Volume II, Chapter 8
Cowlitz Subbasin—Lower Cowlitz

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8.0 Cowlitz Subbasin—Lower Cowlitz

8.1 Subbasin Description

8.1.1 Topography & Geology

For the purposes of this assessment, the Lower Cowlitz basin is the Cowlitz watershed below Mayfield Dam, not including the Toutle and Coweeman basins. The basin encompasses approximately 440 square miles in portions of Lewis and Cowlitz Counties and lies within WRIA 26 of Washington State. The Cowlitz enters the Columbia at RM 68, approximately 3.5 miles southeast of Longview, WA. The Coweeman and Toutle are the two largest tributaries. These basins are covered in separate chapters. Other significant tributaries include Salmon Creek, Lacamas Creek, Olequa Creek, Delameter Creek, and Ostrander Creek.

Mayfield Dam (RM 52), constructed in 1962, blocks all natural passage of anadromous fish to the upper basin. The Cowlitz Salmon Hatchery Barrier Dam (RM 49.5), located below Mayfield Dam, is a collection facility for trapping and hauling fish into the upper basin, a practice that has been in effect since 1969. Below the Barrier Dam, the river flows south through a broad valley. Much of the lower mainstem Cowlitz suffers from channelization features related to industrial, agricultural, and urban development.

The Toutle River, which enters the Cowlitz at RM 20, is a major lower tributary that drains the north and west sides of Mount St. Helens. The Toutle River was impacted severely by the 1980 eruption of Mount St. Helens and the resulting massive debris torrents and mudflows, which also impacted the Cowlitz mainstem downstream of the Toutle confluence. Following the eruption, the lower mainstem Cowlitz was dredged and dredge spoils were placed in the floodplain.

The lower valley is comprised of Eocene basalt flows and flow breccia. Alpine glaciation and subsequent fluvial working of glacially derived sediments have heavily influenced valley morphology and soils. The most common forest soils are Haplohumults (reddish brown lateritic soils) and the most common grassland soils are Argixerolls (prairie soils) (WDW 1990).

8.1.2 Climate

The subbasin has a typical northwest maritime climate. Summers are dry and warm and winters are cool, wet, and cloudy. Mean monthly precipitation ranges from 1.1 inches (July) to 8.8 inches (November) at Mayfield Dam. Annual precipitation averages 46 inches near Kelso, WA (WRCC 2003). Most precipitation occurs between October and March. Snow and freezing temperatures are common in the upper elevations while rain predominates in the middle and lower elevations.

8.1.3 Land Use/Land Cover

Forestry is the dominant land use in the subbasin. Commercial forestland makes up over 80% of the Cowlitz basin below Mayfield Dam. Much of the private land in the lower river valleys is agricultural and residential, with substantial impacts to riparian and floodplain areas in places. Population centers in the subbasin consist primarily of small rural towns, with the larger towns of Castle Rock and Longview/Kelso along the lower river. Projected population change from 2000 to 2020 for unincorporated areas in WRIA 26 is 22%. The following towns in the lower Cowlitz basin are listed with their estimated population change between 2000 and 2020: Longview 21%, Kelso 42%, Castle Rock 2%, Vader 64%, Toledo 64%, and Winlock 49% (LCFRB 2001). A breakdown of land ownership is presented in Figure 8-1. In most areas, climax species are western hemlock, Douglas fir, and western red cedar. Alder, cottonwood, maple, and willow dominate the larger stream riparian areas (WDW 1990). A breakdown of land cover is presented in Figure 8-2. Figure 8-3 displays the pattern of landownership for the basin. Figure 8-4 displays the pattern of land cover / land-use.

