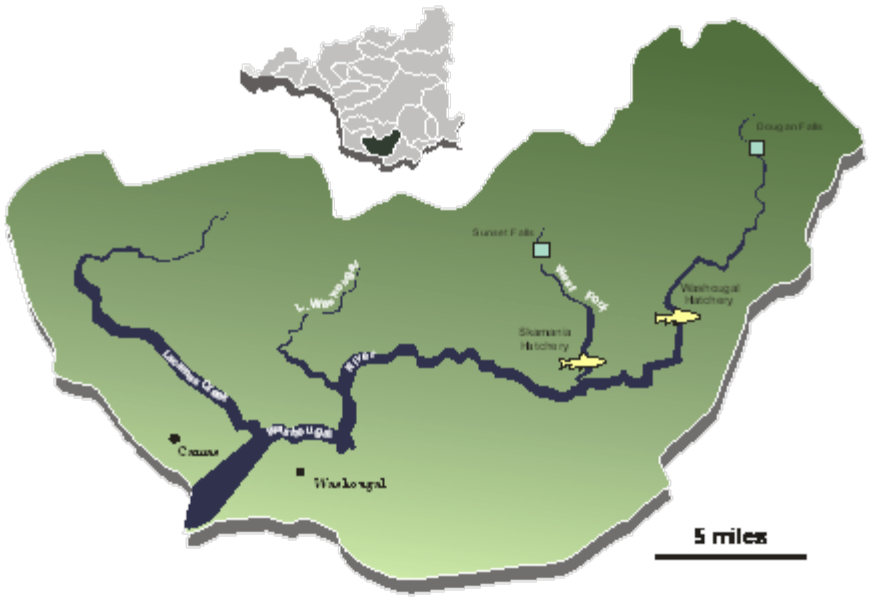


Figure 7-37. Map of the Washougal River.

Below this, the river valley widens, with the lower two miles lying within the broad Columbia River floodplain lowlands. Elevations range from 3,200 feet to nearly sea level. Fish passage was historically blocked to most anadromous fish except steelhead at Sunset Falls until a fish ladder was built there in the 1950's. Most anadromous fish currently reach as far as Dougan Falls (RM 21), however summer steelhead regularly negotiate the falls and continue farther upstream. The watershed is heavily-forested and largely managed for public and private industrial timber production. A small portion of the upper basin is within the Gifford Pinchot National Forest, the balance is primarily owned by private timber companies. The subbasin forest stands are young and road densities are high which has implications for watershed processes such as temperature, flow generation and sediment. The lower reaches suffer from urbanization around the City of Washougal and eastward expansion pressure from Vancouver in Lacamas Creek basin.

Fish Species

Focal salmonid species include fall Chinook, chum, summer and winter steelhead, and coho. Bull trout do not occur in the subbasin. Salmon and steelhead numbers have declined to only a fraction of historical levels (Table 7-26). Extinction risks are significant for all focal species but fall Chinook, chum, and summer steelhead are considered primary for population recovery. Returns of summer and winter steelhead, chum, and fall Chinook include both natural and hatchery produced fish.

Table 7-26. Status and goals for salmon and steelhead populations in the Washougal River subbasin.

Species	Population	Recovery priority	Viability		Improve-ment	Abundance		
			Status	Obj.		Historical	Current	Target
Fall Chinook	Washougal	Primary	VL	H+	190%	2,600	<50	1,200
Chum	Washougal	Primary	VL	H+	>500%	18,000	<100	1,300
Winter Steelhead	Washougal	Contributing	L	M	15%	800	300	350
Summer Steelhead	Washougal	Primary	M	H	40%	2,200	400	500
Coho	Washougal	Contributing	VL	M+	>500%	3,000	<50	1,500

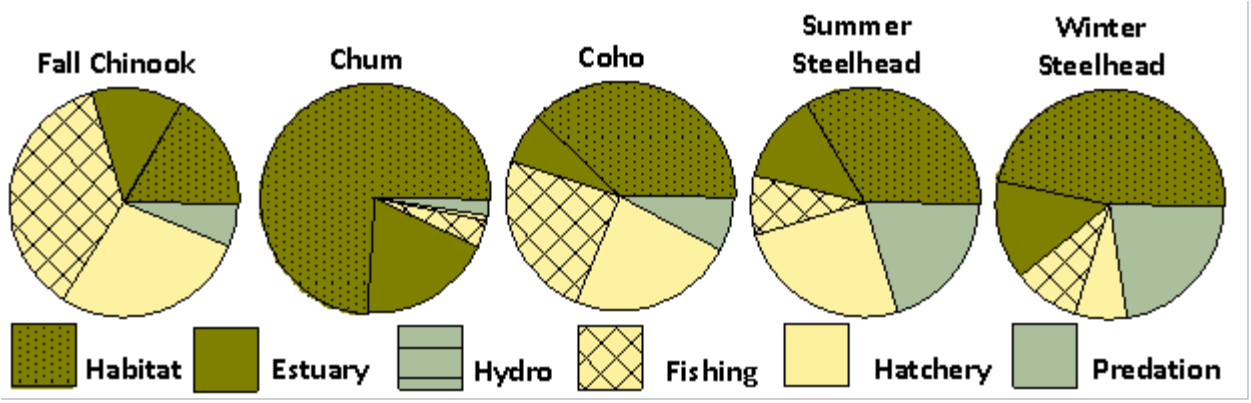


Figure 7-38. Relative significance of potentially manageable factors for Washougal River fish populations.

Threats

The depleted status of subbasin fish populations is the combined effect of significant impacts of multiple factors (Figure 7-38). Loss of tributary habitat quality and quantity accounts for the largest relative impact on all species except for fall Chinook. Harvest impacts are important for fall Chinook and coho, moderate for steelhead, and minimal for chum. Hatchery impacts are significant to fall Chinook, summer steelhead, and coho. Loss of estuary habitat quality and quantity is relatively important to all species. Predation impacts are significant for steelhead and moderate for all other species. Hydrosystem access and passage impacts appear to be relatively minor for all species.

Habitat Strategy

Fish recovery will require significant subbasin habitat improvements in concert with reductions in out-of-subbasin impacts from other limiting factors (Box 7-13). Species-specific recovery goals will require an estimated 15->500% improvement in habitat conditions (Table 7-25). Critical fish habitat problems include loss of habitat diversity, flow, increased sediment, high summer temperature, food, and channel stability. Underlying watershed issues include impaired hydraulic conditions, increased sediment supply, and degraded riparian and floodplain conditions due to timber management in the upper subbasin and urban development in the lower subbasin. The habitat restoration strategy emphasizes the need for process-related actions that provide long-term benefits over short term temporary fixes. High priority reaches for preservation and restoration include: a) the lower mainstem reaches for chum and fall Chinook, b) the middle mainstem for fall Chinook and coho, c) the upper mainstem reaches of the Washougal and West Fork Washougal for summer steelhead, and d) the upper mainstem and Little Washougal for winter steelhead (Figure 7-39, Table 7-27).

