Volume II, Chapter 4
Grays River Subbasin

TABLE OF CONTENTS

4.0 Grays River Subbasin

4.1 Subbasin Description

4.1.1 Topography & Geology

For the purposes of this analysis, the Grays River subbasin includes the Grays River and other tributaries to Grays Bay, including the basins of Deep Creek and Crooked Creek. The Grays River originates in southeast Pacific County, flows southwest through Wahkiakum County, and enters the Columbia River estuary at river mile (RM) 21. Tidal influence extends upriver for 6 miles. The entire basin encompasses 124 mi^2.

The upper reaches of the Grays River flow through steep valleys in the Willapa Hills, and the lower reaches flow through the relatively flat terrain of the plains of the Columbia Valley. In general, the topography consists of low rolling hills and undulating glacial drift plains. The maximum elevation is 2,840 ft. and the minimum elevation is 5 ft. Approximately 49% of the underlying rock in the Grays River watershed is sedimentary, and 35% is of volcanic origin. Soils in the Grays River watershed are mostly of the Lytell-Astoria (43%) and Bunker-Knappton (36%) soil types according to data from the Cowlitz and Wahkiakum Conservation Districts (CCD/WCD). Based on NRCS criteria that incorporates soil type and terrain slope, approximately 26% of the area in the Grays River watershed has high erodability (Wade 2002).

4.1.2 Climate

The subbasin has a typical northwest maritime climate. Summers are dry and cool and winters are mild, wet, and cloudy. Nearly the entire Grays River watershed is in the rain-dominated or lowland precipitation zones according to DNR classification (Wade 2002). Mean temperature at the Grays River Hatchery (on the West Fork) ranges from 33°-47°F (1°-8°C) in the winter to 50°-74° F (10°-23°C) in summer. Average annual precipitation is 110 inches at the hatchery, with less than 2 inches in July and more than 17 inches in December (WRCC 2003). Data from the CCD/WCD lists a mean annual precipitation of 88.3 inches for the entire Grays River watershed (Wade 2002).

4.1.3 Land Use/Land Cover

Approximately 95% of the subbasin is forested. In the Grays River watershed, commercial timber companies own 73% of the land; 3% is in agriculture, 4% is rural residential development, and 19% is non-industrial forestland (CCD/WCD data). State ownership comprises the bulk of the remaining lands. The only population centers are the unincorporated towns of Grays River, Rosburg, and Chinook. Projected population change from 2000-2020 for unincorporated areas in WRIA 25 is 37% (LCFRB 2001). Potential natural vegetation includes western hemlock, western red cedar, Sitka spruce, and Douglas fir. Much of the basin has been impacted by timber harvest and is primarily composed of young forest stands. Approximately 500 acres of the lower Grays River has been acquired by the Columbia Land Trust for protection of natural resources. A breakdown of land ownership and land cover in the Grays basin is presented in Figure 4-1 and Figure 4-2. Figure 4-3 displays the pattern of landownership for the basin. Figure 4-4 displays the pattern of land cover / land-use.

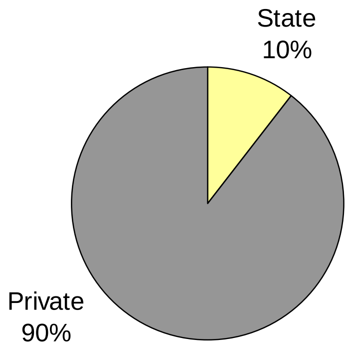


Figure 4-1. Grays River subbasin land ownership

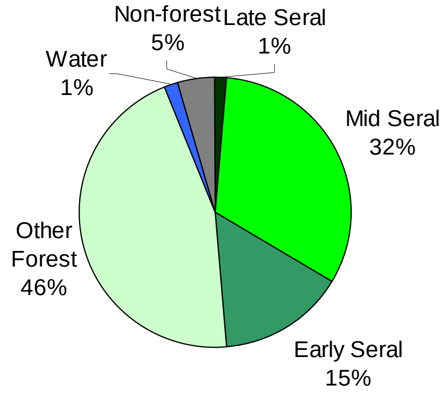


Figure 4-2. Grays River subbasin land cover

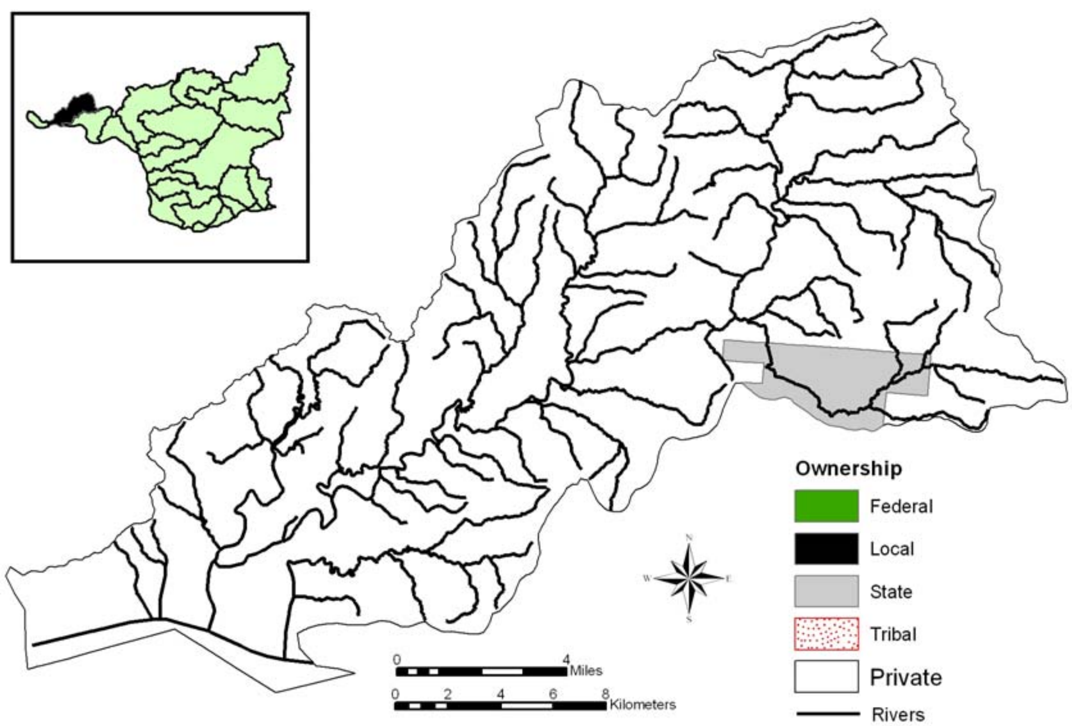


Figure 4-3. Landownership within the Grays basin. Data is WDNR data that was obtained from the Interior Columbia Basin Ecosystem Management Project (ICBEMP).

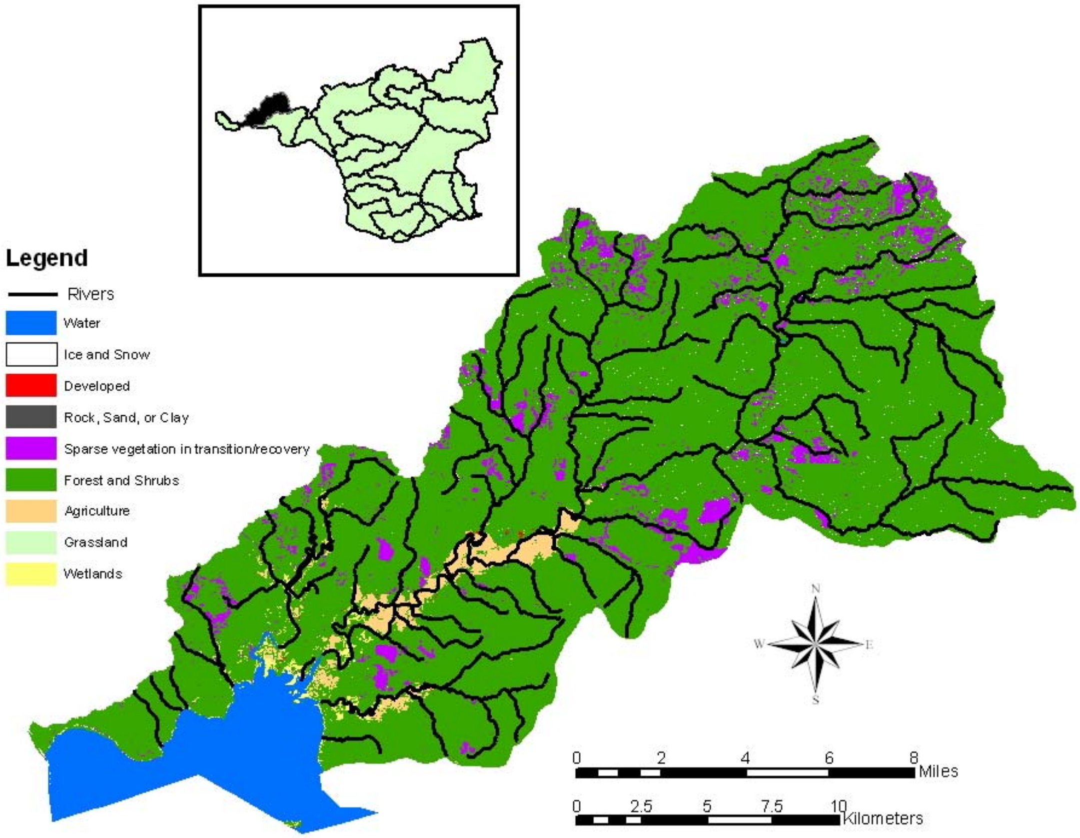
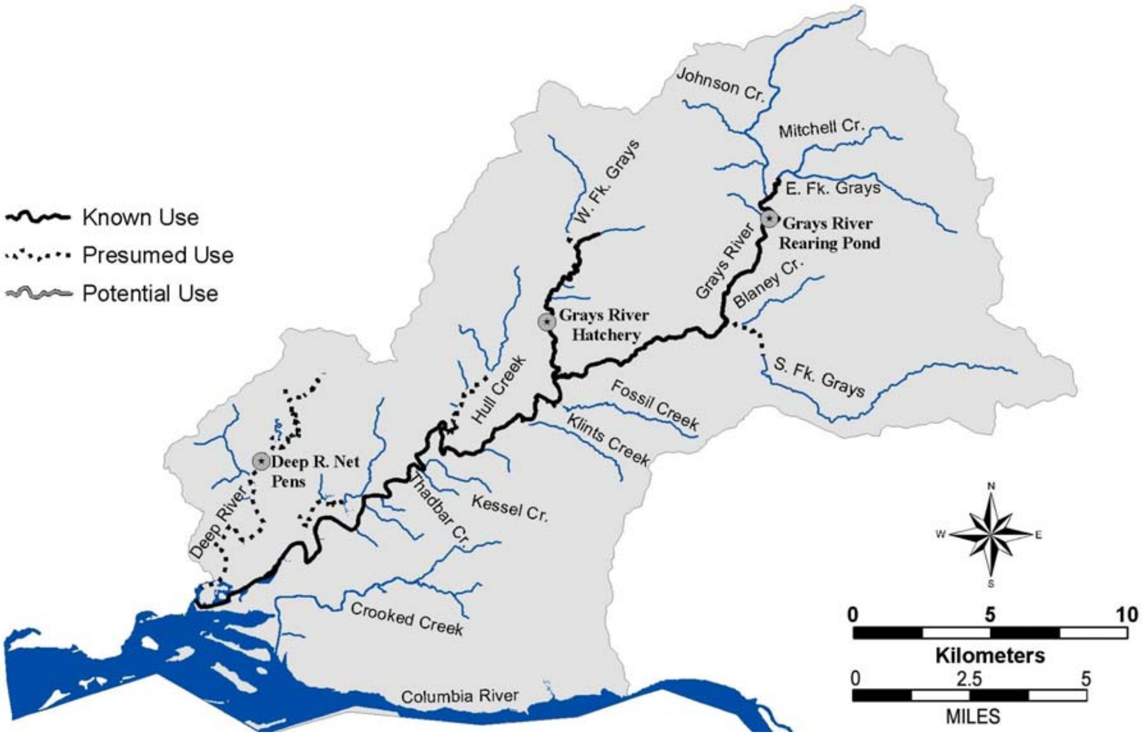


Figure 4-4. Land cover within the Grays basin. Data was obtained from the USGS National Land Cover Dataset (NLCD).

4.2 Focal Fish Species

4.2.1 Fall Chinook—Grays Subbasin

ESA: Threatened 1999	SASSI: Depressed 2002



Distribution

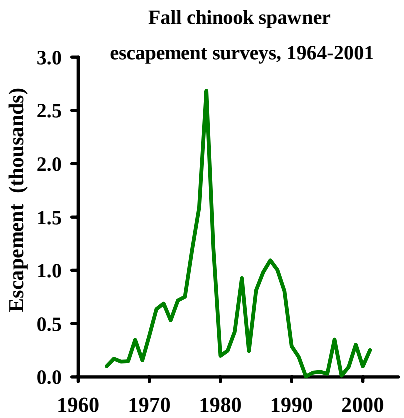
- Spawning occurs in the West Fork below the Grays River Salmon Hatchery (RM 1.4) and in the mainstem Grays River from the area of tidal influence to above the confluence of the West Fork (RM 8-14)

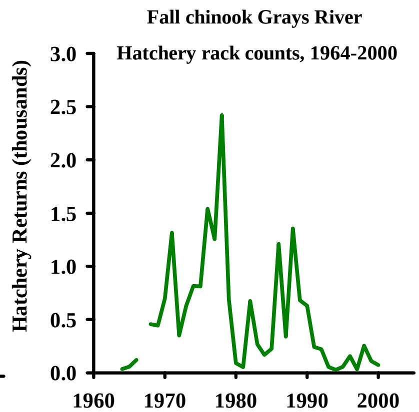
Life History

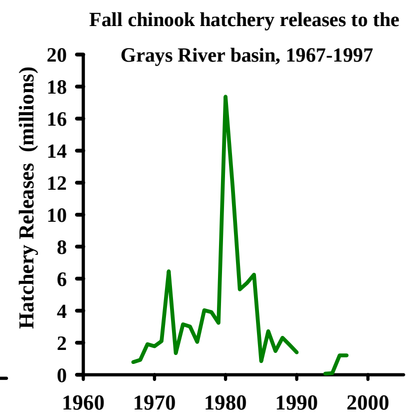
- Columbia River tule fall chinook migration occurs from mid August to mid September, depending partly on early fall rain
- Natural spawning occurs between late September and late October, peaking in mid-October
- Age ranges from 2-year-old jacks to 6-year-old adults, with dominant adult ages of 3 and 4 (averages are 27% and 57% respectively)
- Fry emerge around early April, depending on time of egg deposition and water temperature; fall chinook fry spend the summer in fresh water, and emigrate in the late spring/summer as sub-yearlings

Diversity

- Considered a component of the tule population in the lower Columbia River Evolutionarily Significant Unit (ESU)
- Stock designated based on distinct spawning distribution







Abundance

- In 1951, WDF estimated fall chinook escapement to the Grays River was 1,000 fish
- Spawning escapements from 1964-2001 ranged from 4 to 2,685 (average 523)

Productivity & Persistence

- NMFS Status Assessment indicated a 0.52 risk of 90% decline in 25 years and a 0.72 risk of 90% decline in 50 years; the risk of extinction in 50 years was 0.58
- Evidence suggests few natural fall chinook juveniles are produced annually

Hatchery

- Grays River Hatchery located about RM 2 on the West Fork; hatchery began operation in 1961
- Hatchery releases of fall chinook in the basin began in 1947; Release data are displayed for 1967-97
- The Grays River Hatchery was used as an egg bank facility for North Toutle Hatchery fall chinook stock for several years after the eruption of Mt. St. Helens
- The Grays River Hatchery fall chinook program was discontinued in 1998 because of federal funding cuts
- A significant portion of past years fall chinook spawners in the Grays River were first generation hatchery fish from the Grays River Hatchery; the Grays River Hatchery adult returns were eliminated beginning in 2002