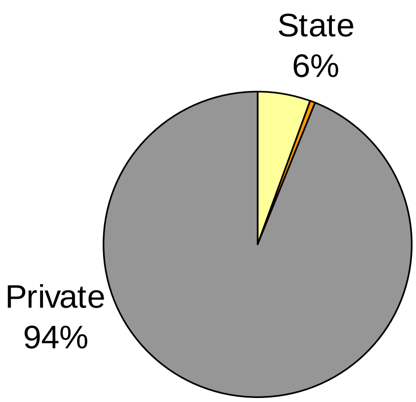


Figure 8-1. Lower Cowlitz River basin land ownership

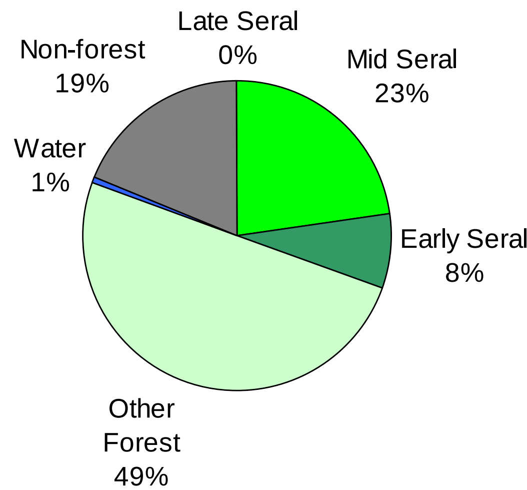


Figure 8-2. Lower Cowlitz River basin land cover

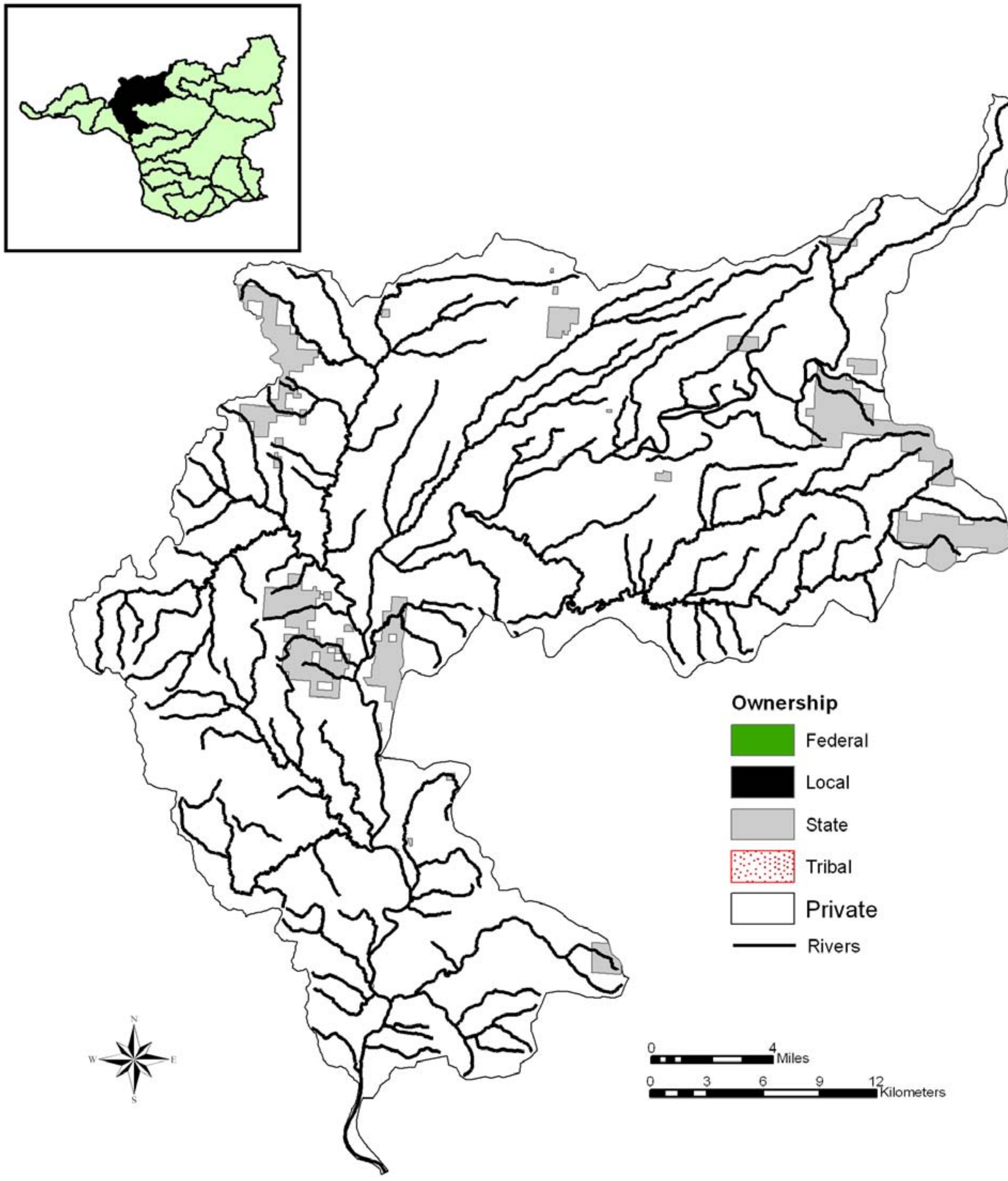


Figure 8-3. Landownership within the Lower Cowlitz basin. Data is WDNR data that was obtained from the Interior Columbia Basin Ecosystem Management Project (ICBEMP).