Box 7-13. Key recovery priorities for the Washougal River subbasin.

- Protect intact forests in headwater basins
- Manage forest lands to protect and restore watershed processes
- Manage growth and development to protect watershed processes and habitat conditions
- Restore passage at culverts and other barriers
- Restore lowland floodplain function, riparian function and stream habitat diversity
- Address immediate risks with short-term habitat fixes
- Align hatchery priorities consistent with conservation objectives
- Manage fishery impacts to reduce near-term population risks and support progress toward recovery
- Reduce out-of-subbasin impacts so that the benefits of in-basin actions can be realized

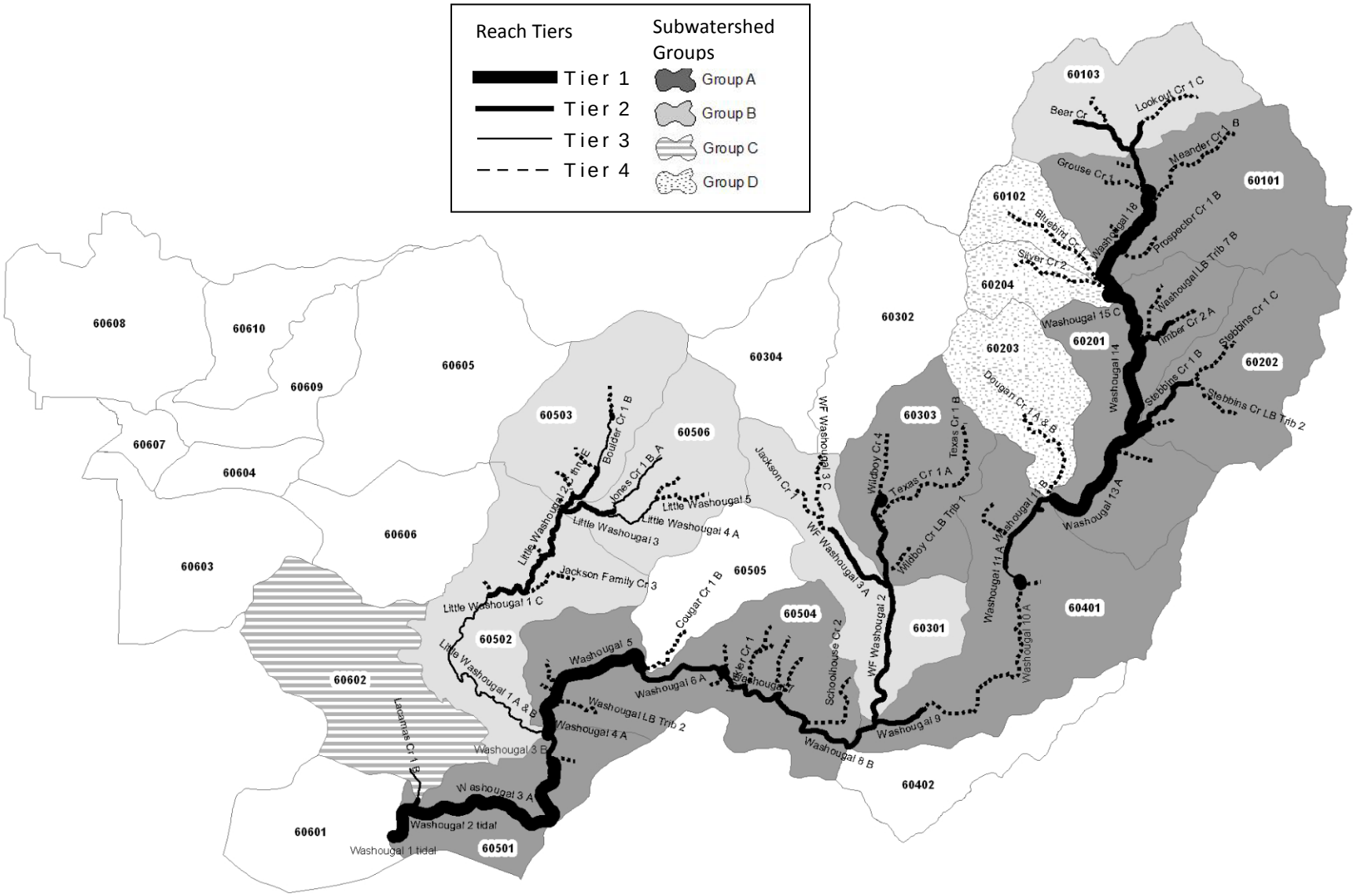


Figure 7-39. Reach tiers and subwatershed groups in the Washougal subbasin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives

Table 7-27. High priority reaches identified for habitat protection and restoration actions in the Washougal River subbasin and corresponding species priorities (High, Medium, Low) based on relative preservation and restoration value within the basin. Reach quality is the estimated proportion of historical fish production potential available for all species.

Reach	Habitat Quality	Priority (Tier)	Species Presence & Reach Priority					
			Chinook		Chum (Prim.)	Coho (Contrib.)	Steelhead	
			Fall (Prim.)	Spring (n/a)			Winter (Contrib.)	Summer (Primary)
Bear Cr	90%	2	--	--	--			M
Boulder Cr 1 A_A	55%	2	--	--	--	H	H	--
Boulder Cr 1 A_B	51%	2	--	--	--	L	H	--
Boulder Cr 1 A_C	40%	2	--	--	--	L	H	--
Boulder Cr 3	49%	2	--	--	--	M	H	--
Jones Cr 1 A	41%	2	--	--	--	L	H	--
Lacamas Cr 1 A	24%	2	--	--	--	H	L	L
Little Wa RB Trib 2 A	58%	2	--	--	--	H	L	--
Little Washougal 1 C	31%	2	--	--	--	M	H	--
Little Washougal 2 A&B	42%	2	--	--	--	M	H	--
Little Washougal 2 C- E	37%	2	--	--	--	M	H	--
Little Washougal 3	57%	2	--	--	--	L	H	--
Lookout Cr 1 A	92%	2	--	--	--	--	--	M
Prospector Cr 1 A	83%	1	--	--	--	--	--	H
Silver Cr 1 A	85%	1	--	--	--	--	--	H
Stebbins Cr 1 A	84%	1	--	--	--	--	--	H
Stebbins Cr 1 B	79%	2	--	--	--	--	--	M
Timber Cr 1	83%	2	--	--	--	--	--	M
Timber Cr 2 A	79%	2	--	--	--	--	--	M
Washougal 1 tidal	21%	1	L	--	H	L	L	L
Washougal 10 B	46%	1	H	--	--	M	M	M
Washougal 11 A	44%	2	--	--	--	M	--	M
Washougal 11 B	47%	2	--	--	--	H	--	M
Washougal 11 C	29%	2	--	--	--	H	--	L
Washougal 12	48%	2	--	--	--	H	--	M
Washougal 13 A	70%	1	--	--	--	L	--	H
Washougal 13 B	76%	1	--	--	--	--	--	H
Washougal 14	74%	1	--	--	--	--	--	H
Washougal 15 A	84%	1	--	--	--	--	--	H
Washougal 15 B	84%	1	--	--	--	--	--	H
Washougal 15 C	73%	1	--	--	--	--	--	H
Washougal 16	86%	1	--	--	--	--	--	H
Washougal 17 A	85%	1	--	--	--	--	--	H
Washougal 17 B	92%	1	--	--	--	--	--	H
Washougal 18	86%	1	--	--	--	--	--	H
Washougal 19 A	82%	1	--	--	--	--	--	H
Washougal 19 B	90%	2	--	--	--	--	--	M
Washougal 19 C	92%	2	--	--	--	--	--	M
Washougal 2 tidal	31%	1	L	--	H	L	L	L
Washougal 20	85%	2	--	--	--	--	--	M
Washougal 3 A	31%	1	H	--	M	L	L	L
Washougal 3 B	20%	2	--	--	M	L	L	--
Washougal 4 A	32%	1	H	--	--	H	L	L
Washougal 4 B	24%	1	H	--	--	H	L	L
Washougal 4 C	26%	1	H	--	--	H	L	L