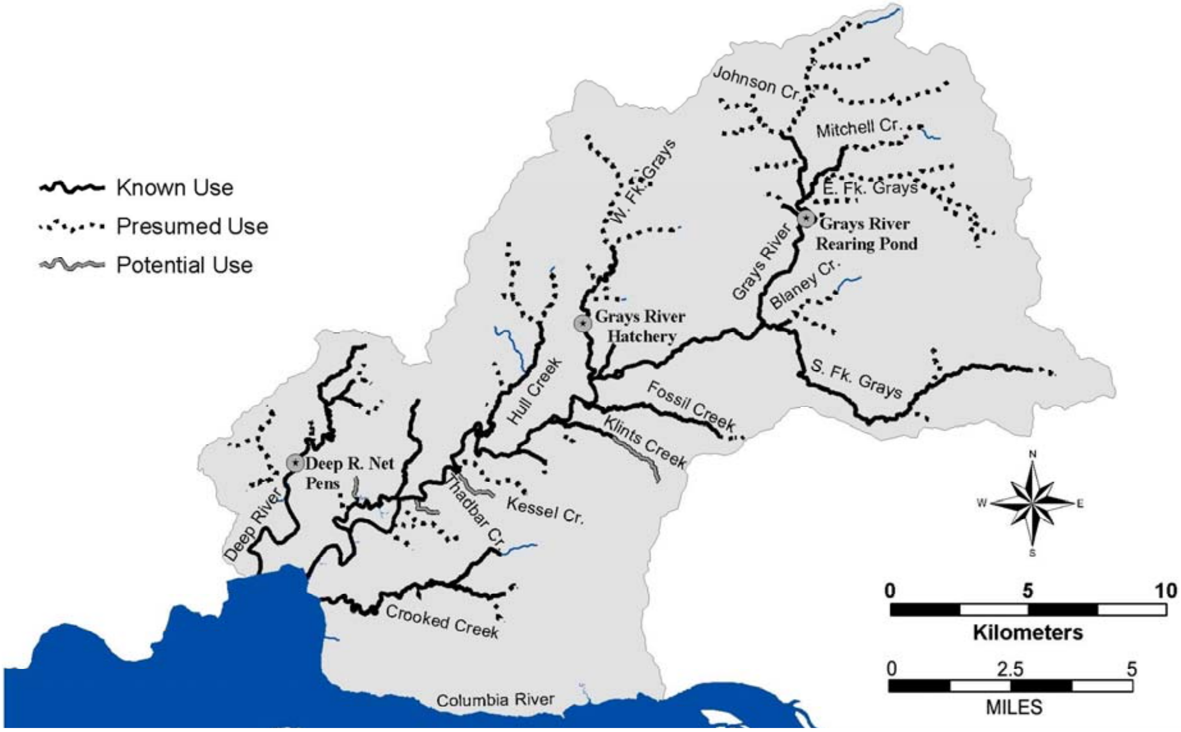
Harvest

- Fall chinook are harvested in ocean commercial and recreational fisheries from Oregon to Alaska, and in Columbia River commercial gill net and sport fisheries
- Lower Columbia tule fall chinook are an important contributor to Washington ocean troll and sport fisheries and to the Columbia River estuary sport fishery
- Columbia River commercial harvest occurs primarily in September, but tule chinook flesh quality is low once they move from salt water; price is low compared to higher quality bright chinook
- CWT data analysis of the 1991-94 brood Grays River Hatchery chinook indicate a harvest rate of 54% of the Grays River stock
- The majority of the Grays River Hatchery fall chinook stock harvest occurred in Southern British Columbia (51.0%), Washington ocean (12.0%), and Columbia River (25.0%) fisheries

- Current annual harvest rate is dependent on management response to annual abundance in PSC (US/Canada), PFMC (US ocean), and Columbia River Compact forums
- Sport harvest in the Grays River averaged 156 fall chinook annually from 1981-1988
- Ocean and mainstem Columbia River fisheries are limited to a 49% harvest due to ESA limits onCoweeman tule fall chinook

4.2.2 Coho—Grays Subbasin

ESA: Candidate 1995	SASSI: Unknown 2002

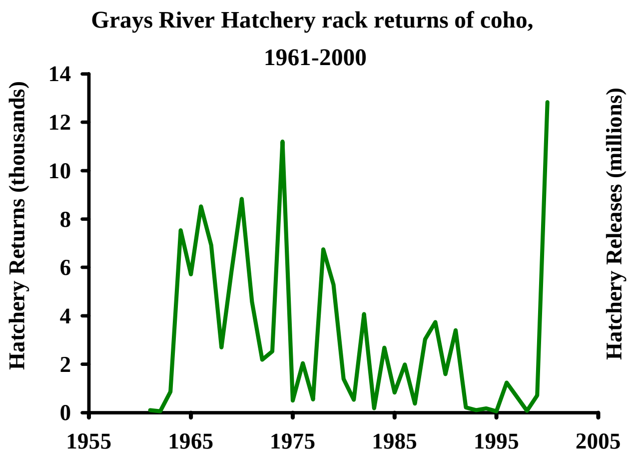


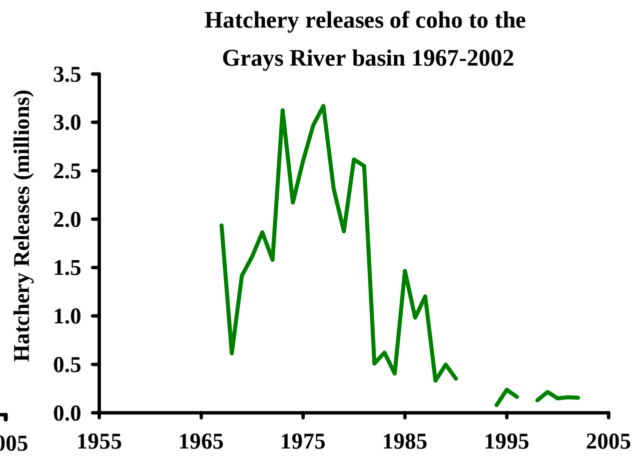
Distribution

- Managers refer to early stock coho as Type S due to their ocean distribution generally south of the Columbia River
- Managers refer to late coho as Type N due to their ocean distribution generally north of the Columbia River
- Potential natural spawning areas include the upper Grays, South Fork, West Fork, Crazy Johnson Creek, and Hull Creek
- Vicinity streams with coho spawning potential include Crooked Creek, Hitchcock Creek, and Jim Crow Creek

Life History

- Adults enter the Grays River from mid-August through February (early stock primarily from mid-August through September and late stock primarily from late September through November)
- Peak spawning occurs in late October for early stock and late November to January for late stock
- Adults return as 2-year-old jacks (age 1.1) or 3-year-old adults (age 1.2)
- Fry emerge in spring, spend one year in fresh water, and emigrate as age-1 smolts in the following spring





Diversity

- Late stock coho (or Type N) were historically present in the Grays basin with spawning occurring from late November into March
- Early stock coho (or Type S) are also present in the basin and are produced at Grays River Hatchery
- Columbia River early and late stock coho produced from Washington hatcheries are genetically similar

Abundance

- Grays River wild coho run is a fraction of its historical size
- USFWS surveys in 1936 and 1937 indicated coho presence in all accessible areas of the Grays River and its tributaries; no population estimate was made
- WDF estimated 2,500 natural spawning late coho in the Grays River in 1951
- Hatchery production accounts for most coho returning to Grays River

Productivity & Persistence

- Natural spawning of early stock coho is presumed to be very low; natural production of late stock coho is likely less then 15% of smolt density estimate
- Smolt density model estimated basin potential to be 125,874 smolts

Hatchery

- Grays River Hatchery is located about 2.5 miles upstream of Highway 4 on the West Fork; hatchery was completed in 1961; hatchery produces early stock coho
- Grays River Hatchery releases of early coho smolts ranged from about 500,000 to 3 million per year during 1967-87; the current program is reduced to 160,000 early coho smolts released annually

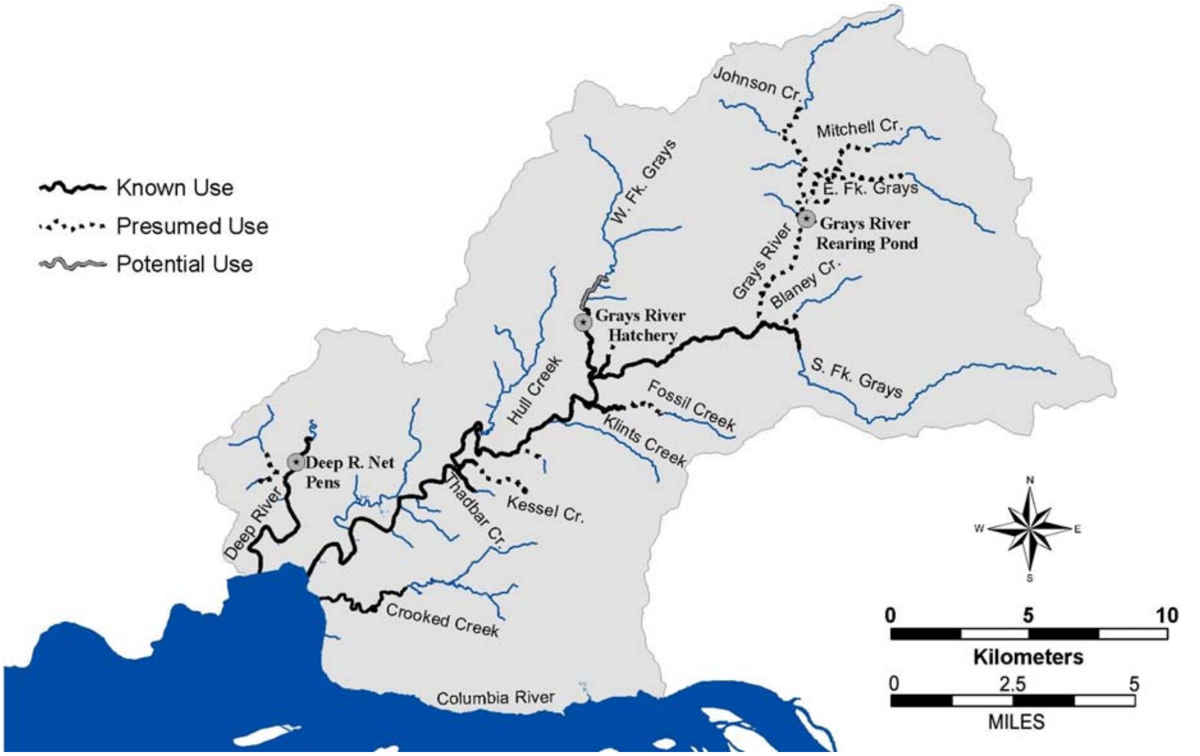
Harvest

- Until recent years, natural produced Columbia River coho were managed like hatchery fish and subjected to similar harvest rates; ocean and Columbia River combined harvest rates ranged from 70% to over 90% during 1970-83
- Ocean fisheries were reduced in the mid 1980s to protect several Puget Sound and Washington coastal wild coho populations

- Columbia River commercial coho fishing in November was eliminated in the 1990s to reduce harvest of late Clackamas wild coho
- Since 1999, returning Columbia River hatchery coho have been mass marked with an adipose fin clip to enable fisheries to selectively harvest hatchery coho and release wild coho
- Natural produced lower Columbia River coho are beneficiaries of harvest limits aimed at Federal ESA listed Oregon Coastal coho and Oregon State listed Clackamas and Sandy River coho
- During 1999-2002, fisheries harvest of ESA listed coho was less than 15% each year
- Hatchery coho can contribute significantly to the lower Columbia River gill net fishery; commercial harvest of early coho is constrained by status of fall chinook and Sandy River coho management; commercial harvest of late coho is focused in October during the peak abundance of hatchery late coho
- A substantial estuary sport fishery exists between Buoy 10 and the Astoria-Megler Bridge; majority of the catch is early coho, but late coho harvest can also be substantial
- An average of 94 coho (1978-1986) were harvested annually in the Grays River sport fishery
- CWT data analysis of 1994, 1996, and 1997 brood early coho releases from Grays River Hatchery indicates 43% were captured in a fishery and 57% were accounted for in escapement
- Fishery CWT recoveries of 1994, 1996, and 1997 brood Grays early coho were distributed between Columbia River (58%), Oregon ocean (21%), Washington ocean (19%), and California ocean (1%) sampling areas

4.2.3 Chum—Grays Subbasin

ESA: Threatened 1999	SASSI: Depressed 1992



Diversity

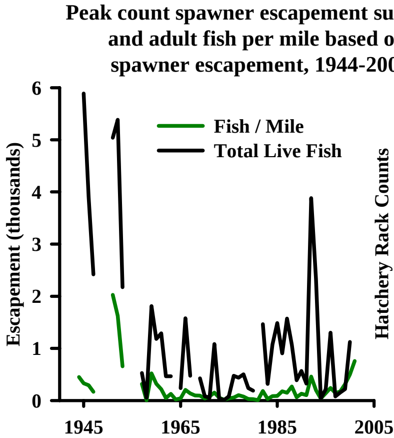
- One of two genetically distinct populations in the Columbia ESU
- Stock designated based on geographic distribution
- Outside stocks used for hatchery brood in the 1980s from Hood Canal and Japan failed to produce significant adult returns
- Outside stock use was discontinued and only Grays Stock currently exists in the hatchery program

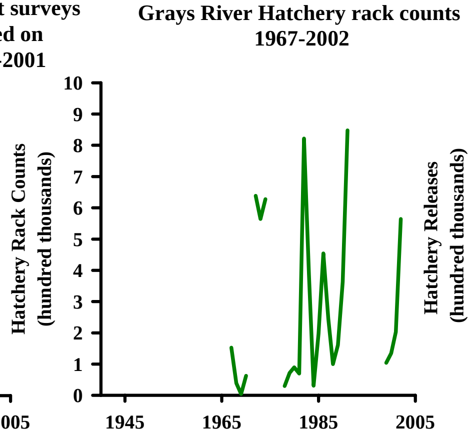
Life History

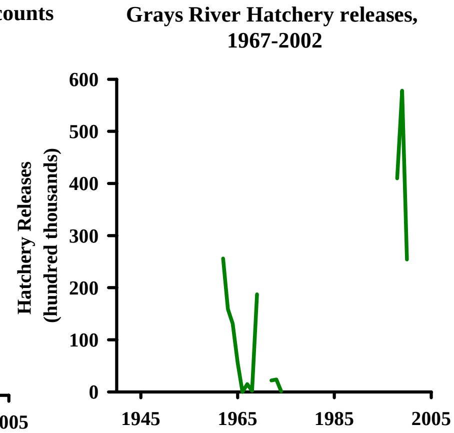
- Adults enter the Grays River from mid-October through November
- Peak spawning occurs in late November
- Dominant adult ages are 3 and 4
- Fry emerge in early spring; chum emigrate as age-0 smolts, generally from March to may with peak migration from mid-April to early May

Distribution

- Spawning occurs in the mainstem Grays River from RM 9.5-13.0, the lower 1.4 miles of the West Fork of the Grays River, the lower 0.5 miles of Crazy Johnson Creek, and in Gorley Creek at RM 12 of the Grays River.