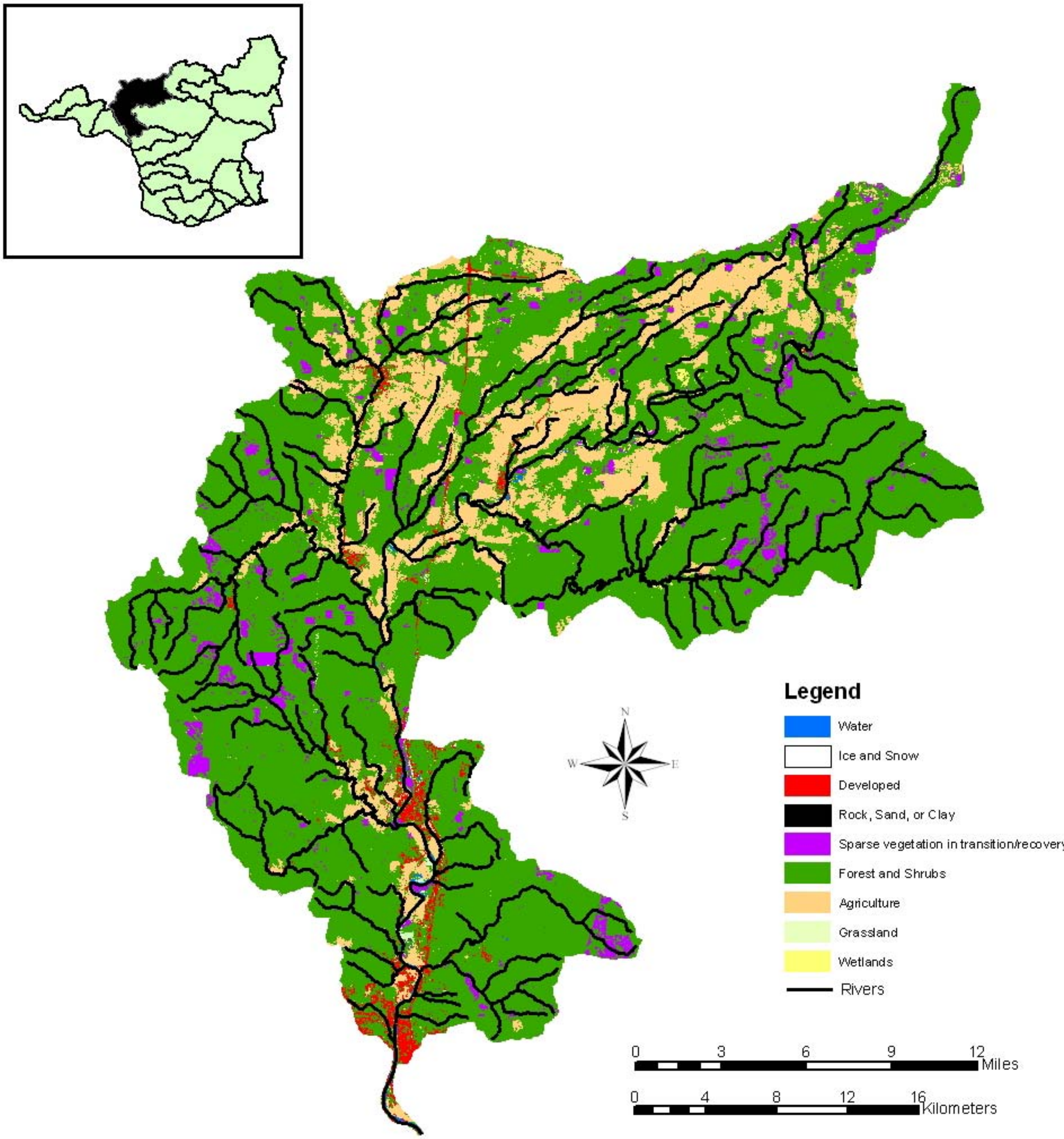
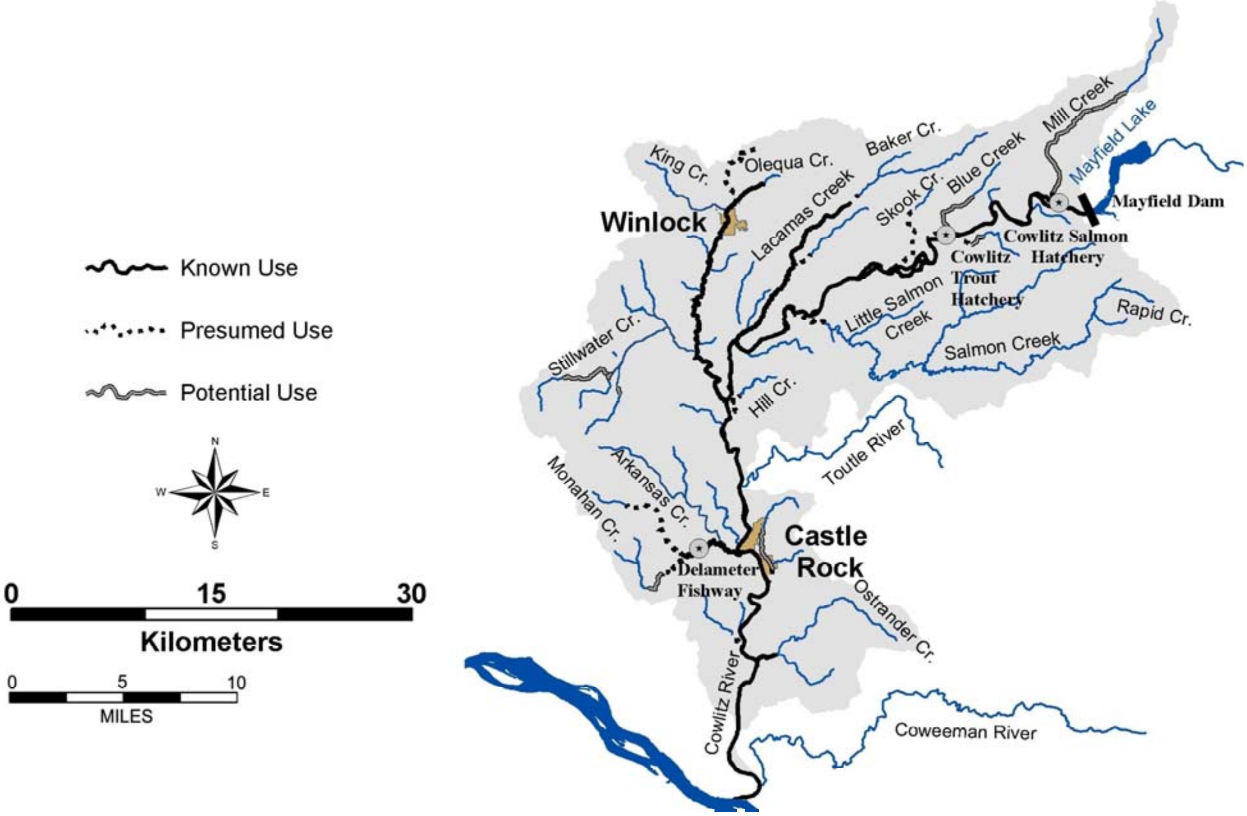


Figure 8-4. Land cover within the Lower Cowlitz basin. Data was obtained from the USGS National Land Cover Dataset (NLCD).

8.2 Focal Fish Species

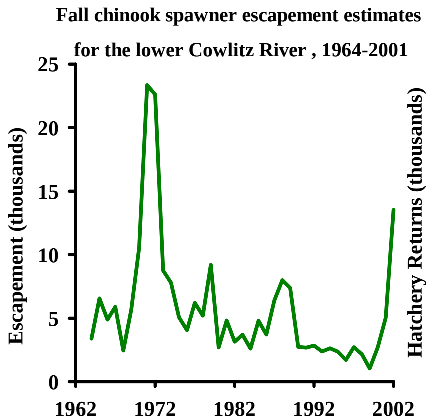
8.2.1 Fall Chinook—Cowlitz Subbasin (Lower Cowlitz)

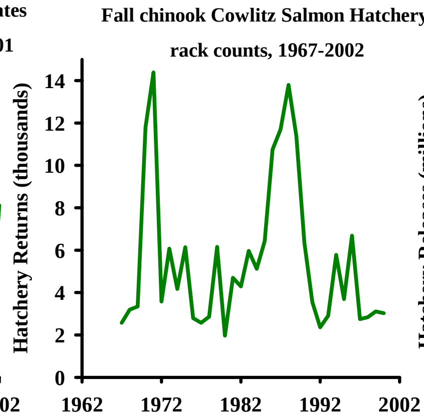
ESA: Threatened 1999 **SASSI: Depressed 2002**