Reach	Habitat Quality	Priority (Tier)	Species Presence & Reach Priority					
			Chinook		Chum (Prim.)	Coho (Contrib.)	Steelhead	
			Fall (Prim.)	Spring (n/a)			Winter (Contrib.)	Summer (Primary)
Washougal 5	33%	1	H	--	--	L	L	L
Washougal 6 A	27%	2	M	--	--	L	L	L
Washougal 6 B	47%	1	H	--	--	L	L	M
Washougal 6 C	30%	2	M	--	--	L	L	L
Washougal 7	36%	2	M	--	--	L	L	L
Washougal 8 A	38%	2	L	--	--	H	L	L
Washougal 8 B	35%	2	M	--	--	M	L	L
Washougal 9	43%	2	M	--	--	H	M	L
Washougal LB Trib 5	64%	2	--	--	--	M	--	M
Washougal RB Trib 4 A	59%	2	--	--	--	L	L	M
WF Washougal 1 A	52%	2	--	--	--	--	H	L
WF Washougal 1 B	29%	2	--	--	--	--	H	M
WF Washougal 2	64%	2	--	--	--	--	--	M
WF Washougal 3 A	52%	2	--	--	--	--	--	M
Wildboy Cr 1 A	87%	2	--	--	--	--	--	M
Wildboy Cr 1 B	86%	2	--	--	--	--	--	M
Wildboy Cr 1 C	84%	2	--	--	--	--	--	M
Wildboy Cr 1 D	77%	2	--	--	--	--	--	M
Wildboy Cr 2	0%	1	--	--	--	--	--	H

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.

7.15 Lower Columbia Gorge Tributaries

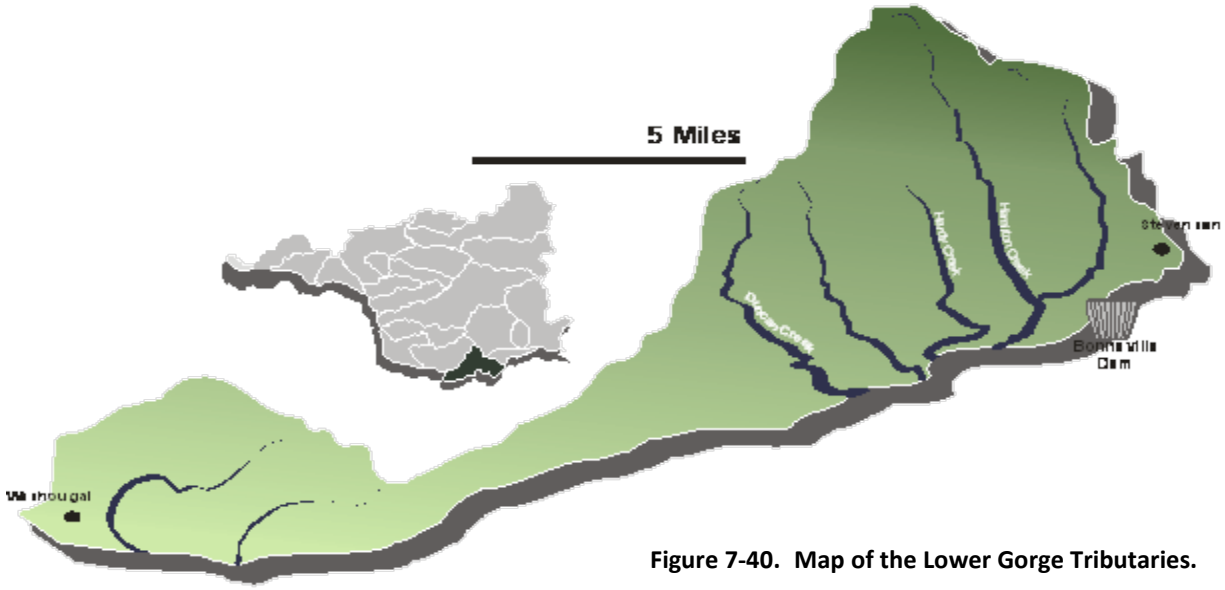


Figure 7-40. Map of the Lower Gorge Tributaries.

The lower Columbia Gorge tributaries include all the streams between Bonneville Dam and the City of Vancouver, except Salmon Creek and the Washougal River which are described separately. The major streams (from west to east) are Gibbons, Lawton, Duncan, Woodward, Hardy, Hamilton, Cedar, and Greenleaf Creeks (Figure 7-40). Hamilton Creek has the largest stream length, at over 8 miles. Streams in this subbasin originate on the steep valley walls of the Columbia Gorge and flow south through Columbia River floodplain terraces before entering the Columbia River. Most of the stream lengths are high gradient and spawning habitat is only available in the lowest reaches. Anthropogenic disturbances are related to expanding development (western portion of basin) especially around Washougal and transportation corridors that parallel the Columbia River. The eastern portion lies within the Columbia River Gorge National Scenic Area where land use and development is limited.

Fish Species

Focal salmonid species include chum, coho, winter steelhead, and fall Chinook. Bull trout do not occur in the subbasin. Salmon and steelhead numbers have declined to only a fraction of historical levels (Table 7-28). Extinction risks are significant for all focal species but winter steelhead, chum and coho are considered primary for population recovery. Returns of lower Columbia Gorge tributaries chum include both natural and hatchery produced fish from the Washougal Hatchery.