Abundance

- Peak escapement counts in 1936 were 7,674 chum; peak counts from 1945-2000 ranged from 12 to 5,887 chum (average 1,149)
- Adult fish/mile generally ranges from 0-500 from 1944-2000 as estimated from escapement ground spawner surveys, except for 4 years during the 1950s
- Recent survey results (since 1999) indicate a small but increasing chum population

Productivity & Persistence

- NMFS Status Assessment indicated a 0.18 risk of 90% decline in 25 years and a 0.38 risk of 90% decline in 50 years; the risk of extinction was not applicable

Hatchery

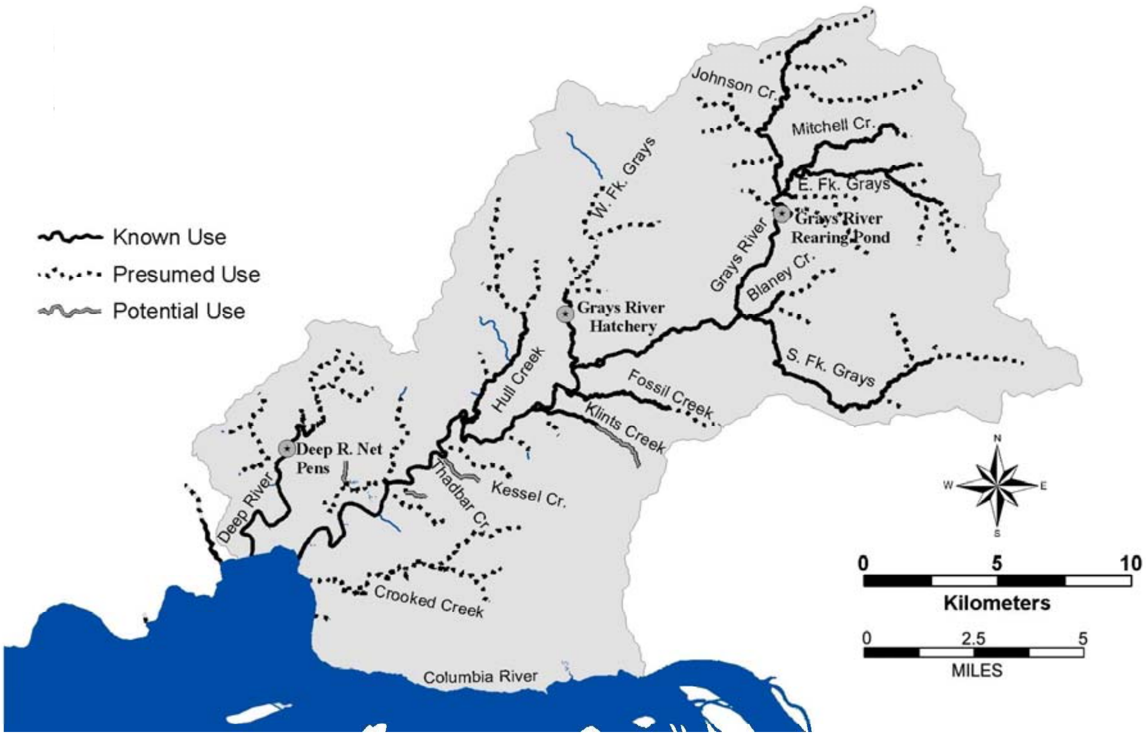
- Grays River hatchery located about RM 2 on the West Fork; hatchery primarily releases chinook and coho; chum are captured annually in the hatchery rack
- Small chum releases have been made with little success
- Hatchery program goal since 1998 is to produce Grays stock chum to augment and reduce risks to naturally spawning Grays River chum

Harvest

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

4.2.4 Winter Steelhead—Grays Subbasin

ESA: Not Warranted	SASSI: Depressed 2002



Distribution

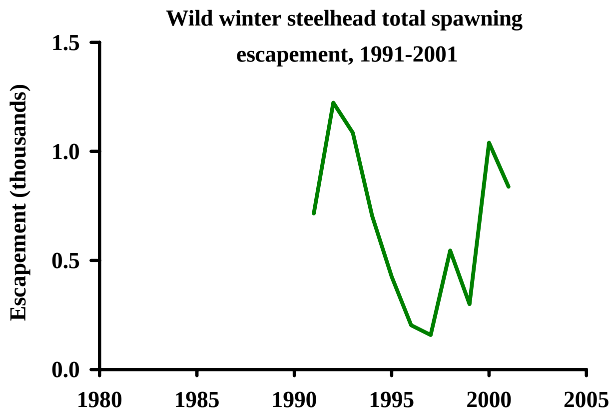
- Winter steelhead are distributed throughout the mainstem above tidal influence and throughout the East, West, and South Forks
- In 1957, Grays River Falls (RM 13) was lowered with explosives, providing easier upstream migration; during the 1950s numerous other natural and man-made barriers above Grays Falls were cleared to improve steelhead access to the upper watershed

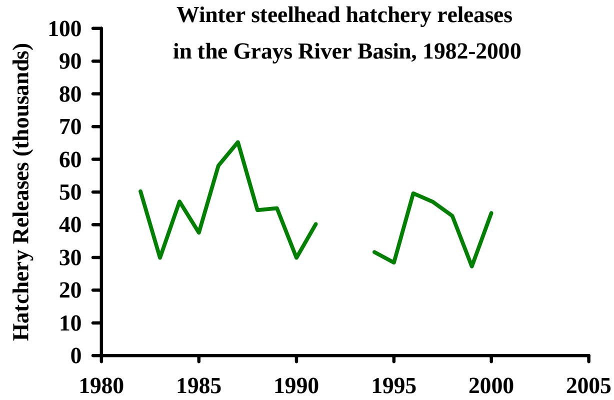
Life History

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

Diversity

- Stock designated based on distinct spawning distribution
- Concern with wild stock interbreeding with hatchery brood stock from the Elochoman River, Chambers Creek, and the Cowlitz River
- Allele frequency analyses of Grays River winter steelhead in 1994 and 1995 were unable to determine the distinctiveness of this stock compared to other lower Columbia steelhead stocks





Abundance

- Steelhead abundance in the Grays River during the 1920s and 1930s was estimated at 2,000 fish annually
- In 1936, more than 100 steelhead were documented in the Grays River during escapement surveys
- Wild winter steelhead run size in the early 1990s was estimated to be 400-600 fish
- Total escapement counts from 1991-2001 ranged from 158-1,224 (average 658)
- Escapement goal for the Grays River is 1,486 wild adult steelhead; this goal has not been met in recent years)

Productivity & Persistence

- The smolt density model estimated potential winter steelhead smolt production was 45,300

Hatchery

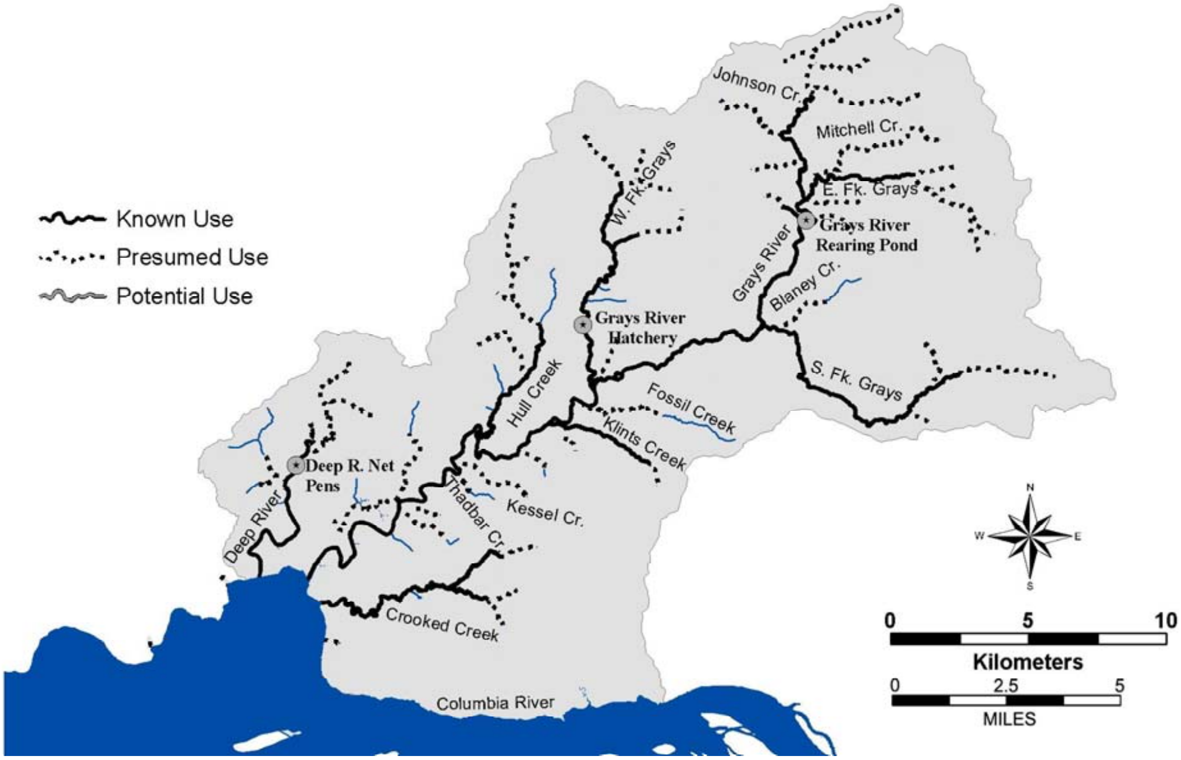
- The Grays River Hatchery, located on the West Fork, does not produce winter steelhead
- Hatchery winter steelhead have been planted in the Grays River basin since 1957; brood stock from the Elochoman and Cowlitz Rivers and Chambers Creek have been used; release data are displayed from 1982-2000
- Hatchery fish contribute little to natural winter steelhead production in the Grays River basin

Harvest

- No directed commercial or tribal fisheries target Grays winter steelhead; incidental mortality currently occurs during the lower Columbia River spring chinook tangle net fisheries
- Treaty Indian harvest does not occur in the Grays River basin
- Winter steelhead sport harvest in the Grays River from 1980-1990 ranged from 354-1,031 (average 533); since 1986, regulations limit harvest to hatchery fish only
- ESA limits fishery impact of wild winter steelhead in the mainstem Columbia River and in the Grays River

4.2.5 Cutthroat Trout—Grays River Subbasin

ESA: Not Listed	SASSI: Depressed 2000



Distribution

- Anadromous, fluvial, and resident forms distribute themselves throughout the basin
- Anadromous forms have access to the entire subbasin but are not believed to use steep gradient upper tributary reaches
- Resident forms are documented throughout the system

Life History

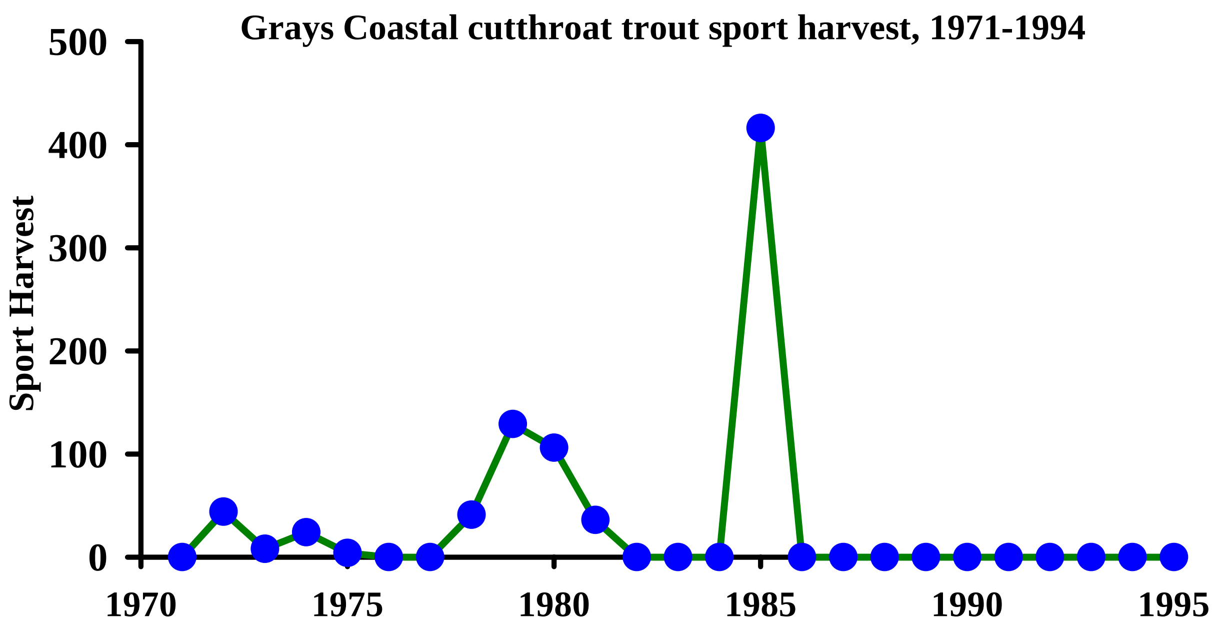
- Anadromous, fluvial, and resident forms are present
- Anadromous adults enter the Grays River from late July through mid-April
- Anadromous spawning occurs from January through mid-April
- Fluvial and resident spawn timing is not documented but is believed to be similar to anadromous timing

Diversity

- No genetic sampling or analysis has been conducted
- Genetic relationship to other stocks and stock complexes is unknown

Abundance

- No total abundance or anadromous run size data are available
- Some incomplete historical sport catch data are available



Hatchery

- Grays River Hatchery (RM 2 of the West Fork) does not produce or release coastal cutthroat

Harvest

- Not harvested in ocean commercial or recreational fisheries
- Angler harvest for adipose fin clipped hatchery fish occurs in mainstem Columbia summer fisheries downstream of the Grays River
- Wild Grays River cutthroat (unmarked fish) must be released in mainstem Columbia and Grays River sport fisheries

4.3 Potentially Manageable Impacts

In Volume I of this Technical Foundation, we evaluated factors currently limiting Washington lower Columbia River salmon and steelhead populations based on a simple index of potentially manageable impacts. The index incorporated human-caused increases in fish mortality, changes in habitat capacity, and other natural factors of interest (e.g. predation) that might be managed to affect salmon productivity and numbers. The index was intended to inventory key factors and place them in perspective relative to each other, thereby providing general guidance for technical and policy level recovery decisions. In popular parlance, the factors for salmon declines have come to be known as the 4-H's: hydropower, habitat, harvest, and hatcheries. The index of potentially manageable mortality factors has been presented here to prioritize impacts within each subbasin.

- Loss of tributary habitat quality and quantity accounts for the largest relative impact on all species. Loss of estuary habitat quality and quantity 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 substantial for coho, moderate for fall chinook, and relatively low for chum salmon and winter steelhead.
- Predation impacts are moderate for all species.
- Hydrosystem access and passage impacts appear to be relatively minor for all species.

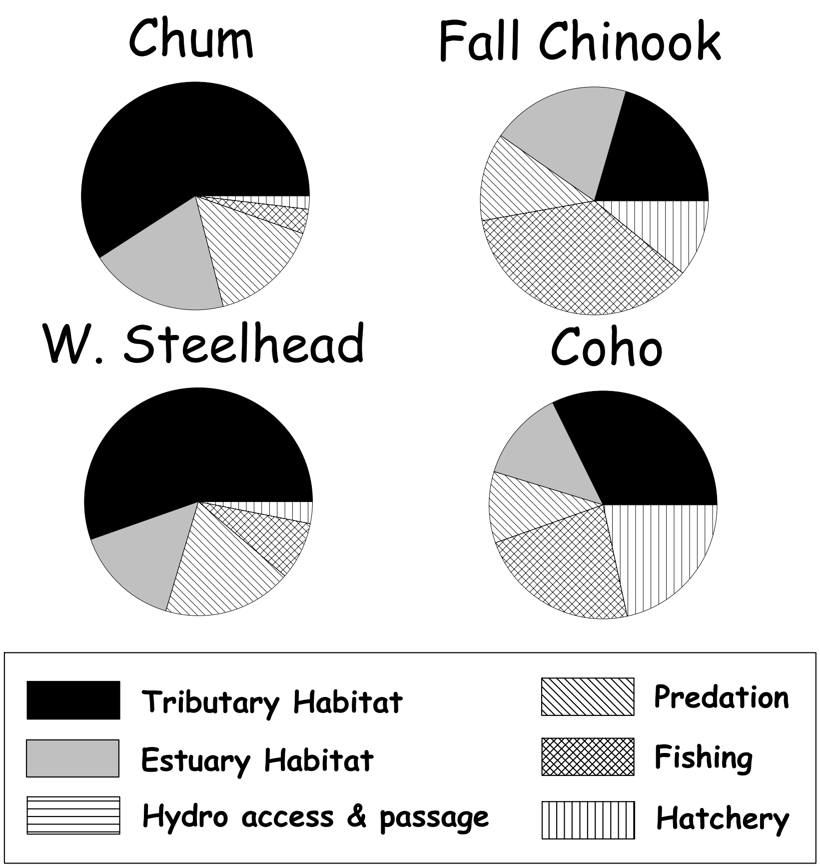


Figure 4-5. Relative index of potentially manageable mortality factors for each species in the Grays subbasin.