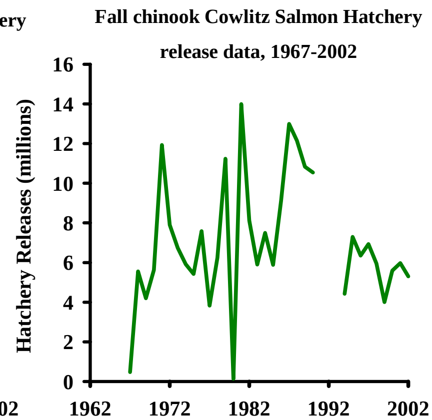


Distribution

- Spawning occurs in the mainstem Cowlitz River between the Cowlitz River Salmon Hatchery and the Kelso Bridge (~45 miles), but is concentrated in the area between the Cowlitz Salmon and Trout Hatcheries (RM 52 and 41.3)
- Historically, Cowlitz River fall chinook were distributed from the mouth to upper tributaries such as the Ohanapecosh and Tilton Rivers and throughout the upper basin
- Completion of Mayfield Dam in 1962 blocked access above the dam (RM 52); all fish were passed over the dam from 1962-66; from 1967-80, small numbers of fall chinook were hauled to the Tilton and upper Cowlitz
- An adult trap and haul program began again in 1994 where fish were collected below Mayfield Dam and released above Cowlitz Falls Dam







Life History

- Fall chinook enter the Cowlitz River from early September to late November
- Natural spawning in the Cowlitz River occurs between October and November, over a broader time period than most lower Columbia fall chinook; the peak is usually occurs during first week of November
- Age ranges from 2-year-old jacks to 6-year-old adults, with dominant adult age of 3, 4, and 5 (averages are 16.49%, 58.05%, and 19.31%, respectively)
- Fry emerge around March/April, depending on time of egg deposition and water temperature; fall chinook fry spend the spring in fresh water, and emigrate in the summer as sub-yearlings
- Cowlitz fall chinook display life history characteristics (spawn timing, migration patterns) that fall between tules and Lewis River late spawning wild fall chinook

Diversity

- The Cowlitz River fall chinook stock is designated based on distinct spawning timing and distribution
- Genetic analysis of Cowlitz River Hatchery fall chinook from 1981, 1982, and 1988 determined they were similar to, but distinct from, Kalama Hatchery fall chinook and distinct from other Washington chinook stocks

Abundance

- Historical abundance of natural spawning fall chinook in the Cowlitz River is estimated to have once been 100,000 adults, declining to about 18,000 adults in the 1950s, 12,000 in the 1960s, and recently to less than 2,000
- In 1948, WDF and WDG estimated that the Cowlitz River produced 63,612 adult fall chinook; escapement above the Mayfield Dam site was at least 14,000 fish
- Fall chinook escapement estimates in 1951 were 10,900 in the Cowlitz River and minor tributaries, 8,100 in the Cispus, and 500 in the Tilton
- From 1961-1966, an average of 8,535 fall chinook were counted annually at Mayfield Dam
- Lower Cowlitz River spawning escapement from 1964-2002 ranged from 1,045 to 23,345 (average 5,522)
- Currently hatchery production accounts for most fall chinook returning to the Cowlitz River
- WDFW interim natural spawning escapement goal is 3,000 fish; the goal was not met from 1990-2000

Productivity & Persistence

- NMFS Status Assessment for the Cowlitz River indicated a 0.15 risk of 90% decline in 25 years and a 0.33 risk of 90% decline in 50 years; the risk of extinction in 50 years was 0
- Two adult production potential estimates have been reported for the upper Cowlitz: 63,818 and 93,015
- Smolt density model predicted natural production potential for the Cowlitz River below Mayfield Dam of 2,183,000 smolts; above Mayfield Dam the model predicts production potential of 357,000 smolts from the Tilton River and 4,058,000 smolts above Cowlitz Falls
- Current juvenile production from natural spawning is presumed to be low

Hatchery

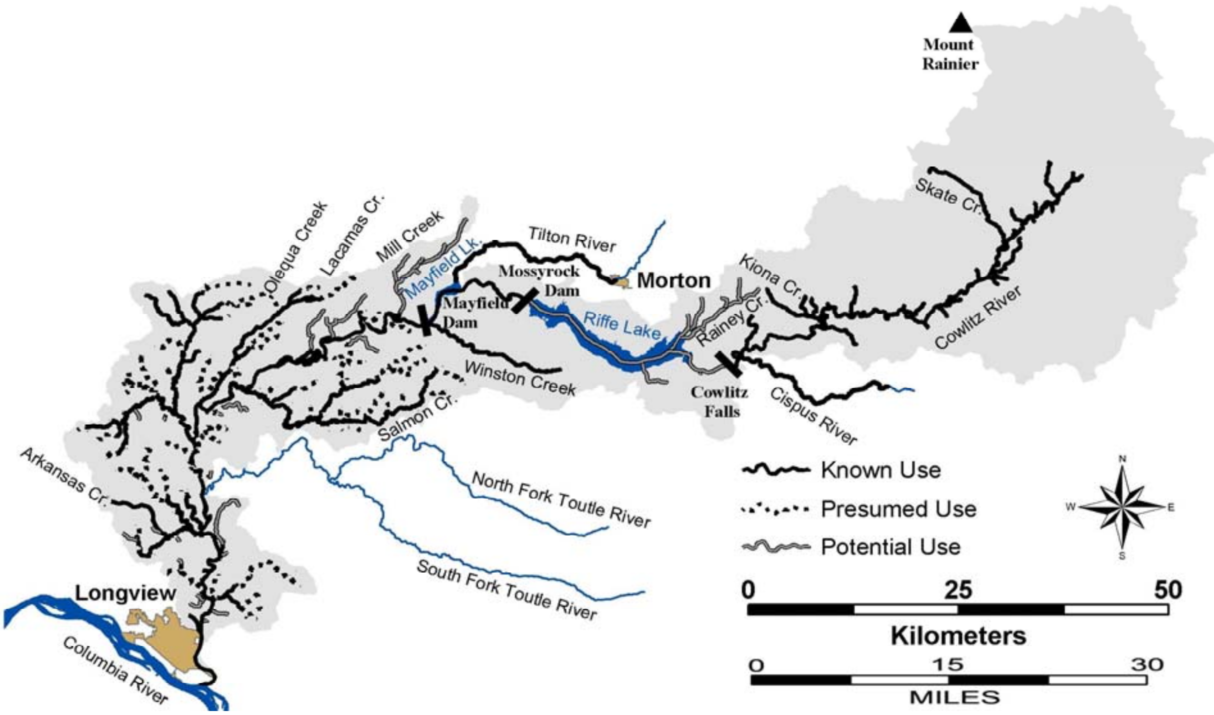
- Cowlitz River Salmon Hatchery is located about 2 miles downstream of Mayfield Dam; hatchery was completed in 1967; broodstock is primarily derivered from native Cowlitz fall chinook
- Hatchery releases of fall chinook in the Cowlitz River began in 1952; hatchery release data are displayed for 1967-2002
- The current hatchery program goal is 5 million fall chinook juveniles released annually
- Cowlitz hatchery fall chinook are not currently being reintroduced above Cowlitz Falls Dam