Table 7-28. Status and goals for salmon and steelhead populations in the lower Columbia Gorge tributaries.

Species	Population	Recovery priority	Viability		Improve-ment	Abundance		
			Status	Obj.		Historical	Current	Target
Fall Chinook	L. Gorge	Contributing	VL	M	>500%	n/a[1]	<50	1,200
Chum	L. Gorge	Primary	H	VH	0%[2]	6,000	2,000	2,000
Winter Steelhead	L. Gorge	Primary	L	H	45%	n/a[1]	200	300
Coho	L. Gorge	Primary	VL	H	400%	n/a[1]	<50	1,900

[1] Historical abundance information is not available.
[2] Improvement increments are based on abundance and productivity, however, this population will require improvements in spatial structure or diversity to meet recovery objectives.

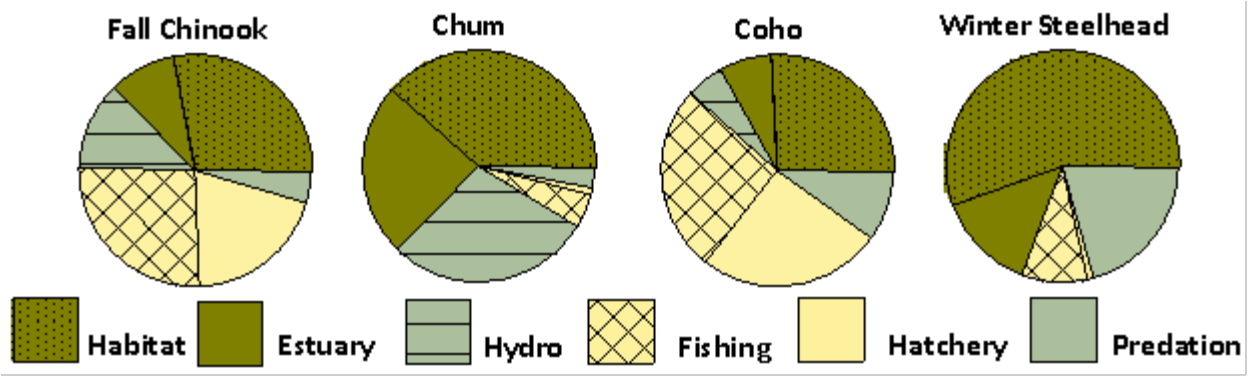


Figure 7-41. Relative significance of potentially manageable factors for the lower Gorge fish populations.

Threats

The depleted status of subbasin fish populations is the combined effect of significant impacts of multiple factors (Figure 7-41). Loss of tributary habitat quality and quantity accounts for the large impacts on all species. Harvest has a sizeable effect on coho and fall Chinook, but is relatively minor for chum; harvest impact on winter steelhead is intermediate. Loss of estuary habitat quantity and quality is also relatively important for all species, but more so for chum. Coho and fall Chinook are significantly impacted by hatcheries in the basin – impacts include potentially detrimental genetic effects of interbreeding of natural salmon with hatchery produced fish. Predation impacts are substantial for winter steelhead. Hydrosystem access and passage impacts are important for fall Chinook and chum yet relatively minor for all other species.

Habitat Strategy

Fish recovery will require significant subbasin habitat improvements in concert with reductions in out-of-subbasin impacts from other limiting factors (Box 7-14). Species-specific recovery goals will require an estimated 0-500% improvement in habitat conditions (Table 7-27). Critical fish habitat problems include loss of habitat diversity, flow, increased sediment, high summer temperature, food, and harassment. Underlying watershed issues include impaired hydraulic conditions, increased sediment supply, degraded riparian and floodplain conditions, and impaired hydraulic regimes. The habitat restoration strategy emphasizes the need for process-related actions that provide long-term benefits over short term temporary fixes. High priority reaches for preservation and restoration include: a) Hamilton and Duncan Creeks for coho, b) Duncan Lake outlet, lower Hamilton, and Hardy Creeks for chum, c) lower Hamilton Creek for fall Chinook and, d) upper Hamilton Creek for winter steelhead (Figure 7-42, Table 7-29).

Box 7-14. Key recovery priorities for the lower Gorge Tributaries.

- Reduce passage mortality at Bonneville Dam and mitigate for effects of reservoir inundation
- Address immediate risks with short-term habitat fixes
- Manage forest lands to protect and restore watershed processes
- Restore riparian function and stream habitat diversity
- Manage growth and development to protect watershed processes and habitat conditions
- Align hatchery priorities consistent with conservation objectives
- Manage fishery impacts to reduce near-term population risks and support progress toward recovery
- Reduce out-of-subbasin impacts so that the benefits of in-basin actions can be realized