4.4 Hatchery Programs

The Grays River Hatchery is located about RM 2 on the West Fork Grays River and primarily has produced fall chinook and early run coho (type-S), and in recent years, chum salmon. The Grays River Hatchery was completed in 1961, although releases of hatchery fall chinook occurred in the basin as early as 1947. The fall chinook hatchery program was discontinued in 1998 because of federal funding cuts. The chum salmon program began collecting adults for broodstock in fall of 1998. While the current annual chum salmon production goal for the Grays River Hatchery is 300,000 chum fry, chum releases to the Grays River in 2002 totaled 555,000 fry (Figure 4-6). An additional 150,000 chum fry produced at the Grays River Hatchery are scheduled for annual release in the Chinook River. Winter steelhead produced at the Elochoman Hatchery have been planted in the Grays River since at least the early 1980s; annual release goal is 40,000 winter steelhead (Figure 4-6).

Genetics—Broodstock for the new chum salmon hatchery program in the Grays River has been from native Grays River chum stock trapped in Gorley Creek, leading to expectations of minimal genetic effects on wild fish from these releases. Winter steelhead releases in the basin have been from Elochoman and Cowlitz rivers, and include Chambers Creek broodstock. Early coho broodstock is trapped at the Grays River Hatchery. Historical releases have included substantial out-of-basin transfers, although all transfers came from within the lower Columbia basin. The largest donor was Toutle Hatchery early coho. In past years, the discontinued fall chinook program also collected broodstock at the Grays River Hatchery. The program included substantial transfers from Lower Columbia ESU basins to fill shortfalls. The primary donors to the Grays River fall chinook program were Spring Creek Hatchery and Kalama Hatchery. The Grays River will be an interesting test case of a lower Columbia stream which will be without first generation local hatchery fall chinook influence on the spawning grounds beginning in 2003.

Interactions—Specific wild/hatchery fish interactions in the Grays River have not been documented. For chum salmon, wild and hatchery adult fish may interact upon return although the hatchery program is intended to augment runs of wild chum. The amount of hatchery fish spawning in the wild is being monitored by otolith marking of hatchery releases. Recent natural chum returns to the Grays are substantially larger then hatchery returns (Figure 4-7). Competition between juvenile wild and hatchery chum may occur as well, although the Grays River is unlikely to be rearing-limited at current production levels. Wild and hatchery chum fry may be susceptible to predation by hatchery coho smolts, as well as numerous other predators. The following hatchery practices are employed to minimize chum fry losses during outmigration: 1) hatchery chum are released during darkness on a falling tide to reduce their visibility and expedite emigration, 2) fish are released in areas away from known concentrations of predatory warm water fishes, and 3) hatchery fish are released during a similar time frame of natural salmonid emigration.

For fall chinook, a significant portion of past years' spawners in the Grays River were first-generation hatchery fish. Few wild fish were present, so hatchery/wild adult fish interactions likely were limited. With past years' annual releases of fall chinook usually between 1 and 6 million, there was significant potential for competition between hatchery-released and naturally produced juvenile fall chinook. However, few natural fall chinook were produced annually and most hatchery releases are smolts that migrate shortly after release, which minimizes potential freshwater competition. In most years, hatchery-released juvenile fall chinook considerably outnumbered naturally produced juveniles. Further, because the Grays

River Hatchery fall chinook program stopped releasing smolts in 1998, adult hatchery returns are expected to cease beginning in 2002.

Spawning of wild coho is presumed to be low so there is little interaction between wild and hatchery fish (Figure 4-7). Also, indigenous wild coho in the Grays River are believed to be late run coho while the hatchery broodstock has been from early run coho; adult coho interaction therefore is minimized through temporal segregation. Hatchery winter steelhead contribute very little to natural production and interaction between hatchery and wild winter steelhead is expected to be minimal (Figure 4-7).

Water Quality/Disease—Water for the Grays River Hatchery is obtained from two sources; Grays River and nearby wells. Grays River water is utilized for holding adults before broodstock collection and for the final stages of rearing before release. Well water is used during incubation and most of the rearing phase; water is supplied to the rearing raceways at a rate of 946 to 1,325 liters/min. Beginning 3 weeks before release, Grays River water is gradually added to the raceway water supply so that fish are exposed to 100% Grays River water for at least 10 days before they are released.

Fish health is continuously monitored in accordance with the Co-Manager Fish Health Policy standards. No disease outbreaks occurred during the incubation-to-ponding period of the 1998 brood; mortality levels were lower than the program standards.

Mixed Harvest—There are no directed chum salmon fisheries on lower Columbia River chum stocks. Minor incidental harvest occurs in fisheries targeting fall chinook and coho. Retention of wild chum salmon is prohibited in lower Columbia River and tributary sport fisheries. There probably is little difference in fishery exploitation rates of lower Columbia River wild and Grays River Hatchery chum salmon.

The purpose of the coho and winter steelhead hatchery programs in the Grays River basin is to mitigate the loss of natural salmonid production as a result of hydroelectric and other development in the Columbia River basin and to provide harvest opportunity. Historically, fishery exploitation rates of Grays River Hatchery fall chinook, coho, and winter steelhead were likely similar to wild fish. However, in recent years, regulations for wild fish release have been in place for coho and steelhead fisheries. All hatchery coho and steelhead are adipose fin-clipped to provide for selective fisheries. Therefore, recent commercial and recreational exploitation rates are higher for Grays River Hatchery coho and winter steelhead than for wild fish.

Passage—The Grays River Hatchery adult collection facility consists of a ladder system; coho salmon collected for broodstock enter the ladder volitionally. Chum salmon for the hatchery program either volunteer into the hatchery adjacent to a temporary weir or are seined from the mainstem and West Fork Grays River from early November to December and transferred to the Grays River Hatchery.

Supplementation—Since 1998, the Grays River Hatchery program goal has been to produce Grays River stock chum to augment and reduce extinction risks to naturally spawning Grays River chum; the hatchery program occurs in conjunction with habitat restoration efforts in the Grays River basin. Recent releases of chum salmon are the largest on record and returning hatchery fish exceeding broodstock needs are allowed to spawn naturally.

The fall chinook hatchery program has been discontinued and the coho program has been reduced to the release of 150,000 smolts annually; this program is not intended for supplementation. Winter steelhead hatchery releases have been from out-of-basin sources and contribute very little to natural spawning; the winter steelhead hatchery program goal provides tributary recreational fishing opportunity rather than supplementation.

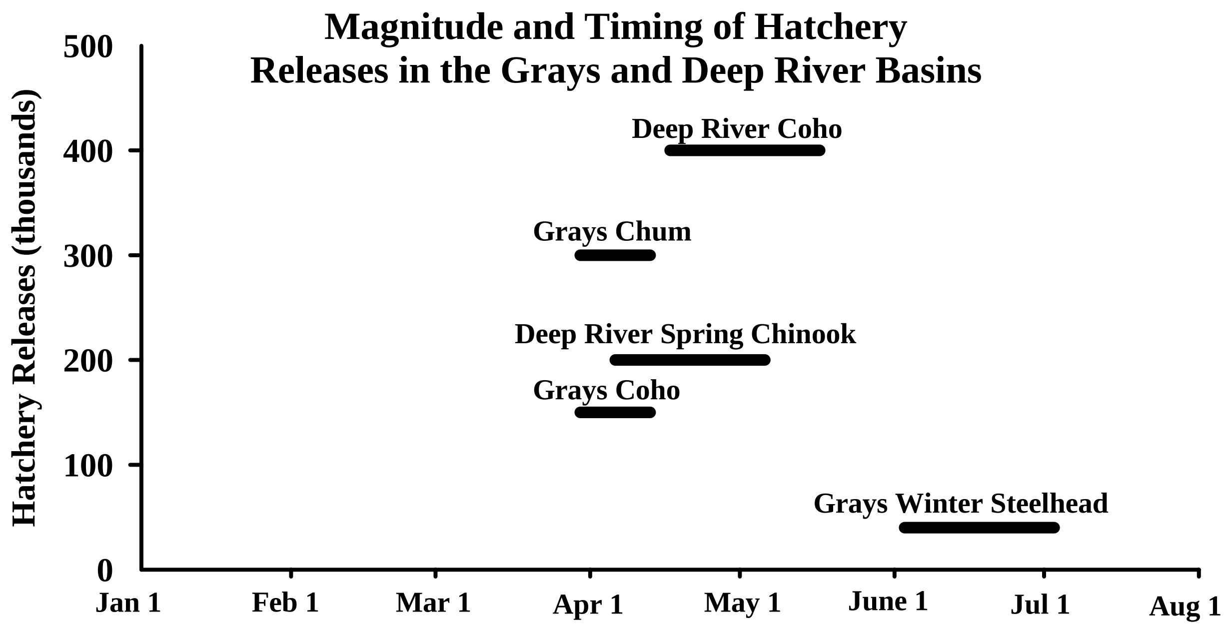


Figure 4-6. Magnitude and timing of hatchery releases in the Deep River and Grays River basins by species, based on 2003 brood production goals.

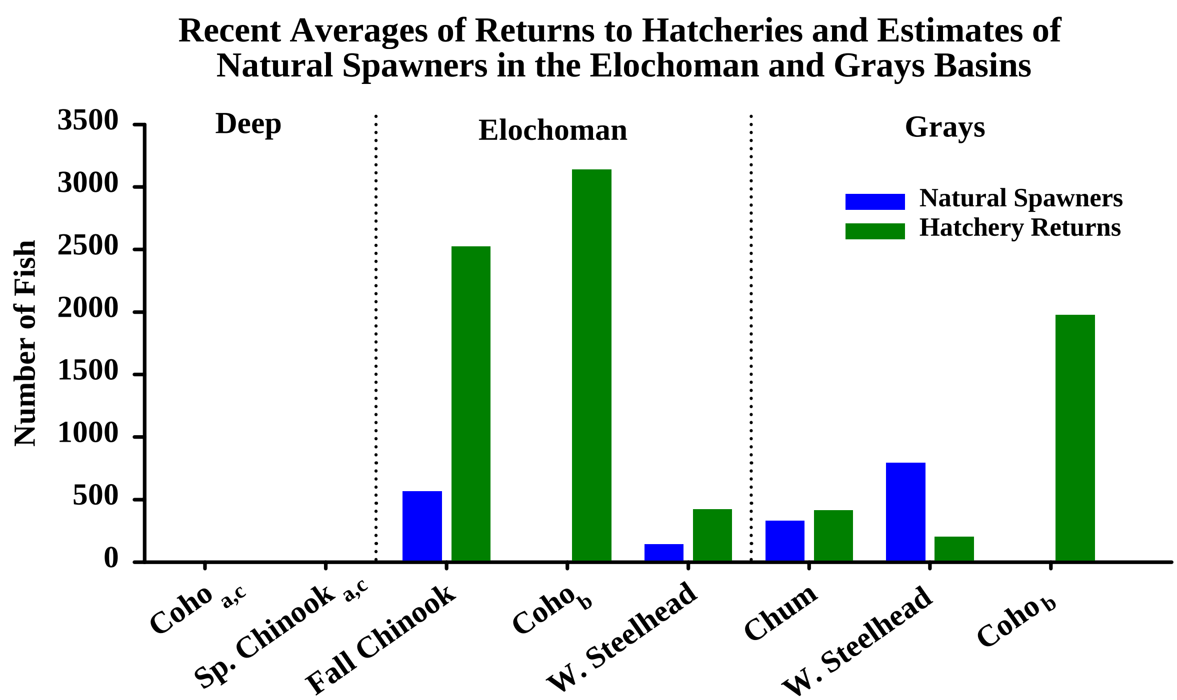


Figure 4-7. Recent average hatchery returns and estimates of natural spawning escapement in the Deep, Grays, and Elochoman River basins by species. The years used to calculate averages varied by species, based on available data. The data used to calculate average hatchery returns and natural escapement for a particular species and basin were derived from the same years in all cases. All data were from 1992 to the present. Calculation of each average utilized a minimum of 5 years of data, except for Grays chum (1998–2000) and Grays winter steelhead (1998 and 2000).

4.5 Fish Habitat Conditions

4.5.1 Passage Obstructions

Low flow passage problems are a concern at the mouth of the Grays and on lower Seal River. Flow alterations on the middle mainstem that are related to the breaching of a dike at Gorley Springs in 1999 may create passage problems at certain times of the year. Sediment accumulations on lower Shannon Creek (West Fork tributary) create subsurface flow during the summer. A natural falls at approximately RM 13 was blasted in 1957 to improve fish passage. The numerous tide gates on tributaries and sloughs that connect to Grays Bay present potential passage problems. Various other culvert, low flow, and tidegate concerns are discussed in detail in Wade (2002).

4.5.2 Stream Flow

From west to east, the major stream systems in the subbasin are the Sisson Creek, Deep River, Grays River, and Crooked Creek basins. Major tributaries to the Grays River include Hull Creek, the West Fork Grays, the South Fork Grays, and Mitchell Creek. Peak flows are associated with fall and winter rains and low flows typically occur in late summer. The USGS collected streamflow data at several sites in the subbasin for various periods, though no data exists since 1979.

Results of the Integrated Watershed Assessment (IWA), which are presented in greater detail later in the chapter, indicate that nearly all of the Grays Subbasin is 'impaired' with regards to an increased risk of elevated peak flows. Only subwatersheds within the South Fork Grays River basin are rated as 'moderately impaired' and there are no 'functional' subwatersheds. These results are corroborated by an analysis conducted by Lewis County GIS (2000), which identified 'impaired' peak flow conditions throughout most of the subbasin, with 'likely impaired' peak flow conditions in the South Fork Grays River. The lack of mature vegetation, combined with high road densities (many subwatesheds have greater than 5 miles of road per square mile), contribute to hydrologic impairment.

Low flow volumes are also a concern in the subbasin. As part of an instream flow analysis, Toe-Width flows were estimated for the Grays River in 1998. The results showed that fall flows for salmon spawning and spring flows for steelhead spawning were sufficient; but that summer rearing flows were inadequate (Caldwell et al. 1999). A similar study on Crooked Creek indicated that flows were below optimum for rearing in mid-September and were below optimum for spawning into the first part of November (Caldwell et al. 1999).

Current and future effects of flow withdrawals on stream flow were estimated as part of watershed planning efforts by the LCFRB. Combined surface water and groundwater demand in the Grays subbasin, which totaled 1,264 acre-feet per year in 2000, is expected to increase 9.8% by 2020. Based on the population projections and the estimated total groundwater use in the subbasin, groundwater withdrawal does not appear to be significant compared to groundwater baseflow within the subbasin (LCFRB 2001).

4.5.3 Water Quality

High water temperatures are a concern throughout the subbasin. The West Fork Grays was listed on the state's 303(d) list of impaired water bodies due to elevated temperatures (WDOE 1998). Summer temperature monitoring conducted by the WCD on the mainstem and the West Fork Grays indicates that stream temperatures commonly exceed 16ºC. Stream temperature in the upper Grays River near the South Fork confluence regularly exceeded 16ºC in the summer of 2000. This may be due to its width and north-south orientation. High temperatures (>17ºC) have also been recorded in Hull Creek in the lower basin and in Crooked Creek (Wade 2002).

Problems other than water temperature also exist in the subbasin. Fecal coliform standards were exceeded on the Grays River in 1998. Malone Creek may have fecal coliform problems associated with failing residential septic systems. This stream also appears turbid at high flows. Turbidity is an observed problem in tributaries to Klints and King Creeks. Various sources of increased turbidity have been identified in the West Fork and the South Fork basins. High summer turbidity levels have been observed in the Grays Bay tributary of Hendrickson Creek, likely associated with mass wasting in the upper watershed. Nutrient levels are likely lower than they were historically due to lower salmonid escapement levels compared to historical conditions (Wade 2002).