Harvest

- Fall chinook are harvested in ocean commercial and recreational fisheries from Oregon to Alaska, and in Columbia River commercial and sport fisheries
- Ocean and mainstem Columbia River fisheries are managed for Snake River and Coweeman River wild fall chinook Endangered Species Act (ESA) harvest rate limits which limits the harvest of Cowlitz fall chinook
- Cowlitz River fall chinook are important contributors to Washington ocean sport and troll fisheries and to the Columbia River estuary sport (Buoy 10) fishery
- CWT data analysis of the 1989-94 brood years indicates a total Cowlitz Hatchery fall chinook harvest rate of 33% with 67% accounted for in escapement
- The majority of fishery CWT recoveries of 1989-94 brood Cowlitz Hatchery fall chinook were distributed between Washington ocean (30%), British Columbia (21%), Alaska (15%), Cowlitz River (11%), and Columbia River (8%) sampling areas
- Annual harvest is variable depending on management response to annual abundance in Pacific Salmon Commission (PSC)(US/Canada), Pacific Fisheries Management Council (PFMC) (US ocean), and Columbia River Compact Forums
- Sport harvest in the Cowlitz River averaged 2,672 fall chinook annually from 1977-1986
- Freshwater sport fisheries in the Cowlitz River are managed to achieve adult fall chinook hatchery escapement goals

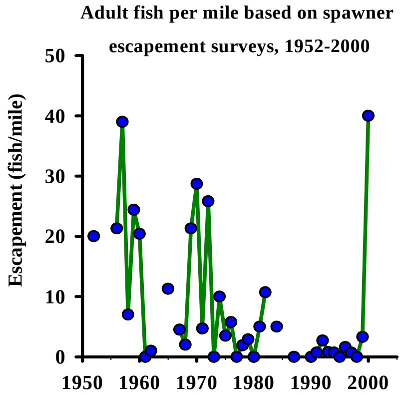
8.2.2 Coho—Cowlitz Subbasin

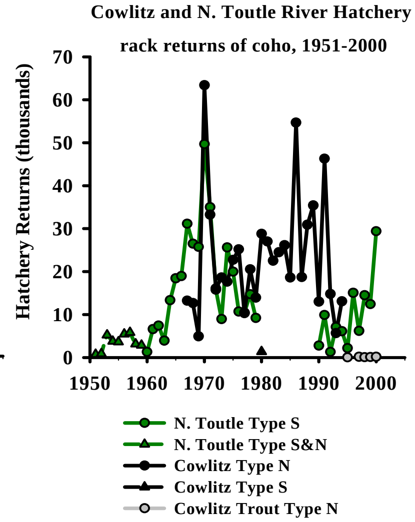
ESA: Candidate 1995	SASSI: Cowlitz—Depressed 2002;

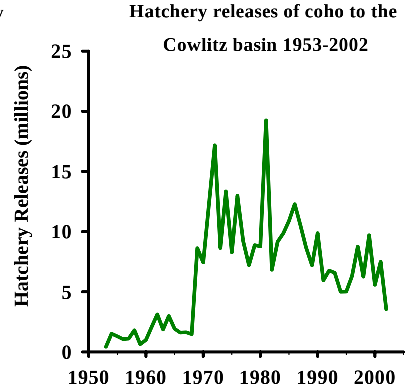


Distribution

- Managers refer to early stock coho as Type S due to their ocean distribution generally south of the Columbia River and late stock coho as Type N due to their ocean distribution generally north of the Columbia River
- Natural spawning is thought to occur in most areas accessible to coho, including the Toutle, SF Toutle, Coweeman, and Green Rivers and all accessible tributaries
- Natural spawning in lower Cowlitz tributaries occurs primarily in Olequa, Lacamas, Brights, Ostrander, Blue, Otter, Mill, Arkansas, Foster, Stillwater, Campbell, and Hill Creeks
- Natural spawning in the Coweeman River basin is primarily in tributaries downstream of the confluence of Mulholland Creek
- The post Mt. St. Helens eruption Toutle River system includes tributaries at various stages of recovery and some tributaries (primarily on the Green and South Toutle) with minor effects of the eruption. Bear, Hoffstadt, Johnson, Alder, Devils, and Herrington Creeks are examples of tributaries important to coho; coho adults are collected and passed to tributaries above the North Toutle Sediment Retention Dam
- Completion of Mayfield Dam in 1962 blocked access above the dam; a returning adult trap and haul program began in 1994 where fish were collected below Mayfield Dam and released above Cowlitz Falls Dam, restoring some access to the upper watershed.