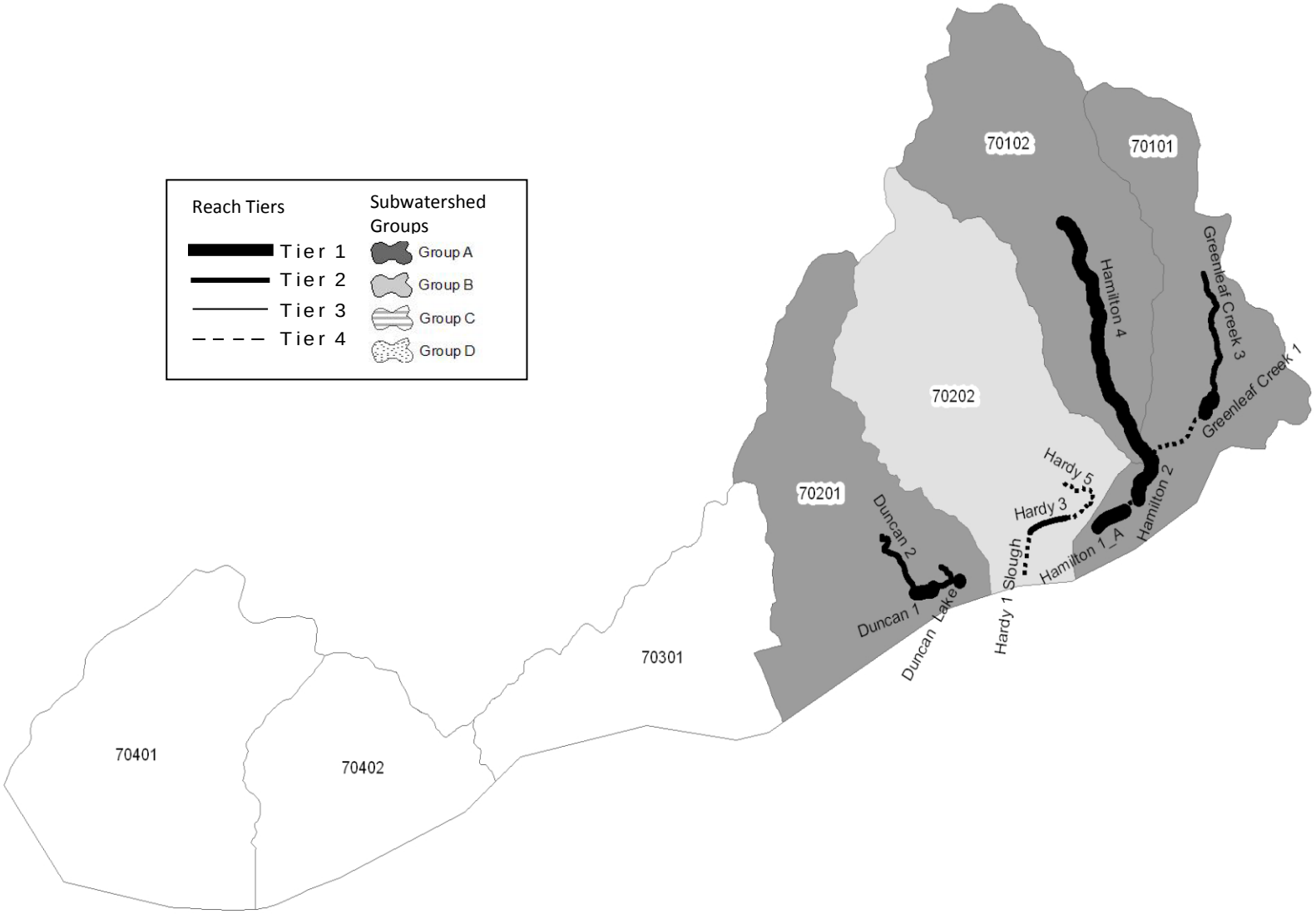


Figure 7-42. Reach tiers and subwatershed groups in the lower Columbia River gorge tributaries subbasin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives.

Table 7-29. High priority reaches identified for habitat protection and restoration actions in the lower Columbia River gorge tributaries subbasin and corresponding species priorities (High, Medium, Low) based on relative preservation and restoration value within the basin. Reach quality is the estimated proportion of historical fish production potential available for all species.

			Species Presence & Reach Priority					
	Habitat	Priority	Chinook		Chum	Coho	Steelhead	
Reach	Quality	(Tier)	Fall (Contrib.)	Spring (n/a)	(Primary)	(Primary)	Winter (Primary)	Summer (n/a)
Duncan Lake	25%	2	--	--	L	M	L	--
Duncan 1	62%	1	--	--	--	H	L	--
Duncan 2	61%	2	--	--	--	M	M	--
Duncan Springs	93%	2	--	--	L	M	--	--
Greenleaf Creek 1	66%	1	--	--	--	H	L	--
Greenleaf Creek 2	65%	2	--	--	--	M	L	--
Greenleaf Creek 3	63%	2	--	--	--	M	L	--
Hamilton 1_A	40%	1	H	--	H	M	L	--
Hamilton 2	42%	1	M	--	H	H	L	--
Hamilton 3	8%	1	--	--	--	H	L	--
Hamilton 4	54%	1	--	--	--	L	H	--
Hamilton Springs	66%	2	--	--	M	M	--	--
Hardy 2	78%	2	--	--	M	M	L	--
Hardy 3	69%	2	--	--	L	M	L	--
Lake outlet	51%	1	--	--	H	M	L	--

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.

7.16 Wind River

The Wind River originates in McClellan Meadows in the southern Gifford Pinchot National Forest. The major tributaries include the Little Wind River, Bear, Panther, Trout, Trapper, Dry Falls, and Paradise Creeks (Figure 7-43). This is a rain-on-snow dominated system with elevation ranging as high as 3,900 feet. The northwest portion of the basin is steep and the northeast is relatively flat and consists of alpine meadows. Trout Creek has a broad alluvial bench before entering into a steep v-shaped canyon in the lower 20 miles of the stream. The lower southwest portion of the subbasin, including Panther Creek and Little Wind River basins, is quite steep. Shipherd Falls is located at approximately RM 12 and has historically blocked all anadromous fish except steelhead, until it was laddered in the 1950's. The lower reaches are influenced by backwater effects from Bonneville Dam impoundments.

Figure 7-43. Map of the Wind River.

Most of the basin is used for industrial timber production which has resulted in high road densities and younger forest stands. Roads and timber harvest, combined with unstable sedimentary soils and a history of large fires, has affected basin hydrology, sediment transport, soil conditions, and riparian function.

Fish Species

Focal salmonid species include fall Chinook, chum, summer and winter steelhead, and coho. Bull trout do not occur in the subbasin. Salmon and steelhead numbers have declined to only a fraction of historical levels (Table 7-30). Extinction risks are significant for all focal species but summer steelhead and coho are considered primary for population recovery. Returns of summer and winter steelhead, chum, and fall Chinook include both natural and hatchery produced fish.

Table 7-30. Status and goals for salmon and steelhead populations in the Wind River subbasin.

Species	Population	Recovery priority	Viability		Improve-ment	Abundance		
			Status	Obj.		Historical	Current	Target
Fall Chinook	U. Gorge	Contributing	VL	M	>500%	n/a[1]	<50	1,200
Chum	U. Gorge	Contributing	VL	M	>500%	11,000	<50	900
Winter Steelhead	U. Gorge	Stabilizing	L	L	0%	n/a[1]	200	200
Summer Steelhead	Wind	Primary	H	VH	0%[2]	n/a[1]	1,000	1,000
Coho	U. Gorge	Primary	VL	H	400%	n/a[1]	<50	1,900

[1] Historical abundance information is not available.
[2] Improvement increments are based on abundance and productivity, however, this population will require improvements in spatial structure or diversity to meet recovery objectives.

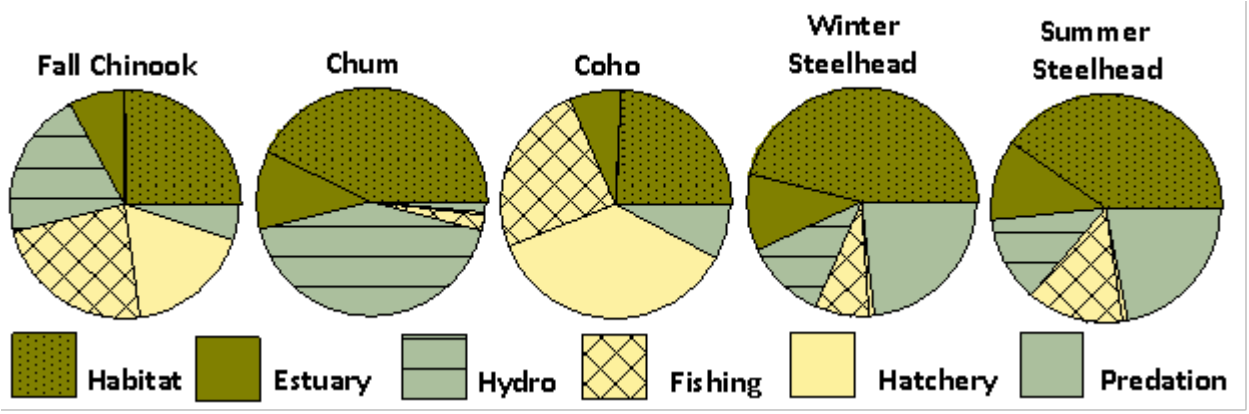


Figure 7-44. Relative significance of potentially manageable factors for Wind River fish populations.