4.5.4 Key Habitat

Side channel habitat has been removed from most of the lower Grays River mainstem and lower mainstem tributaries as a result of diking. Side channel habitats in the upper Grays River basin are limited by naturally confined valleys and steep stream gradients, with generally adequate side channel habitats where they exist. The Deep River and Crooked Creek have few side channels, partly due to channelizaton associated with agriculture. On most other Grays Bay tributaries, tidegates limit access to side channel habitat in the lower reaches. Information on side channels is lacking for much of the subbasin (Wade 2002).

WCD surveys rated nearly the entire subbasin as having inadequate pool habitat. In each of the major Grays River basins, over 77% of surveyed reaches contained less than 40% pools, and 100% of the reaches in the West Fork and South Fork basins were identified as having a lack of pools. The percentage of the channel in pool habitat generally increases as gradient increases. Inadequate pool habitat is concentrated in the mainstem and in the lower reaches of tributaries, where agricultural practices and channel straightening have reduced pool quality and quantity. Good pool habitat generally corresponds with the presence of logjams (Wade 2002). In Grays Bay tributary streams, most streams had over 50% of reaches with less than 40% of the stream surface area in pools (Wade 2002).

4.5.5 Substrate & Sediment

Fine sediments naturally exist in the tidally influenced lower reaches of most streams. Reaches above tidal influence have a higher percentage of gravels but they are generally of soft rock and are highly embedded with fine sediment. This is in part due to the presence of sedimentary rock that breaks down quickly once delivered to stream channels. WCD surveys using visual estimates of fine sediment revealed that within the Grays River basin over 76% of surveyed reaches had greater than 17% fines.

High road densities and road crossings over streams can increase the potential for sediment production and delivery to streams. The Grays River basin contains a very high 7.32 miles of road / square mile, over twice as much as is considered high by NMFS standards. The number of stream crossings is also high, with 34.1 stream crossings per mile in the Mitchell Creek basin (upper watershed), the second highest value in the lower Columbia region. The results of the IWA, which are presented in greater detail later in the chapter, indicate that high road densities and naturally unstable soils have contributed to 'moderately impaired' sediment supply conditions throughout the subbasin, with a few areas experiencing 'impaired' conditions (lower Grays subwatershed and West Fork Grays subwatersheds). A preponderance of mass failures also provides a source for increased fine and coarse sediment production. A study by the WCD identified greater than 4 mass failures/mi^2 in several areas, including the West Fork Grays River basin, the lower Grays River basin, the Deep River Basin, and the Crooked Creek basin (Wade 2002).

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

4.5.6 Woody Debris

WCD stream surveys found that LWD was virtually non-existant in the lower mainstem Grays River. Throughout the entire lower basin 75% of surveyed reaches had inadequate LWD. LWD abundance is also low in the middle Grays, with over 74% of surveyed reaches below accepted standards. Only middle Klints Creek has decent wood quantities. All surveyed reaches in the West Fork basin were rated "poor" for LWD. Most of the LWD that is present is located in large logjams. Logging debris and debris flows have contributed to these jams. LWD quantities are low throughout the South Fork basin. All surveyed reaches rated "poor" for LWD. Wood in the South Fork is transported out of the system due to high gradient channels or it is deposited on the floodplains during high flows. Sixty-one percent of reaches in the upper Grays basin had "poor" LWD numbers. Most of the LWD that was present was in large logjams or deposited on the flooplain (Wade 2002).

In other Grays Bay tributaries, WCD stream surveys identified 89.7% of surveyed channels as lacking adequate LWD. Where LWD existed it was often deciduous and/or of small diameter (Wade 2002).

4.5.7 Channel Stability

The WCD recorded areas of bank instability in the subbasin during 1994 stream surveys. Areas of concern were identified on the lower Grays (along some of the dikes), upper Impie Creek, lower Thadbar Creek, lower Hull Creek, lower Silver Creek, and Honey Creek. Many of these sites have cattle access to the stream. Bank stability is low along the middle mainstem in the Gorley Springs area, where a dike breach in 1999 created a highly unstable channel. Portions of King and Fossil Creeks, primarily in the lower reaches, have bank stability concerns. Debris flows occur frequently in the West Fork and South Fork systems. Many of these events are related to shallow landslides on steep, geologically unstable slopes in confined river valleys. Areas of instability in the South Fork basin may be contributing to elevated turbidity levels. Only a handful of areas in the upper Grays have been noted for bank stability concerns. Railroad grades along the East Fork have experienced numerous slope failures that have caused debris flows (Wade 2002).

Grays Bay tributaries also have some bank stability concerns. According to WCD Surveys, reaches of Ragilla, Anderson, and Person Creeks had extensive streambank erosion. Lower Hendrickson Creek, lower Crooked Creek, and the North Fork Deep River had localized areas of unstable banks. A WCD assessment identified mass failure frequencies of 4.67 and 6.25 failures / mi^2 in the Deep River and Crooked Creek, respectively (Wade 2002).

4.5.8 Riparian Function

According to IWA watershed process modeling, which is presented in greater detail later in this chapter, 3 of 17 subwatersheds in the Grays subbasin are rated as 'impaired' for riparian function, 12 are rated as 'moderately impaired', and 2 are rated as 'functional'. The greatest impairments are in the lower basin and the least amount of impairment is located in the northeast portion of the basin. These results are consistent with the generally impaired condition of riparian forests identified in surveys conducted by the WCD.

WCD's riparian surveys in 1994 measured tree size, composition, and buffer width. Areas with small trees, an abundance of hardwoods, and narrow buffer widths were rated as having poor conditions. Based on the WCD's criteria, riparian forests were in poor shape throughout the basin. Eighty-eight percent of reaches in the West Fork, 90% in the Lower basin, and 98% in the middle basin were rated as having "poor" riparian conditions. Most riparian forests along low gradient reaches lack coniferous cover or adequate buffer widths, whereas steeper reaches in the upper watershed suffer primarily from immature forests. Agricultural practices and cattle access were noted by the WCD as sources of riparian problems in the lower basin and timber harvest was cited as the primary cause of problems in the upper basin. The West Fork basin in particular is almost entirely (99%) composed of private and state forestland, with 77% of the area having forest stands less than 50 years old.

Poor conditions were identified for most reaches of the Deep River and the lower portions of the Crooked River. All of the surveyed streams had at least 33% of riparian areas in the "poor" category, except for the North Fork Deep River. Poor conditions were attributed primarily to agricultural practices and livestock access (Wade 2002).

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

4.5.9 Floodplain Function

The lower Grays River mainstem and most lower mainstem tributary streams have been diked, armored, drained, and/or relocated, primarily for agricultural purposes (WCD surveys). A project is underway by Columbia Land Trust to preserve over 500 acres of degraded floodplain habitat and restore tidal function to 200 acres of the Grays River estuary.

Portions of the middle Grays have been diked for agricultural purposes and armored to protect streambanks from erosion. Streambed aggradation in Klints Creek is associated with bedload supplied during winter 1996 flooding, which may have actually improved floodplain connectivity. Significant aggradation occurred in lower Fossil Creek in 1996 as well, reducing sediment transport out of this tributary. Efforts to reconnect Fossil Creek to the Grays River have caused erosion of the aggraded sediment, and flooding problems still exist (Wade 2002).

The lower reaches of Deep Creek (up to RM 3.9) have been diked and the lower 2 miles of Crooked Creek is channelized and entrenched, reducing access to off-channel habitats. The effect of tidegates on floodplain connectivity on Grays Bay tributaries has not been assessed (Wade 2002).

4.6 Fish/Habitat Assessments

The previous descriptions of fish habitat conditions can help identify general problems but do not provide sufficient detail to determine the magnitude of change needed to affect recovery or to prioritize specific habitat restoration activities. A systematic link between habitat conditions and salmonid population performance is needed to identify the net effect of habitat changes, specific stream sections where problems occur, and specific habitat conditions that account for the problems in each stream reach. In order to help identify the links between fish and habitat conditions, the Ecosystem Diagnosis and Treatment (EDT) model was applied to Grays River steelhead, chum, fall chinook and coho. A thorough description of the EDT model, and its application to lower Columbia salmonid populations, can be found in Volume VI.

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

4.6.1 Population Analysis

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

Habitat-based assessments were completed in the Grays River subbasin for winter steelhead, fall chinook, coho, and chum (Table 4-1). Chum in the Grays River make up one of the few remaining chum populations in the Columbia River. The other intact population is Hardy, Hamilton, and Duncan Creeks—lower Columbia Gorge tributaries. Despite the relatively healthy population of chum in the Grays, this population has witnessed the greatest decline in numbers compared to other Grays River populations (Figure 4-8). Model results indicate that chum abundance has decreased by more than 84% from historical levels (Table 4-1). Similarly, winter steelhead abundance shows a near 70% decrease from historical levels, while fall chinook shows just under a 40% decrease (Table 4-1). Change in diversity (as measured by the diversity index) is the smallest for fall chinook and the greatest for winter steelhead and coho (Table 4-1). Coho and winter steelhead diversity has been negatively impacted by reduced and/or degraded tributary spawning habitat.

Modeled historical-to-current changes in smolt productivity and abundance reveal different trends when compared to the adult figures. For fall chinook, coho and winter steelhead, current smolt productivity is only 20- 25% of historical productivity levels (Table 4-1). However, in the case of chum, smolt productivity is still approximately 60% of historical levels (Table 4-1). This seems counter-intuitive due to the fact that chum adult abundance has declined the most out of the four species. However, this relatively higher productivity is merely an artifact of the way the EDT model calculates productivity. That is, the higher productivity of chum smolts is because Grays chum now have many less trajectories (life history pathways) that are viable (those that result in return spawners), but the few trajectories that remain have higher productivities than historical trajectories (many of which were only marginally viable). Modeled adult chum productivity does not follow this same trend due to recent poor estuary and ocean survival.

Current smolt abundance is substantially less than the historical level for all species (Table 4-1), reflecting the significant loss of trajectories (which is also reflected in the life history diversity index). Historical-to-current change in fall chinook, coho and chum smolt abundance shows a 72%, 64%, and a 72% decrease, respectively, from historical levels. Winter steelhead smolt abundance appears to have declined less dramatically, with a modeled 46% decrease from past levels.

Model results indicate that restoration of properly functioning habitat conditions (PFC) would substantially increase adult abundance for all species (Table 4-1). Chum and coho would benefit most from restoration of PFC, with chum showing a 255% increase from current adult abundance, and coho a 205% increase. Chinook and winter steelhead would experience a 45% and a 57% increase, respectively. Restoration of PFC would also increase smolt abundance and productivity for all species (Table 4-1). Chum and winter steelhead would benefit from an approximate 120% and 55% increase, respectively, in smolt abundance due to restoration of PFC, while both fall chinook and coho would see a greater than 200% increase.

Table 4-1. Population productivity, abundance, and diversity (of both smolts and adults) based on EDT analysis of current (P or patient), historical (T or template), and properly functioning (PFC) habitat conditions.

	Adult Abundance			Adult Productivity			Diversity Index			Smolt Abundance			Smolt Productivity		
Species	**P**	**PFC**	**T[1]**	**P**	**PFC**	**T[1]**	**P**	**PFC**	**T[1]**	**P**	**PFC**	**T[1]**	**P**	**PFC**	**T[1]**
Fall Chinook	550	795	869	3.5	6.7	7.9	0.97	0.98	0.98	22,538	68,778	79,245	70	225	293
Chum	1,569	5,575	10,174	2.5	7.3	10.5	0.96	1.00	1.00	441,069	963,068	1,209,737	530	762	891
Coho	1,239	3,773	4,344	3.9	12.7	16.6	0.76	0.93	0.94	22,538	68,778	79,245	70	225	293
Winter Steelhead	1,201	1,885	3,716	4.4	13.5	35.9	0.72	0.78	0.94	16,436	25,530	30,556	60	181	290

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

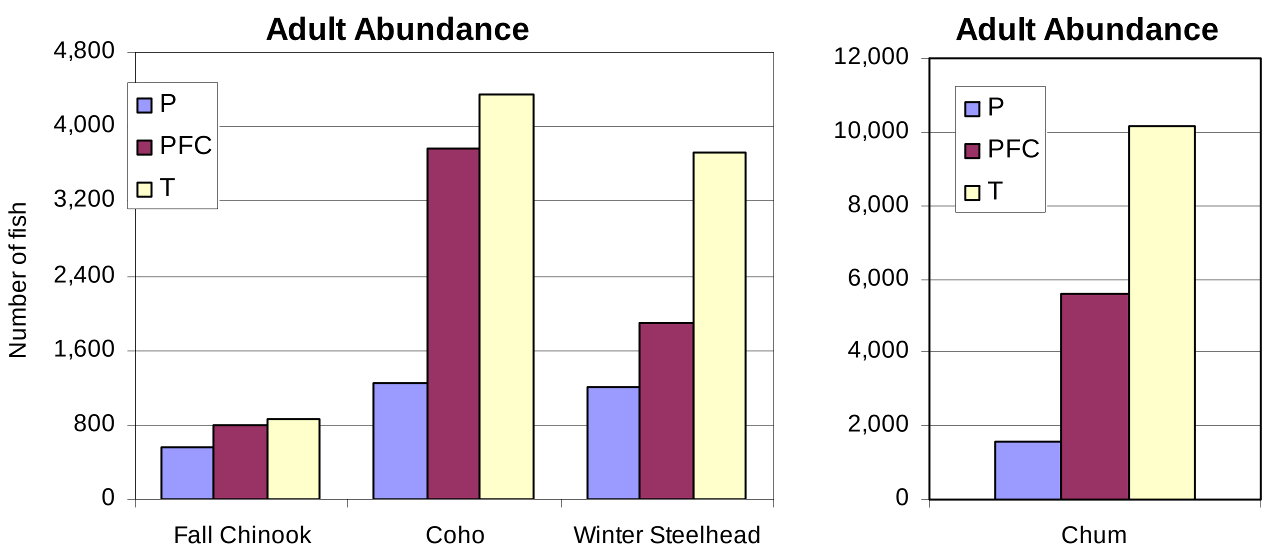


Figure 4-8. Adult abundance of Grays River fall chinook, coho, winter steelhead and chum based on EDT analysis of current (P or patient), historical (T or template), and properly functioning (PFC) habitat conditions.

4.6.2 Restoration and Preservation Analysis

Habitat conditions and suitability for fish are better in some portions of a subbasin than in others. The reach analysis of the EDT model uses estimates of the difference in projected population performance between current/patient and historical/template habitat conditions to identify core and degraded fish production areas. Core production areas, where habitat degradation would have a large negative impact on the population, are assigned a high value for preservation. Likewise, currently degraded areas that provide significant potential for restoration are assigned a high value for restoration. Collectively, these values are used to prioritize the reaches within a given subbasin. For the purpose of this EDT analysis, the Grays subbasin was divided into approximately 60 reaches. Reach locations are displayed in Figure 4-9.

Winter steelhead utilize the greatest proportion of Grays River subbasin habitats. Historically, only winter steelhead were able to ascend a falls located on the mainstem just upstream of its confluence with the West Fork Grays. This falls was lowered in 1957 to facilitate passage, and coho now commonly access the portion of the basin upstream of this former barrier. Chum primarily utilize the mainstem up to the West Fork confluence and the major tributaries Hull Creek and Seal Creek. Most of the spawning occurs in the mainstem in reach Grays 2 to 2C and the small tributary Crazy Johnson Creek, which flows into reach Grays 2C just upstream of the West Fork confluence. There is also dense chum spawning in the Gorley Creek spawning channel. Fall chinook have a similar distribution to chum but are unable to access Hull Creek due to their earlier run timing. Chinook also utilize the lower West Fork Grays.