Life History

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

Diversity

- Late stock (or Type-N) coho are informally considered synonymous with Cowlitz River stock
- Early stock(or Type-S) coho are informally considered synonymous with Toutle River stock
- Columbia River early and late stock coho produced from Washington hatcheries are genetically similar

Abundance

- Cowlitz River wild coho run is a fraction of its historical size
- In 1948, WDF estimated coho escapement to the basin was 77,000; in the early 1950s, escapement to the basin was estimated as 32,500 coho
- Escapement surveys on Olequa Creek from 1952-1990 established a range of 0-40 fish/mile
- Average total escapement of natural coho to the Toutle River was estimated as 1,743 for the years 1972-1979, prior to the 1980 eruption of Mt. St. Helens
- In 1985, an estimated 5,229 coho naturally spawned in lower Cowlitz River tributaries (excluding the Coweeman and Toutle systems), but the majority of spawners were fish originating from the Cowlitz Hatchery
- Hatchery production accounts for most coho returning to the Cowlitz River

Productivity & Persistence

- Natural coho production is presumed to be very low in the lower Cowlitz basin with Olequa Creek the most productive

- The Toutle River system likely provided the most productive habitat in the basin in the 1960s and 1970s, but was greatly reduced after the 1980 Mt. St. Helens eruption
- Reintroduction efforts in the upper Cowlitz River basin have demonstrated good production capabilities in tributaries above the dams, but efforts are challenged in passing juvenile production through the system
- Smolt density model natural production potential estimates were made on various sections of the Cowlitz River basin: 123,123 smolts for the lower Cowlitz River, 131,318 smolts for the Tilton River and Winston Creek, 155,018 smolts above Cowlitz Falls, 142,234 smolts for the Toutle River, and 37,797 smolts for the Coweeman River

Hatchery

- The Tilton River Hatchery released coho in the Cowlitz basin from 1915-1921
- A salmon hatchery operated in the upper Cowlitz River near the mouth of the Clear Fork until 1949
- The Cowlitz Salmon Hatchery is located about 2 miles downstream of Mayfield Dam; hatchery was completed in 1967; the hatchery is programmed for an annual release of 4.2 million late coho smolts
- Cowlitz Hatchery coho are important to the reintroduction effort in the upper basin
- The North Toutle Hatchery is located on the Green River less than a mile upstream of the confluence with the North Fork Toutle River; the hatchery is programmed for an annual release of 1 million early coho smolts

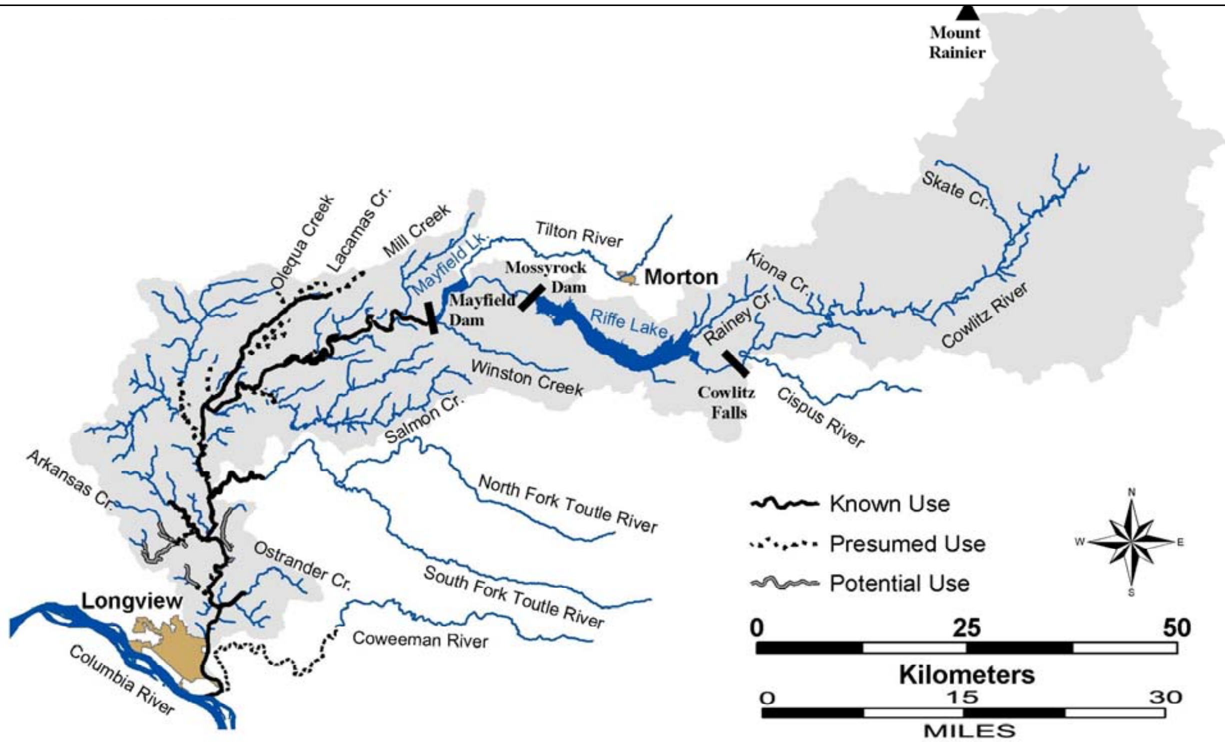
Harvest

- Until recent years, natural produced coho were managed like hatchery fish and subjected to similar harvest rates; ocean and Columbia River combined harvest of Columbia produced coho ranged from 70% to over 90% from 1970-83
- Ocean fisheries were reduced in the mid 1980s to protect several Puget Sound and Washington coastal wild coho stocks
- Columbia River commercial coho fisheries in November were eliminated in the 1990s to reduce harvest of late Clackamas River wild coho
- Since 1999, Columbia River hatchery fish 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 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 hatchery coho, but late coho harvest can also be substantial
- An average of 1,494 coho (1986-1990) were harvested annually in the Cowlitz River sport fishery