Threats

The depleted status of subbasin fish populations is the combined effect of significant impacts of multiple factors (Figure 7-44). 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.

Habitat Strategy

Fish recovery will require significant subbasin habitat improvements in concert with reductions in out-of-subbasin impacts from other limiting factors (Box 7-15). Species-specific recovery goals will require an estimated 0->500% improvement in habitat conditions (Table 7-29). Critical fish habitat problems include loss of habitat diversity, flow, increased sediment, high summer temperature, predation, harassment, competition (hatchery), pathogens, and channel stability. Underlying watershed issues include impaired hydraulic conditions, increased sediment supply, and degraded riparian and floodplain conditions due to timber management. The habitat restoration strategy emphasizes the need for process-related actions that provide long-term benefits over short term temporary fixes. High priority reaches for preservation and restoration include: a) the lower mainstem and Little Wind reaches for fall Chinook, coho, and winter steelhead, b) the middle and upper mainstem for winter steelhead and coho and, c) Trout Creek and Panther Creek for summer steelhead (Figure 7-45, Table 7-31).

Box 7-15. Key recovery priorities for the Wind subbasin.

- Reduce passage mortality at Bonneville Dam and mitigate for effects of reservoir inundation
- Protect intact forests in headwater basins
- Manage forest lands to protect and restore watershed processes
- Manage growth and development to protect watershed processes and habitat conditions
- Restore floodplain function, riparian function and stream habitat diversity
- Evaluate and address passage issues at Hemlock Dam and Lake and other barriers
- Align hatchery priorities consistent with conservation objectives
- Manage fishery impacts to reduce near-term population risks and support progress toward recovery
- Reduce out-of-subbasin impacts so that the benefits of in-basin actions can be realized

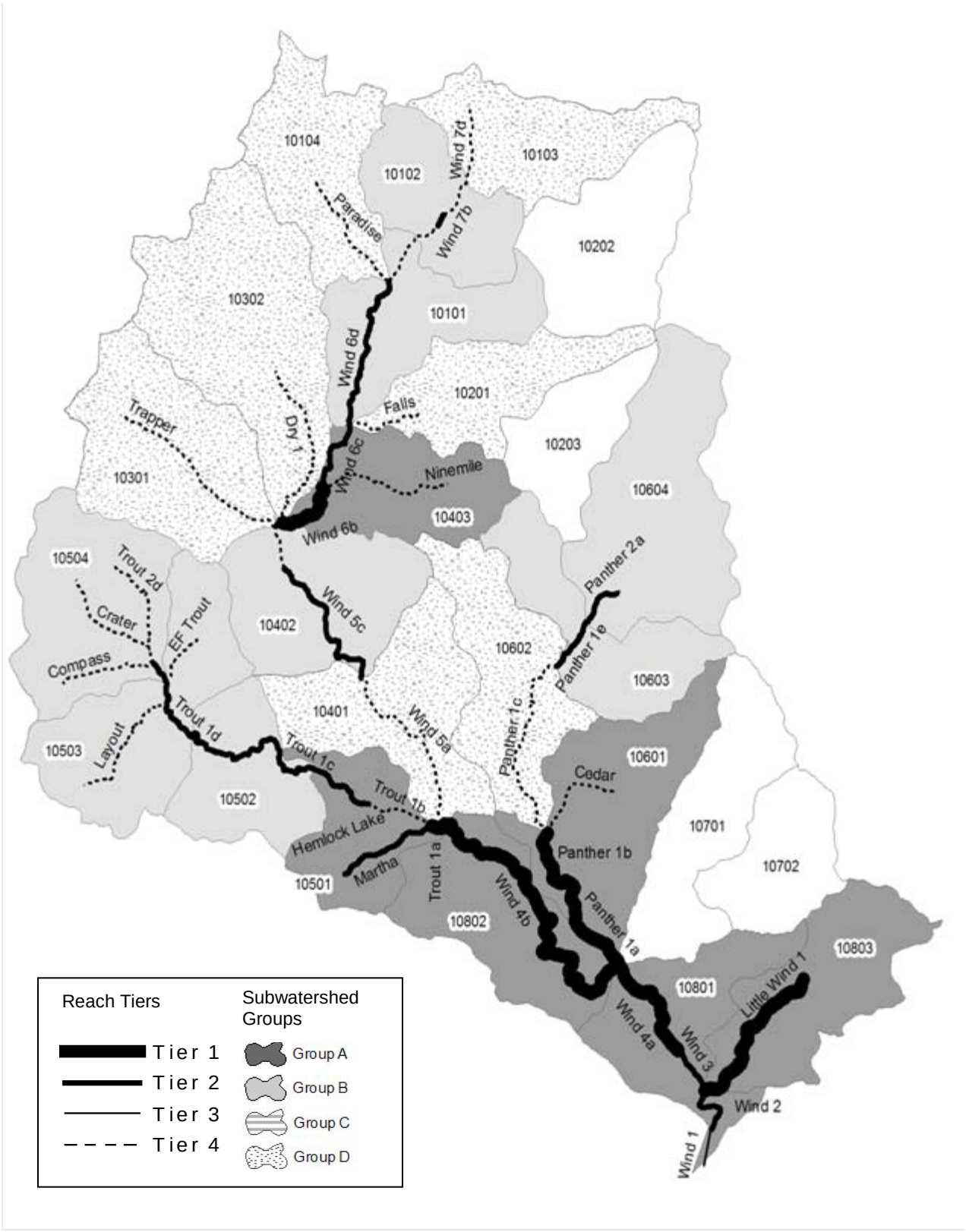


Figure 7-45. Reach tiers and subwatershed groups in the Wind River subbasin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives.

Table 7-31. High priority reaches identified for habitat protection and restoration actions in the Wind River subbasin and corresponding species priorities (High, Medium, Low) based on relative preservation and restoration value within the basin. Reach quality is the estimated proportion of historical fish production potential available for all species.