Some of the high priority reaches for winter steelhead include the EF, WF and SF Grays 1, and the SF and WF Grays 2 (Figure 4-10). High priority reaches also exist in the upper Grays and the headwaters, including WF, EF, and SF Grays 3, and Grays 4A and 4B. These upper areas represent some of the main spawning and rearing sites for winter steelhead. The middle mainstem is important as a rearing area for age 1 juveniles that originate from upstream spawning areas. High priority reaches for chum include Grays 2B, 2C, and 2D, and spawning reaches such as Crazy Johnson Creek (a tributary to Grays 2C) and Grays 2 (Figure 4-11). For fall chinook, the higher priority areas are in the lower river, including Grays 2, 2A and 2C (Figure 4-12). High priority reaches for Grays River coho also seem to be in the lower river. These reaches consist of Grays 2, 2A, 2B, 2C and Grays 1G tidal (Figure 4-13).

Many of the above mentioned reaches currently support significant production and therefore have high preservation value. They also have considerable restoration potential. The important steelhead reaches in the upper basin have been affected by intense forestry activities and currently have low instream LWD and degraded riparian conditions. The lower river (including the tidal reaches) have experienced heavy agricultural use that affects riparian and sediment conditions. Lower river reaches have also experienced a loss of historical off-channel habitats due to hydromodifications.

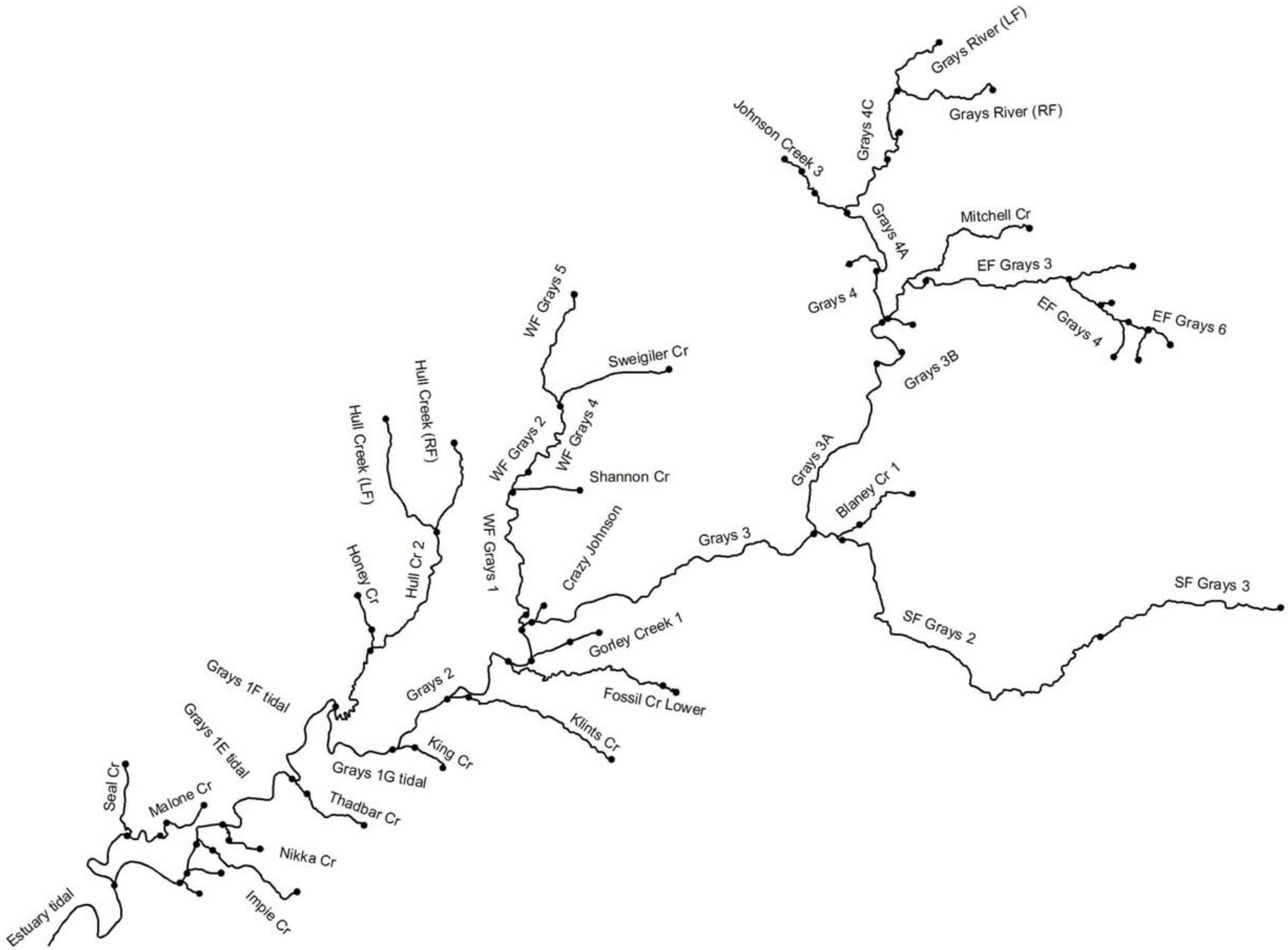


Figure 4-9. Grays subbasin with EDT reaches identified. For readability, not all reaches are labeled.

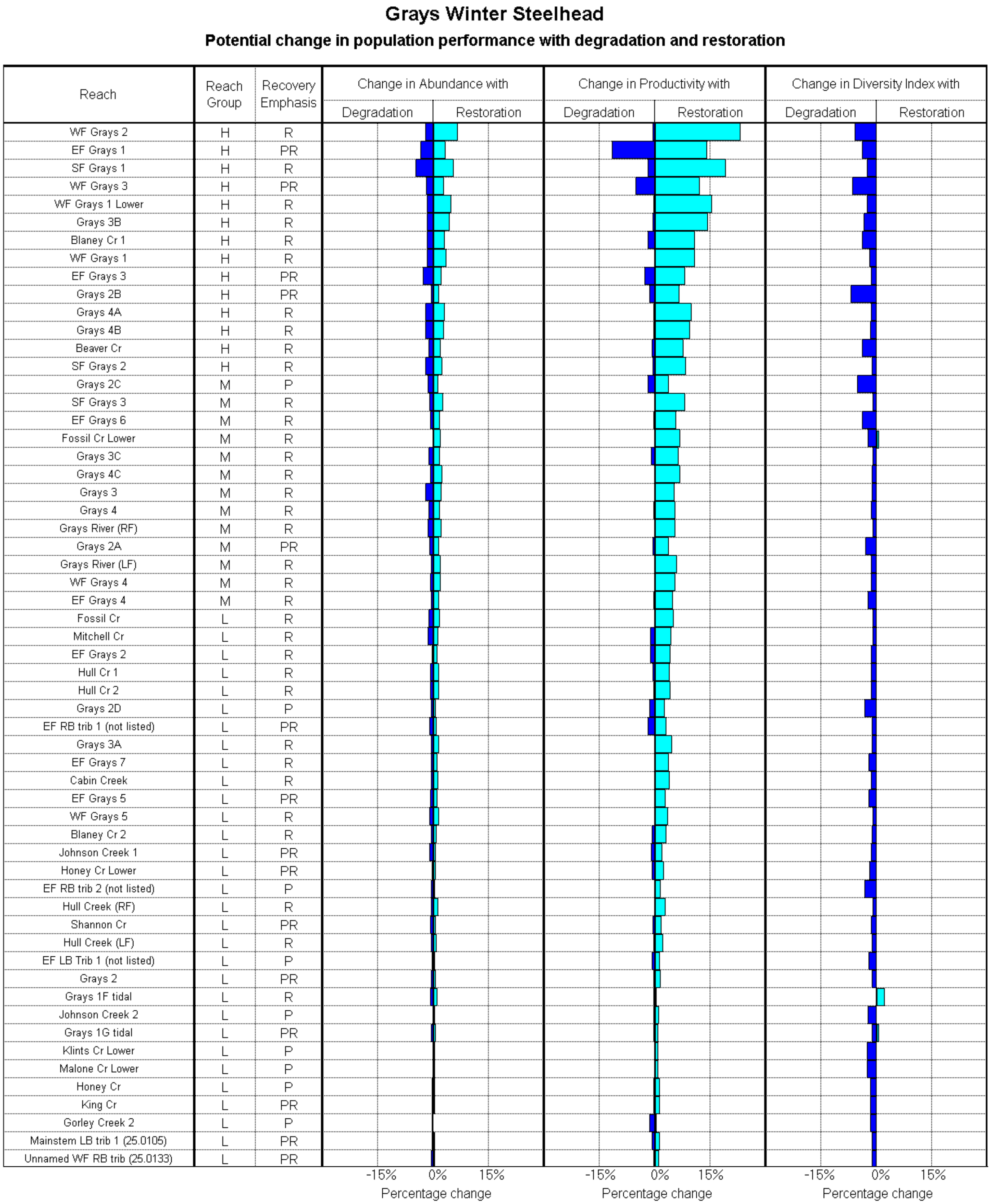


Figure 4-10. Grays River subbasin winter steelhead ladder diagram. The rungs on the ladder represent the reaches and the three ladders contain a preservation value and restoration potential based on abundance, productivity, and diversity. The units in each rung are the percent change from the current population. For each reach, a reach group designation and recovery emphasis designation is given. Percentage change values are expressed as the change per 1000 meters of stream length within the reach. See Volume VI for more information on EDT ladder diagrams. Some low priority reaches are not included for display purposes.

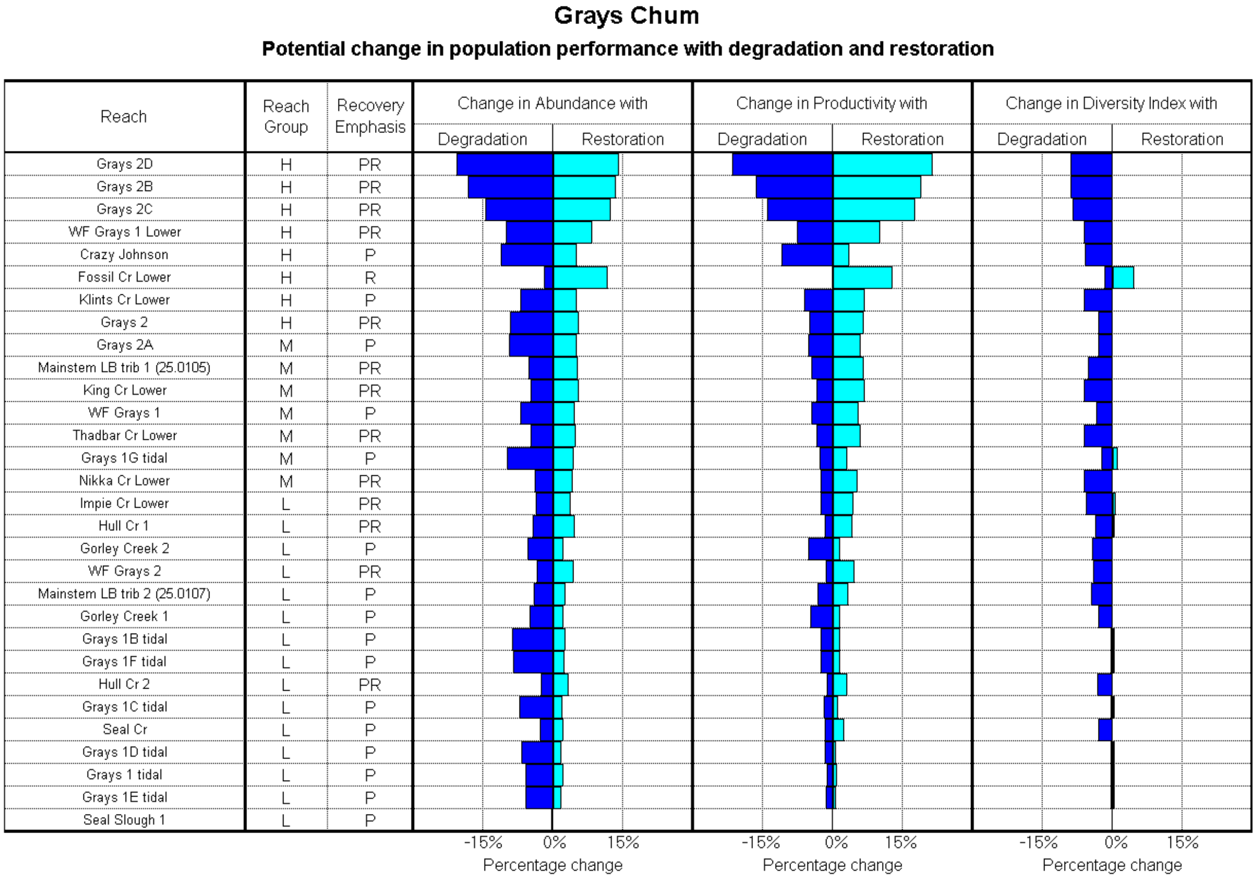


Figure 4-11. Grays River subbasin chum ladder diagram.

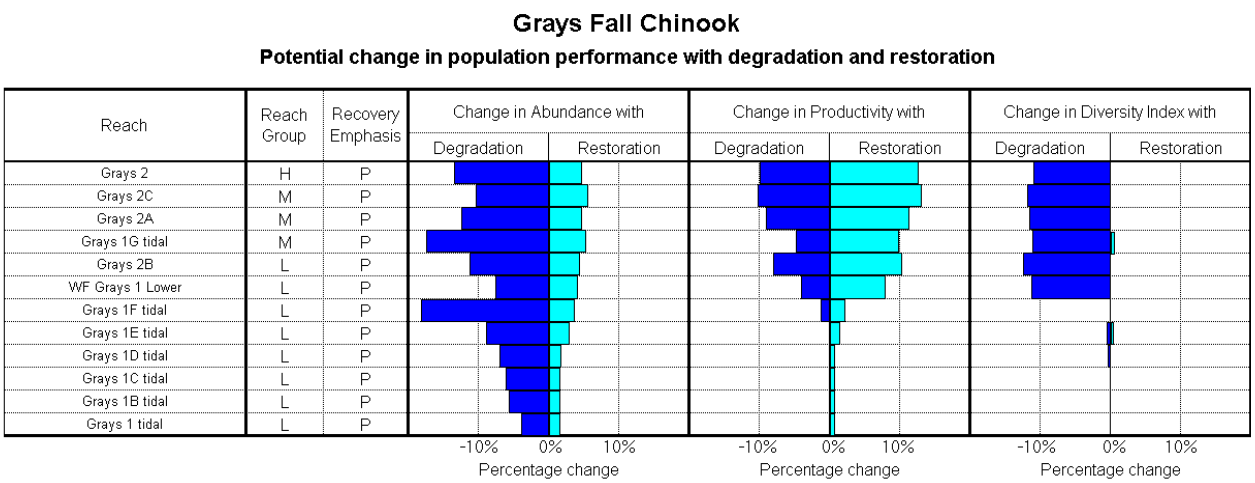


Figure 4-12. Grays River subbasin fall chinook ladder diagram.