- The Toutle River sport fishery was closed in 1982 after the eruption of Mt. St. Helens; the Green River sport fishery was closed from 1981 to 1988 after the eruption of Mt. St. Helens and was reopened in 1989
- CWT data analysis of the 1995-97 North Toutle Hatchery early coho indicates 34% were captured in fisheries and 66% were accounted for in escapement
- CWT data analysis of the 1994 and 1997 brood Cowlitz Hatchery late coho indicates 64% were captured in fisheries and 36% were accounted for in escapement
- Fishery CWT recoveries of 1995-97 Toutle coho were distributed between Columbia River (47%), Washington ocean (37%), and Oregon ocean (15%) sampling areas
- Fishery CWT recoveries of 1994 and 1997 brood Cowlitz coho were distributed between Columbia River (55%), Washington ocean (30%), and Oregon ocean (15%) sampling areas

8.2.3 Chum—Cowlitz Subbasin

ESA: Threatened 1999	SASSI: NA



Distribution

- Chum were reported to historically utilize the lower Cowlitz River and tributaries downstream of the Mayfield Dam site

Life History

- Lower Columbia River chum salmon run from mid-October through November; peak spawner abundance occurs in late November
- Dominant age classes of adults are 3 and 4
- Fry emerge in early spring; chum emigrate as age-0 smolts generally from March to May

Diversity

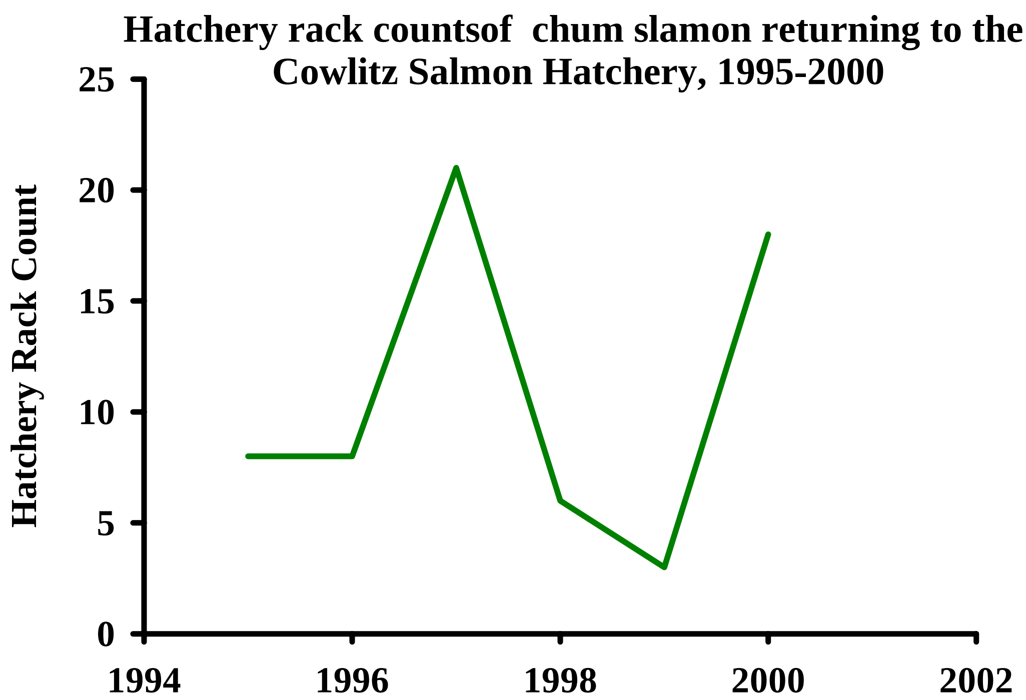
- No hatchery releases of chum have occurred in the Cowlitz basin

Abundance

- Estimated escapement of approximately 1,000 chum in early 1950's
- Between 1961 and 1966, the Mayfield Dam fish passage facility counted 58 chum
- Typically less than 20 adults are collected annually at the Cowlitz Salmon Hatchery

Productivity & Persistence

- Anadromous chum production primarily in lower watershed
- Harvest, habitat degradation, and to some degree construction of Mayfield and Mossyrock Dams contributed to decreased productivity



Hatchery

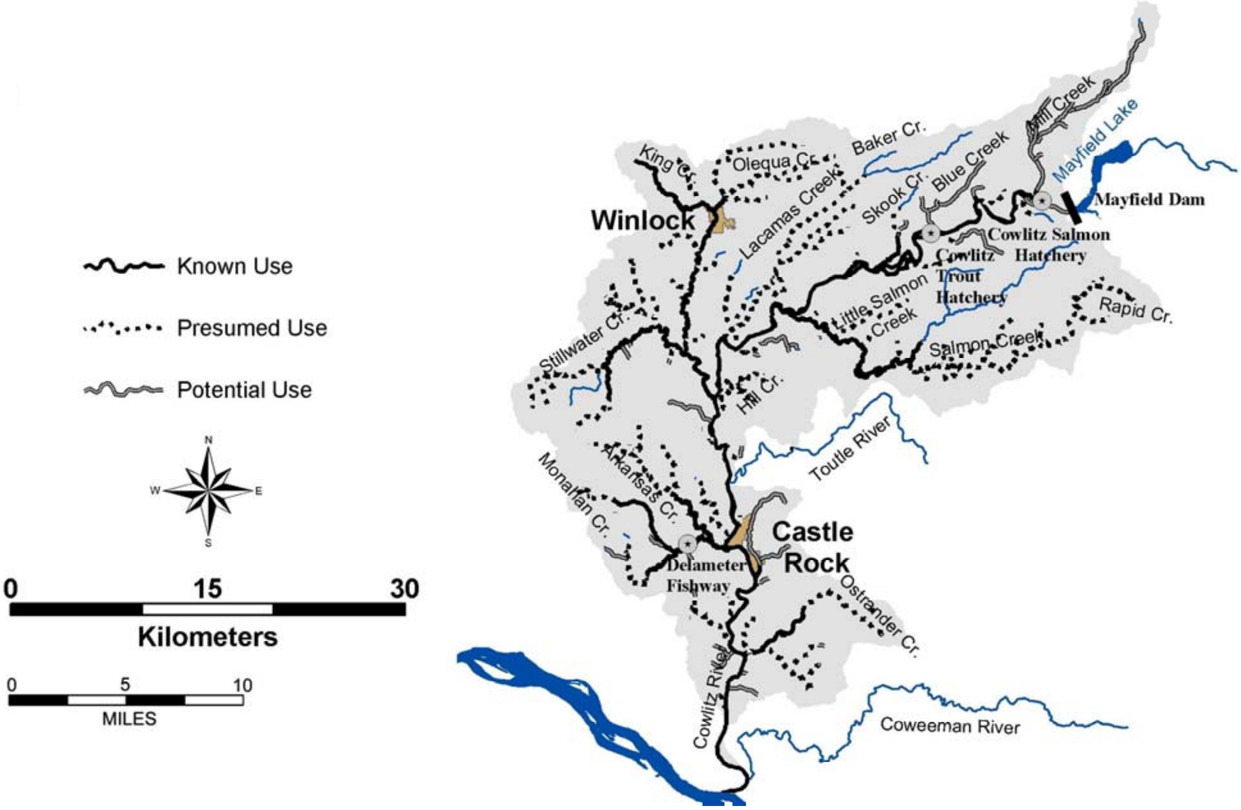
- Cowlitz Salmon Hatchery does not produce/release chum salmon
- Chum salmon are captured annually in the hatchery rack