Reach	Habitat Quality	Priority (Tier)	Species Presence & Reach Priority					
			Chinook		Chum (Contrib.)	Coho (Primary)	Steelhead	
			Fall (Contrib.)	Spring (n/a)			Winter (Stabilizing)	Summer (Primary)
Little Wind 1	61%	1	--	--	--	H	H	
Martha	69%	2	--	--	--	--	--	M
Panther 1a	84%	1	--	--	--	--	--	H
Panther 1b	86%	1	--	--	--	--	--	H
Panther 1e	79%	2	--	--	--	--	--	M
Panther 2a	78%	2	--	--	--	--	--	M
Trout 1a	86%	1	--	--	--	--	--	H
Trout 1c	72%	2	--	--	--	--	--	M
Trout 1d	81%	2	--	--	--	--	--	M
Trout 2a	78%	2	--	--	--	--	--	M
Trout 2b	77%	2	--	--	--	--	--	M
Wind 1	10%	3	M	--	M	L	L	L
Wind 2	57%	2	H	--	H	M	L	L
Wind 3	57%	2	L	--	L	L	M	M
Wind 4a	84%	1	--	--	--	--	--	H
Wind 4b	77%	1	--	--	--	--	--	H
Wind 5b	54%	2	--	--	--	--	--	M
Wind 5c	57%	2	--	--	--	--	--	M
Wind 6a	84%	2	--	--	--	--	--	M
Wind 6b	87%	1	--	--	--	--	--	H
Wind 6c	83%	2	--	--	--	--	--	M
Wind 6d	71%	2	--	--	--	--	--	M
Wind 7b	81%	2	--	--	--	--	--	M

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.

7.17 Little White Salmon River

Figure 7-46. Map of the Little White Salmon River.

The Little White Salmon originates just east of the Cascade crest in the Gifford Pinchot National Forest and flows south until it meets the Columbia at Drano Lake (RM 162)(Figure 7-46). Major tributaries include Rock, Lava, Moss, Wilson, Cabbage, Berry, Homes, Lusk, and Beetle Creeks. The subbasin drains the Indian Heaven Wilderness and the Monte Cristo Range. Elevation extends as high as 5,300 feet and Drano Lake is formed by backwater influences from Bonneville Dam impoundments. A major feature is the Big Lava Bed, comprising a large area in the basin and made up of pyroclastic flows. This type of geology is susceptible to large, deep seated landslides. Nearly the entire basin is forested and located within the Gifford Pinchot National Forest.

Parts of the basin are set aside as wilderness areas with little anthropogenic changes to them, other parts are used for industrial timber production. There is limited habitat available for anadromous fish in the subbasin as passage is naturally blocked by a falls at RM 1.5 although a few fish are believed to ascend as far as a larger falls at RM 2.5-3. Most of the available spawning habitat (400-500 meters) occurs between the first falls and Drano Lake.

Fish Species

Focal salmonid species include fall Chinook which are present in the basin, as well as coho, winter and summer steelhead, and chum which are not known to occur but are included as part of the Wind and Upper Gorge populations. Bull trout do not occur in the subbasin, however occasionally Bull trout (potentially from the Hood River population) have been captured in Drano Lake. Salmon and steelhead numbers have declined to only a fraction of historical levels (Table 7-32). Extinction risks are significant for all focal species but summer steelhead and coho are considered primary for population recovery. Returns of fall Chinook include both natural and hatchery produced fish. Carson Stock spring Chinook are produced at the Little White Salmon Hatchery.

Table 7-32. Status and goals for salmon and steelhead populations in the Little White Salmon.

Species	Population	Recovery priority	Viability		Improve-ment	Abundance		
			Status	Obj.		Historical	Current	Target
Fall Chinook	Upper Gorge	Contributing	VL	M	>500%	n/a[1]	<50	1,200
Chum	Upper Gorge	Contributing	VL	M	>500%	11,000	<50	900
Winter Steelhead	Upper Gorge	Stabilizing	L	L	0%	n/a[1]	200	200
Coho	Upper Gorge	Primary	VL	H	400%	n/a[1]	<50	1,900

[1] Historical abundance and recovery goal information is not available at this time due to a lack of information regarding population dynamics.

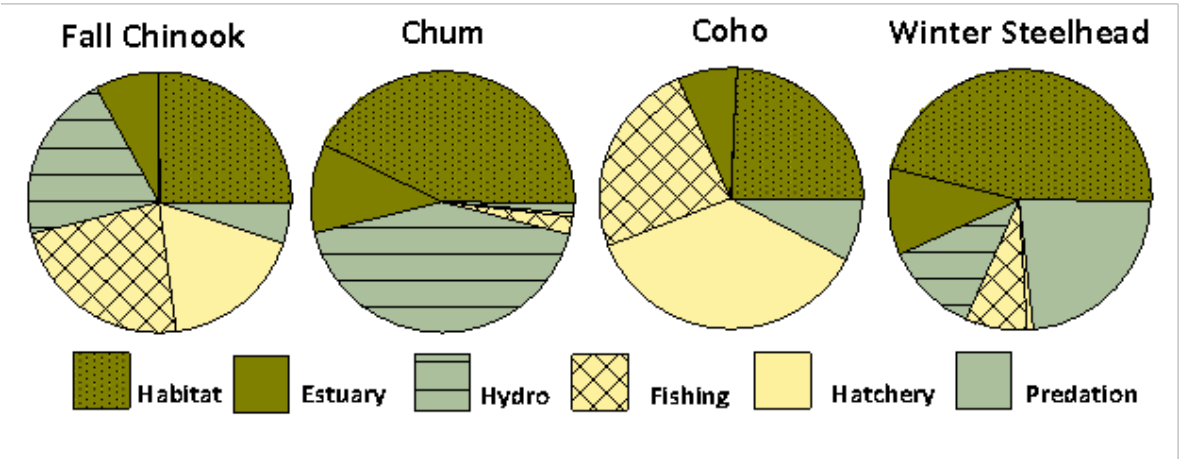


Figure 7-47. Relative significance of potentially manageable factors for White Salmon River fish populations.

Threats

Due to the small amount of available habitat, the Little White Salmon populations have not been analyzed using the EDT model and reaches have not been prioritized using the methodology applied to other subbasins. Non-modeled assessments of limiting factors assumed that loss of tributary habitat quality and quantity is relatively significant for all species as is loss of estuary habitat quantity and quality (Figure 7-47). Harvest is assumed to have a sizeable effect on fall Chinook and coho. All species are assumed to be impacted by hatcheries but the most significant impact is to coho. Predation impacts are assumed moderate for all species. The impact of hydro system access and passage is one of the more important impacts for chum and only moderately so for fall Chinook and steelhead.

Habitat Strategy

Fish recovery will require habitat protection and restoration in concert with reductions in out-of-subbasin impacts from other limiting factors (Box 7-16). Due to the small size of this subbasin and limited contribution to fish recovery, an in-depth stream habitat assessment was not conducted using EDT. Priority measures and actions were based on existing studies and an IWA. Species-specific recovery goals will require an estimated 0->500% improvement in habitat conditions (Table 7-31). The habitat restoration strategy emphasizes the need for process-related actions that provide long-term benefits over short term temporary fixes.