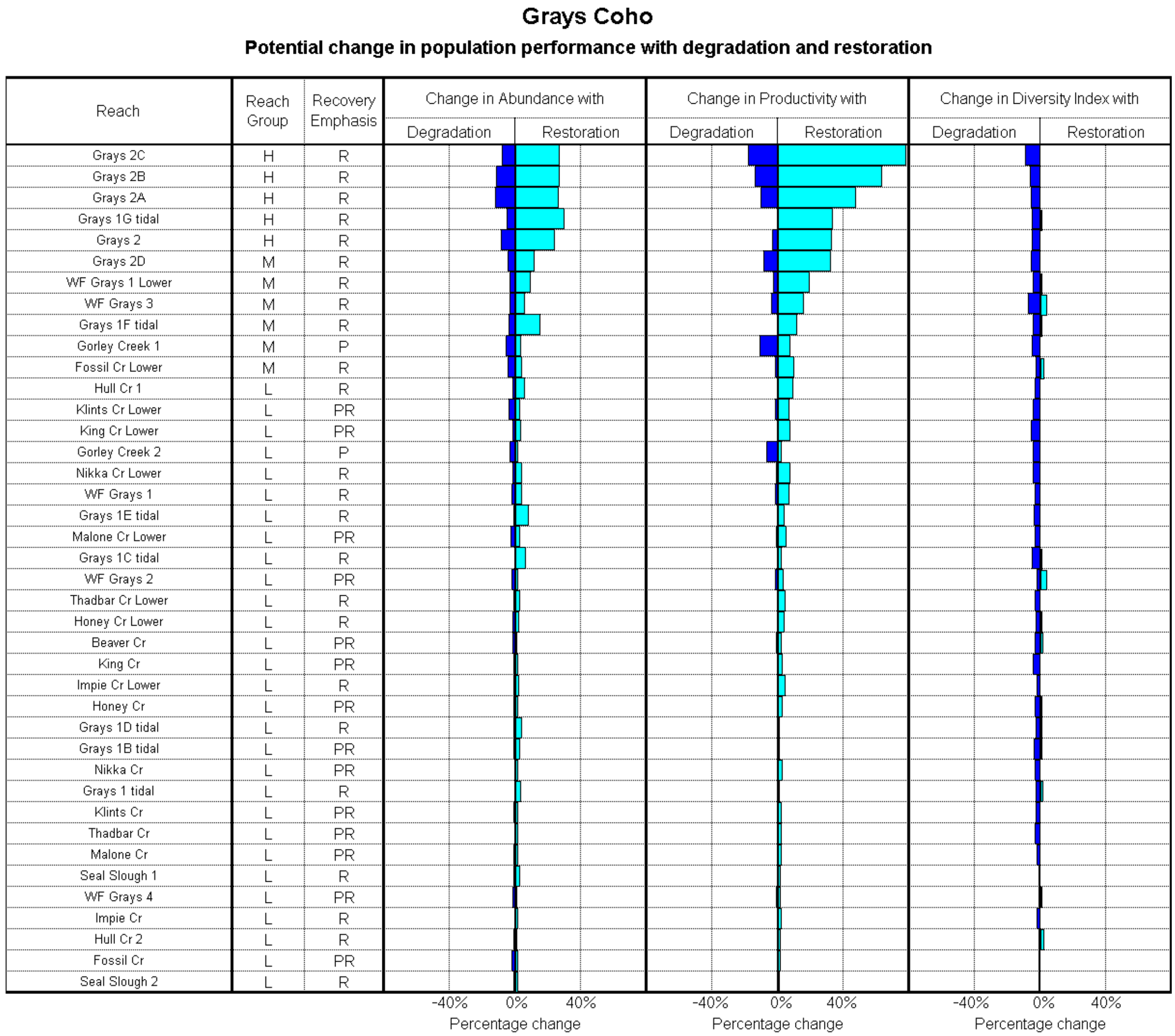


Figure 4-13. Grays River subbasin coho ladder diagram.

4.6.3 Habitat Factor Analysis

The Habitat Factor Analysis of EDT identifies the most important habitat factors affecting fish in each reach. Whereas the EDT reach analysis identifies reaches where changes are likely to significantly affect the fish, the Habitat Factor Analysis identifies specific stream reach conditions that may be modified to produce an effect. Like all EDT analyses, the reach analysis compares current/patient and historical/template habitat conditions. The figures generated by habitat factor analysis display the relative impact of habitat factors in specific reaches. The reaches are ordered according to their combined restoration and preservation rank. The reach with the greatest potential benefit is listed at the top. The dots represent the relative degree to which overall population abundance would be affected if the habitat attributes were restored to historical conditions.

The top priority restoration areas for winter steelhead are in upper sections of the subbasin, which suffer primarily from impacts to flow, sediment, temperature, and habitat diversity (Figure 4-14). Flow and sediment impacts are believed to originate primarily from upper basin timber harvest, roads, and naturally unstable soils. The land ownership in the basin is predominantly private (90%) and most of the upper basin is in timber production. Road densities in upper basin subwatersheds are between 4 and 7 mi/mi^2. This area represents one of the highest concentrations of densely roaded subwatersheds in the entire lower Columbia region. Roads and timber harvest, combined with unstable sedimentary soils, result in a proliferation of mass wasting. Soil survey reports have indicated as many as 4.22 mass failures/mi^2 in the basin (Wade 2002). Channel stability, temperature, and habitat diversity are largely influenced by the poor condition of riparian forests. There is little shade provided by tree canopies and there is low LWD recruitment. The moderate impact from predation is due to a recently discontinued (2000) steelhead and coho rearing facility in Grays 3B. The population is expected to be recovering from these impacts. The South Fork Grays has high sediment impacts from channel and upslope sources. The South Fork basin is steep, with unstable soils, and has experienced intensive timber harvest. High flow impacts in the South Fork basin are related to high road densities and young vegetation. Approximately 17% of the basin is in early seral conditions and 0% is in late seral. Road densities are over 4 mi/mi^2. Temperature and habitat diversity impacts are related primarily to degraded riparian zones and lack of LWD. Key habitat has been impacted by sedimentation and loss of instream LWD that is important for maintaining habitat.

The top chum restoration priority is in the lower river (Grays 2B, 2C and 2D). Sediment and habitat diversity are the major factors (Figure 4-15). Sediment and the moderate flow impact are from upstream sources and contribute to sediment aggradation and bed scour that reduce channel stability. The lower gradient, alluvial nature of these channels makes them prone to excess sedimentation. Habitat diversity is due to artificially confined channels, low quantities of LWD, and denuded riparian conditions. Local agricultural practices have confined channels, reduced riparian vegetation, and reduced floodplain function. Seventy-nine percent of the subwatersheds that encompasses reaches Grays 1 tidal upstream into Grays 2 are either non-forest (pavement, bare soil, structures) or other forest (shrubs, lawns, pasture, cropland). Low to moderate predation and competition impacts stem from Grays River Hatchery releases.

Fall chinook restoration priorities are similar to chum, as many of the same habitats are utilized (Figure 4-16). Sediment and temperature are the major factors. The major land uses affecting chinook are the same as the ones discussed above for chum.

As for coho, restoration priorities again focus in the lower river (Grays 2, 2A, 2B, 2C, 2D, and Grays 1G tidal (Figure 4-17). In these areas channel stability, temperature, sediment, and key habitat quantity are the major factors affecting coho.

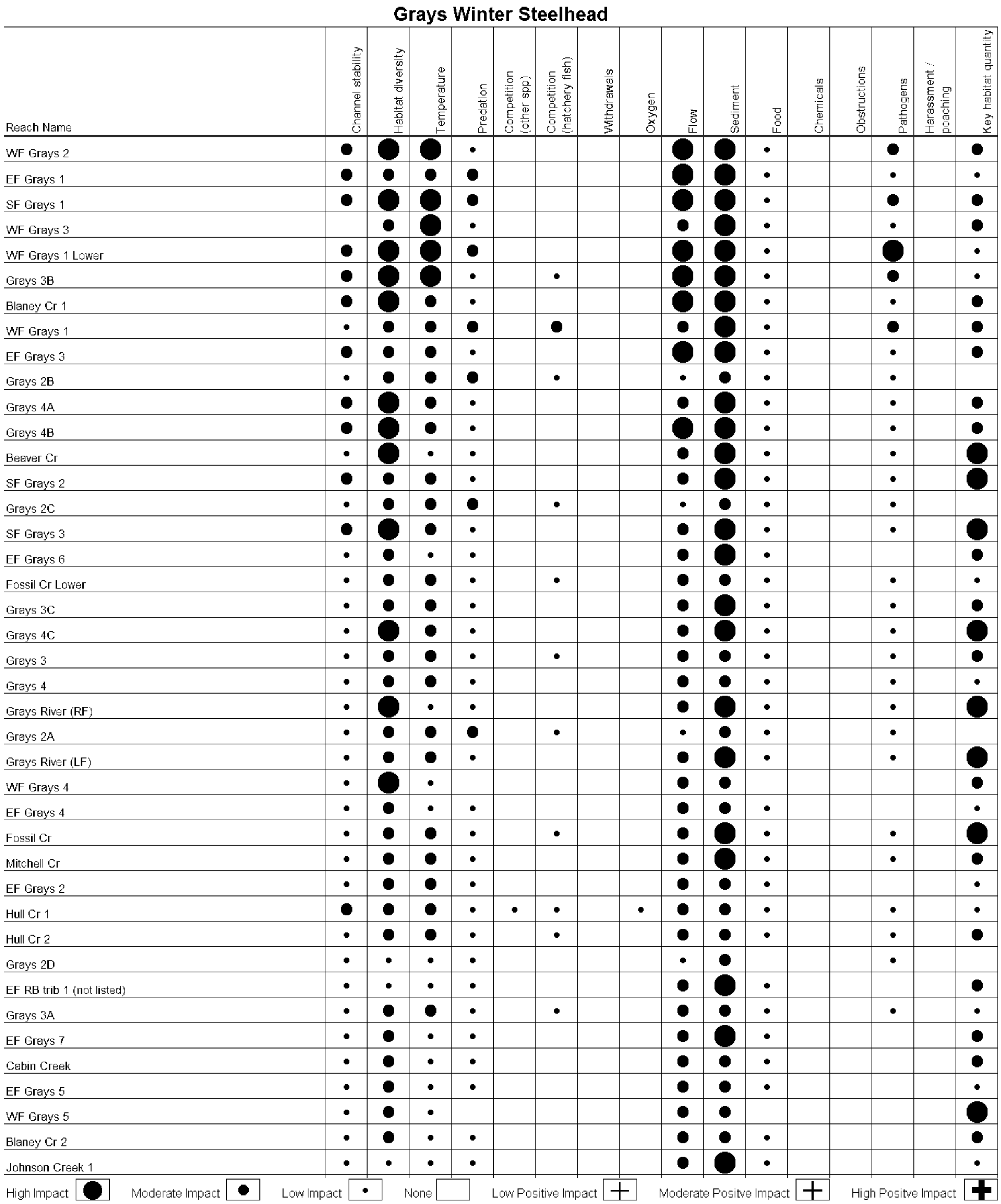


Figure 4-14. Grays River subbasin winter steelhead habitat factor analysis diagram. Diagram displays the relative impact of habitat factors in specific reaches. The reaches are ordered according to their restoration and preservation rank, which factors in their potential benefit to overall population abundance, productivity, and diversity. The reach with the greatest potential benefit is listed at the top. The dots represent the relative degree to which overall population abundance would be affected if the habitat attributes were restored to template conditions. See Volume VI for more information on habitat factor analysis diagrams. Some low priority reaches are not included for display purposes.

Grays Chum

Reach Name	Channel stability	Habitat diversity	Temperature	Predation	Competition (other spp)	Competition (hatchery fish)	Withdrawals	Oxygen	Flow	Sediment	Food	Chemicals	Obstructions	Pathogens	Harassment / poaching	Key habitat quantity
Grays 2D	●	⬤	•	•					●	⬤	●					+
Grays 2B	●	⬤	•	●					●	⬤	●				●	•
Grays 2C	●	⬤	•	●					●	⬤	●				●	•
WF Grays 1 Lower	•	⬤	•						●	●	•				•	⬤
Crazy Johnson																●
Fossil Cr Lower	•	⬤							●	●	•					•
Klints Cr Lower	•	●	•						●	⬤	●					•
Grays 2	●	●	•	•	•				●	●	•				•	•
Grays 2A	●	●	•	•					●	⬤	•				•	•
Mainstem LB trib 1 (25.0105)	•	⬤							●	●	•					●
King Cr Lower	•	⬤			•				●	●	•					•
WF Grays 1	•	●	•	•					●	●	•					⬤
Thadbar Cr Lower	•	●			•				●	●	•					•
Grays 1G tidal	•	●	•	•	•				•	●	•				•	•
Nikka Cr Lower	•	●			•				•	●	•					•
Impie Cr Lower	•	●			•				•	●	•					•
Hull Cr 1	•	●			•				•	●	•					●
Gorley Creek 2																•
WF Grays 2	•	●							•	●	•					⬤
Mainstem LB trib 2 (25.0107)	•	●							•	●	•					•
Gorley Creek 1			●							⬤	●					•
Grays 1B tidal	•	●		•	•				•	•	•				•	•
Grays 1F tidal	•	•		•	•				•	•	•				•	•
Hull Cr 2	•	●							•	•	•					●
Grays 1C tidal	•	•		•	•				•	•	•				•	•
Seal Cr	•	●			•				•	●	•					•
Grays 1D tidal	•	•		•	•				•	•	•				•	•
Grays 1 tidal	•	●		•	•				•	•	•				•	•
Grays 1E tidal	•	•		•	•				•	•	•				•	•
Seal Slough 1																

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

Figure 4-15. Grays subbasin chum habitat factor analysis diagram.

Grays Fall Chinook

Reach Name	Channel stability	Habitat diversity	Temperature	Predation	Competition (other spp)	Competition (hatchery fish)	Withdrawals	Oxygen	Flow	Sediment	Food	Chemicals	Obstructions	Pathogens	Harassment / poaching	Key habitat quantity
Grays 2	Moderate	Low	Moderate	Low					Low	High	Low					High Positive
Grays 2C	Moderate	Low	High						Low	High						High Positive
Grays 2A	Moderate	Low	High	Low					Low	High	Low					High Positive
Grays 1G tidal	Moderate	Low	High	Low	Low	Low			Low	High	Low					Moderate Positive
Grays 2B	Moderate	Low	High	Low					Low	High	Low					High Positive
WF Grays 1 Lower	Moderate	Moderate	Moderate	Low					Low	High						High
Grays 1F tidal	Moderate	Moderate	Low	Moderate	Low	Low			Moderate	Moderate	Moderate				Low	Low
Grays 1E tidal	Moderate	Low	Low	Moderate	Low	Low			Low	Moderate	Low				Low	Low
Grays 1D tidal	Low	Low	Low	Low	Low	Low			Low	Moderate	Low				Low	Low
Grays 1C tidal	Low	Low	Low	Low	Low	Low			Low	Low	Low				Low	Low
Grays 1B tidal	Low	Low	Low	Low	Low	Low			Low	Low	Low				Low	Low
Grays 1 tidal	Low	Low	Low	Low	Low	Low			Low	Low	Low				Low	Low

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

Figure 4-16. Grays fall chinook habitat factor analysis diagram.

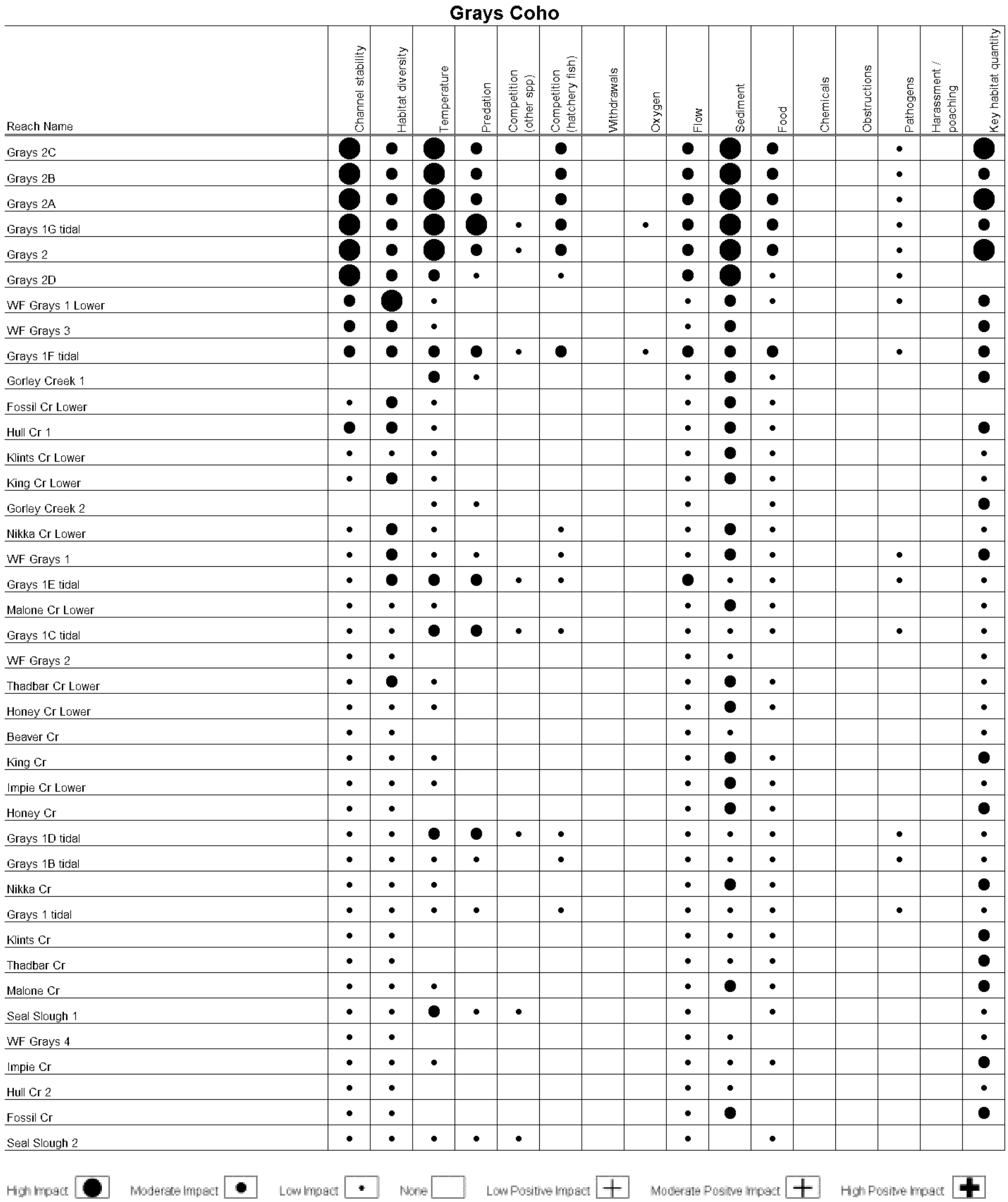


Figure 4-17. Grays coho habitat factor analysis diagram.