Box 7-16. Key recovery priorities for the Little White Salmon subbasin.

- Reduce passage mortality at Bonneville Dam and mitigate for effects of reservoir inundation
- Protect intact forests in headwater basins
- Manage forest lands to protect and restore watershed processes
- Manage growth and development to protect watershed processes and habitat conditions
- Evaluate and restore passage at artificial barriers
- Align hatchery priorities consistent with conservation objectives
- Manage fishery impacts to reduce near-term population risks and support progress toward recovery
- Reduce out-of-subbasin impacts so that the benefits of in-basin actions can be realized

7.18 Upper Columbia Gorge Tributaries

The Upper Columbia Gorge tributaries include all the tributaries between Bonneville Dam and the White Salmon River, except the Wind River and Little White Salmon River, which are addressed separately. The major streams (from west to east) are Rock Creek, which is the water source for Stevenson, Carson, Collins, and Dog Creeks (Figure7-48).

Figure7-48. Map of the Upper Columbia Gorge Tributaries.

Streams in the Upper Gorge Tributaries originate on the steep valley walls of the Columbia River Gorge and flow south through incised drainages before entering the Columbia River. Most of the stream lengths are high gradient and spawning habitat is only available in the lowest reaches. Anthropogenic disturbances are related to commercial timber harvest, transportation corridors that parallel the Columbia River, and rural residential development. In portions of Rock Creek basin there is natural geologic instability which has resulted in large-scale landslides.

Fish Species

Focal salmonid species include chum, coho, and winter steelhead which are combined with Wind River and Little White Salmon River populations to form the Upper Columbia Gorge populations. Bull trout do not occur in the subbasin. Salmon and steelhead numbers have declined to only a fraction of historical levels (Table 7-33). Extinction risks are significant for all focal species in the subbasin but coho are considered primary for population recovery. Returns of Upper Columbia Gorge chum include both natural and potentially some hatchery produced fish from the Washougal Hatchery.

Table 7-33. Status and goals for salmon and steelhead populations in the Upper Columbia Gorge tributaries.

Species	Population	Recovery priority	Viability		Improve-ment	Abundance		
			Status	Obj.		Historical	Current	Target
Fall Chinook	U. Gorge	Contributing	VL	M	>500%	n/a[1]	<50	1,200
Chum	U. Gorge	Contributing	VL	M	>500%	11,000	<50	900
Winter Steelhead	U. Gorge	Stabilizing	L	L	0%	n/a[1]	200	200
Coho	U. Gorge	Primary	VL	H	400%	n/a[1]	<50	1,900

[1] Historical abundance and recovery goal information is not available at this time due to a lack of information regarding population dynamics.

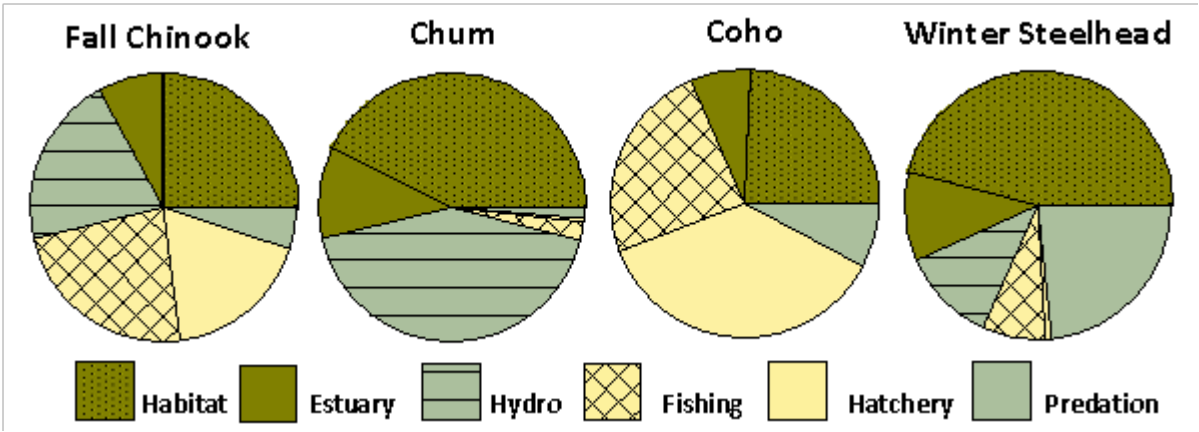


Figure 7-49. Relative significance of potentially manageable factors for the Upper Gorge fish populations.

Threats

Due to the small amount of available information on habitat, the Upper Columbia Gorge Tributary populations have not been analyzed using the EDT model and reaches have not been prioritized using the methodology applied to other subbasins. Non-modeled assessments of limiting factors assumed that loss of tributary habitat quality and quantity accounts for the largest relative impact on chum and winter steelhead and moderate impact to fall Chinook and coho (Figure 7-49). Loss of estuary habitat quantity and quality is estimated as moderate for all species. Harvest is assumed to have a sizeable effect on fall Chinook and coho, and minimal to steelhead and chum. Coho and fall Chinook are the only species impacted by hatcheries in the subbasin. Predation impacts are assumed moderate for all species, except steelhead where they are quite significant. The impact of hydrosystem access and passage is one of the more important impacts for chum and fall Chinook.

Habitat Strategy

Fish recovery will require significant subbasin habitat improvements in concert with reductions in out-of-subbasin impacts from other limiting factors (Box 7-17). The habitat restoration strategy emphasizes the need for process-related actions that provide long-term benefits over short term temporary fixes. Review of available information found that the greatest amount of habitat exists in the lower mile of Rock Creek. Small amounts of habitat are found in Nelson, Carson, Collins, and Dog Creeks. These streams are impacted by channel modifications, passage limitations, and riparian habitat degradation associated with urbanization and road/railroad corridors along the Columbia River. Due to the small size of the Upper Gorge Tributaries Basin, an in-depth stream habitat assessment was not conducted using EDT. Priority measures and actions were based on existing studies and an IWA. Species-specific recovery goals will require an estimated 0->500% improvement in habitat conditions (Table 7-33).

Box 7-17. Key recovery priorities for the Upper Gorge subbasin.

- Reduce passage mortality at Bonneville Dam and mitigate for effects of reservoir inundation
- Address immediate risks with short-term habitat fixes
- Manage forest lands to protect and restore watershed processes
- Restore riparian function and stream habitat diversity
- Manage growth and development to protect watershed processes and habitat conditions
- Align hatchery priorities consistent with conservation objectives
- Manage fishery impacts to reduce near-term population risks and support progress toward recovery
- Reduce out-of-subbasin impacts so that the benefits of in-basin actions can be realized