4.7 Integrated Watershed Assessment

The Grays River Subbasin encompasses 124 mi^2, making up 17 subwatersheds. The dominant land-use in the subbasin is private commercial timber production. Less than 10% of the land is under public ownership and the highest amount of public ownership within any individual subwatershed is only 55%. Most of the public land lies in the Hull Creek (30402) and SF Grays (30301 and 30303) drainages, and nearly all of it is under WDNR management. Other land-uses include small amounts of rural residential and commercial/industrial.

4.7.1 Results and Discussion

IWA results for the Grays River watershed are shown in Table 4-2. As indicated, IWA results are calculated for each subwatershed at the local level (i.e., within a subwatershed, not considering upstream effects) and the watershed level (i.e., integrating the effects of the entire upstream drainage area as well as local effects). A reference map showing the location of each subwatershed in the basin is presented in Figure 4-18. Maps of the distribution of local and watershed level IWA results are displayed in Figure 4-19.

Table 4-2. IWA results for the Grays River Watershed

Subwatershed[a]	Local Process Conditions[b]			Watershed Level Process Conditions[c]		Upstream Subwatersheds[d]
	Hydrology	Sediment	Riparian	Hydrology	Sediment	
30101	I	M	M	M	M	30104
30102	I	I	M	I	I	30105
30103	I	M	M	I	M	30101, 30102, 30104, 30105
30104	M	M	F	M	M	none
30105	I	M	M	I	M	none
30201	I	I	M	I	M	30202
30202	I	I	M	I	I	none
30301	I	M	M	M	M	30303
30302	I	M	M	I	M	30101, 30102, 30103, 30104, 30105, 30301, 30303
30303	M	M	F	M	M	none
30401	I	I	I	I	M	30101, 30102, 30103, 30104, 30105, 30201, 30202, 30301, 30302, 30303, 30402, 30403
30402	I	M	M	I	M	none
30403	I	M	M	I	M	30101, 30102, 30103, 30104, 30105, 30201, 30202, 30301, 30302, 30303
30404	I	M	M	I	M	none
30405	F	M	M	F	M	none
30406	F	M	I	I	M	30101, 30102, 30103, 30104, 30105, 30201, 30202, 30301, 30302, 30303, 30401, 30402, 30403
30407	I	I	I	I	I	none

Notes:

[a] LCFRB subwatershed identification code abbreviation. All codes are 14 digits starting with 170800030#####.
[b] IWA results for watershed processes at the subwatershed level (i.e., not considering upstream effects). This information is used to identify areas that are potential sources of degraded conditions for watershed processes, abbreviated as follows:

- F: Functional
- M: Moderately impaired
- I: Impaired

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

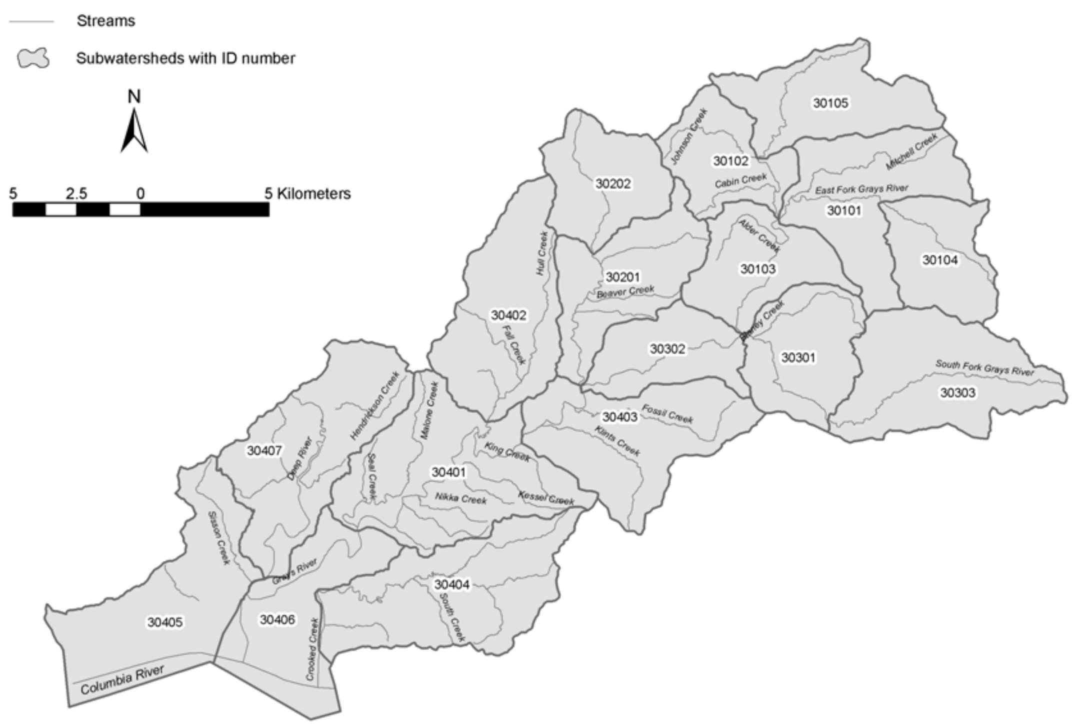


Figure 4-18. Map of the Grays basin showing the location of the IWA subwatersheds.

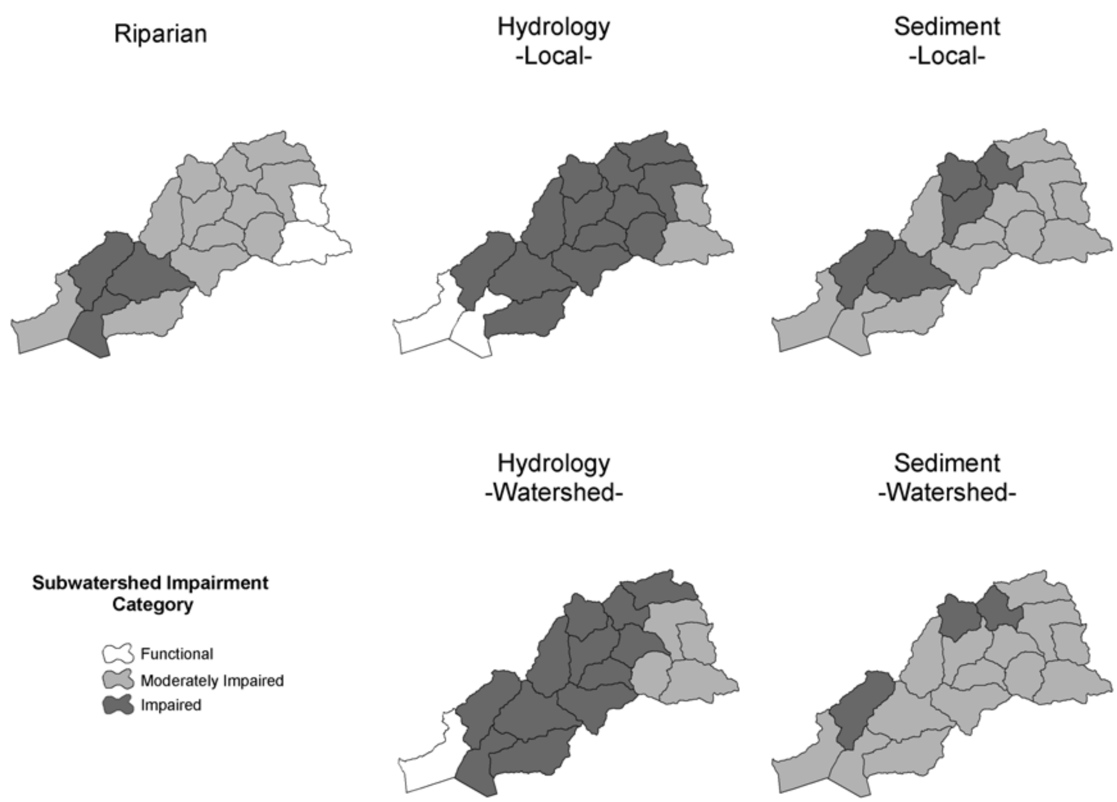


Figure 4-19. IWA subwatershed impairment ratings by category for the Grays basin

4.7.1.1 Hydrology

Functional hydrologic conditions are distributed exclusively along the mainstem Columbia, incorporating the lower reaches of the Grays River, Deep River, and assorted small tributaries (30503, 30405, 30406). Moderately impaired hydrologic condition ratings are located within the upper reaches of the East Fork and South Fork of the Grays River (30104, 30303). The rest of the subwatersheds have an impaired IWA hydrology rating.

For the most part, the watershed level hydrology ratings are consistent with the local ratings. Possibly the most significant watershed level effect is apparent in subwatershed 30406, at the mouth of the Grays River. The hydrologic condition rating is downgraded to impaired from a functional rating at the local level. This is due to the overwhelming predominance of impaired hydrologic conditions upstream. However, it should be noted that the subwatershed is largely within the slough-like, tidally influenced portion of the river. This suggests that upstream effects may not be as severe as the IWA watershed level rating may suggest. A second, notable change in hydrologic rating occurs in the upper East and South Forks of the Grays River, where two downstream subwatersheds are upgraded into the moderately impaired category (30101, 30301) due to effects from their headwater subwatersheds.

4.7.1.2 Sediment Supply

With respect to sediment conditions, there are no subwatersheds within the Grays River Planning watershed classified as functional. The large majority (12) are characterized as moderately impaired, with the balance rated as impaired (5). Impaired conditions can be found throughout the WF Grays River drainage (30201 and 30202), the Deep River drainage (30407), and in the Grays mainstem – Malone Creek subwatershed (30401). It should be noted that the natural levels of erodability are low to moderate within the watershed, scoring an area-adjusted composite rating of 16 on a scale of 0-126. Current, “managed” conditions have elevated that value substantially to near 40, but the overall erodability is still moderate

As with hydrologic conditions, watershed level sediment conditions do not change drastically from the local level. The lower West Fork Grays subwatershed (30201) improves to a moderately impaired rating, as does the Grays – Malone Creek subwatershed (30401) due to upstream inputs.

4.7.1.3 Riparian

Functional riparian conditions are found in two subwatersheds, while 12 subwatersheds are rated as moderately impaired, and three are classified as impaired. As with hydrologic conditions, the headwaters of the South and East Forks of the Grays River (30308 and 30101) have functional ratings, whereas the Deep River subwatershed (30407) is categorized as impaired. According to IWA, the estuarine subwatershed at the mouth of Crooked Creek and the Grays River also has impaired riparian conditions.

4.7.2 Predicted Future Trends

4.7.2.1 Hydrology

All of subwatershed 30101 (Mitchell Creek and East Fork Grays River) is in private holdings, and primarily used for timber production. Hydrologic conditions are unlikely to improve in the short term with existing high road densities (6.0 mi/mi^2), stream crossing densities (4.3 crossings/stream mile), and only moderate mature forest coverage (45%). Improved forest practices may lead to improved conditions over the long term.

Approximately one third of subwatersheds 30301 and 30303 on the South Fork are in public hands, managed by the WDNR. Road densities on these timberlands are high, although streamside road density is relatively low. Hydrologic conditions are likely to improve or remain stable.

The upper mainstem subwatersheds (30105, 30102, 30103, 30302) are uniformly rated as hydrologically impaired. These subwatersheds have very high stream crossing densities (5.0-7.6 crossings/stream mile), high road densities, and roughly 33% mature forest cover. These key subwatersheds likely will take a long time to recover from past forestry and road building activities.

Lower mainstem subwatersheds are also almost exclusively under private ownership with variable stream crossing densities, ranging from a high of 5.1 crossings/stream mile in 30403 to a low of 2.2 in the tidally influenced area within 30406. Road densities in general show a similar pattern. Conditions in subwatersheds 30403 and 30401 are substantially degraded and hydrologic conditions will take some time to recover. Subwatershed 30406 is composed primarily of wetlands (86%), lending hydrologic integrity and resilience to this subwatershed if wetlands are adequately protected. It should be noted, however, that despite a functional rating in the IWA, 30406 contains extensive diking and other channel revetments. The Columbia Land Trust is actively negotiating on over 800 acres of land in the lower Grays River and Deep River watershed, including subwatershed 30406. Restoration goals include removing tidegates and dikes to reconnect the river with the floodplain to benefit salmon and a host of other fish and wildlife species. These projects have been identified as some of the most important conservation work in the Columbia River estuary.

4.7.2.2 Sediment Supply

Watershed level sediment condition ratings are moderately impaired in all subwatersheds encompassing important anadromous stream reaches, with the exception of 30102 along the upper mainstem where conditions are rated as impaired. Along the East and South Fork, as well as in the upper mainstem subwatersheds, natural erodability levels are quite low, ranging from 5-18 on a scale of 0-126. Managed erodability levels are certainly higher, but all remain in the low or moderate categories, ranging from 3-43 on the erodability index. As described in the hydrology section above, land-use intensity is quite high in these upper areas, as measured by the density of roads, stream crossings and the level of timber harvest activities. Sediment conditions are unlikely to improve over the short term, with the possible exception of certain publicly managed timber parcels on the South Fork (30301, 30303).

Along the lower mainstem, current condition ratings are exceptionally poor in subwatersheds 30403 and 30401 with respect to land-use intensity as described above. Managed erodability is exceedingly high in subwatershed 30401 at 97 points on the index (scale of 0-126). Sediment conditions in these subwatersheds are unlikely to improve in the near future.

Although sediment conditions are rated as moderately impaired in subwatershed 30406, the estuarine character of the subwatershed, coupled with low road and stream side road density, high proportion of wetlands and ongoing efforts to protect the tidal areas, suggest that conditions in this subwatershed may improve over the next 20 years.

4.7.2.3 Riparian Condition

Riparian conditions are rated moderately impaired to impaired throughout the majority of the Grays River Subbasin, with only two subwatersheds rated as functional (30303- SF Grays headwaters & 30104- EF Grays headwaters). New forestry regulations should allow for recovery of riparian corridors over time.

The most impaired ratings are found in the estuary and lower river (30406, 30401), where the majority of the mainstem has been channelized through diking and most side-channel habitat has been lost. The presence of dikes and other channel revetments reduces the potential for riparian recovery. However, conservation easements and other public-private partnerships (such as those already being developed by the Columbia Trust) offer some promise that floodplain dynamics and riparian conditions in this estuarine area may improve over the next 20 years.

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