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

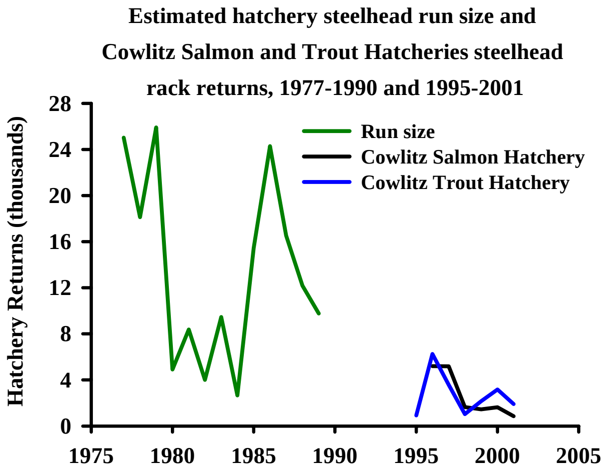
8.2.4 Winter Steelhead—Cowlitz Subbasin (Cowlitz)

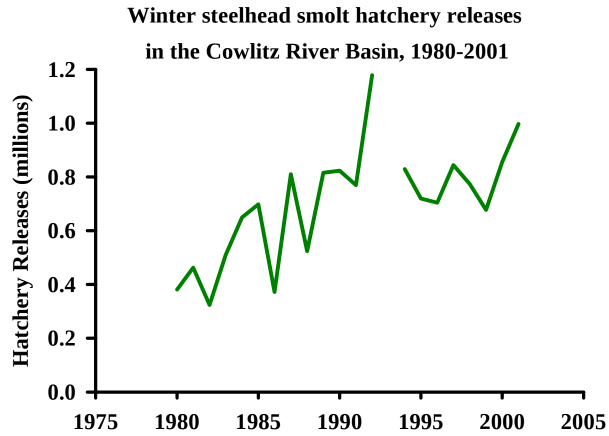
ESA: Threatened 1998	SASSI: Unknown 2002



Distribution

- Winter steelhead are distributed throughout the mainstem Cowlitz below Mayfield Dam; natural spawning occurs in Olequa, Ostrander, Salmon, Arkansas, Delameter, Stillwater and Whittle Creeks
- Historically, winter steelhead were distributed throughout the upper Cowlitz, Cispus, and Tilton Rivers; known spawning areas include the mainstem Cowlitz near Riffle and the reach between the Muddy Fork and the Clear Fork and the lower Ohanapecosh River
- Construction of Mayfield Dam in 1963 blocked winter steelhead access to the upper watershed; approximately 80% of the spawning and rearing habitat are not accessible
- In 1994, a trap and haul program began to reintroduce anadromous salmonids to the watershed above Cowlitz Falls Dam; adult winter steelhead are collected at the Cowlitz hatcheries and released in the Upper Cowlitz, Cispus, and Tilton basins; smolts resulting from natural production in the upper watershed are collected at the Cowlitz Falls Fish Collection Facility, acclimated at the Cowlitz Salmon Hatchery, and released in the mainstem Cowlitz





Life History

- Adult migration timing for Cowlitz winter steelhead is from December through April
- Spawning timing on the Cowlitz is generally from early March to early June
- Limited age composition data for Cowlitz River winter steelhead indicate that the dominant age classes are 2.2 and 2.3 (54.2% and 32.2 %, respectively)
- 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

- Cowlitz winter steelhead stock designated based on distinct spawning distribution
- Concern with wild stock interbreeding with hatchery brood stock from Chambers Creek and the Cowlitz River (Cowlitz and late Cowlitz stock)
- Allele frequency analysis of Cowlitz Hatchery late winter steelhead in 1996 was unable to determine the distinctiveness of the stock compared to other lower Columbia steelhead stocks

Abundance

- Historically, annual wild winter steelhead runs to the Cowlitz River were estimated at 20,000 fish; escapement was estimated as 11,000 fish
- In 1936, steelhead were observed in the Cispus River and reported in the Tilton River during escapement surveys
- Between 1961 and 1966, an average of 11,081 adult steelhead were collected annually at the Mayfield Dam Fish Passage Facility
- In the late 1970s and 1980s, wild winter steelhead annual average run size in the Cowlitz River was estimated to be 309 fish
- From 1983-1995, the annual escapement of Cowlitz River (hatchery and wild)winter steelhead ranged from 4,067 to 30,200 (average 16,240)

Productivity & Persistence

- In the late 1970s and 1980s, wild winter steelhead contribution to the annual winter steelhead return was estimated to be 1.7%
- Estimated potential winter steelhead smolt production for the Cowlitz River is 63,399

Hatchery

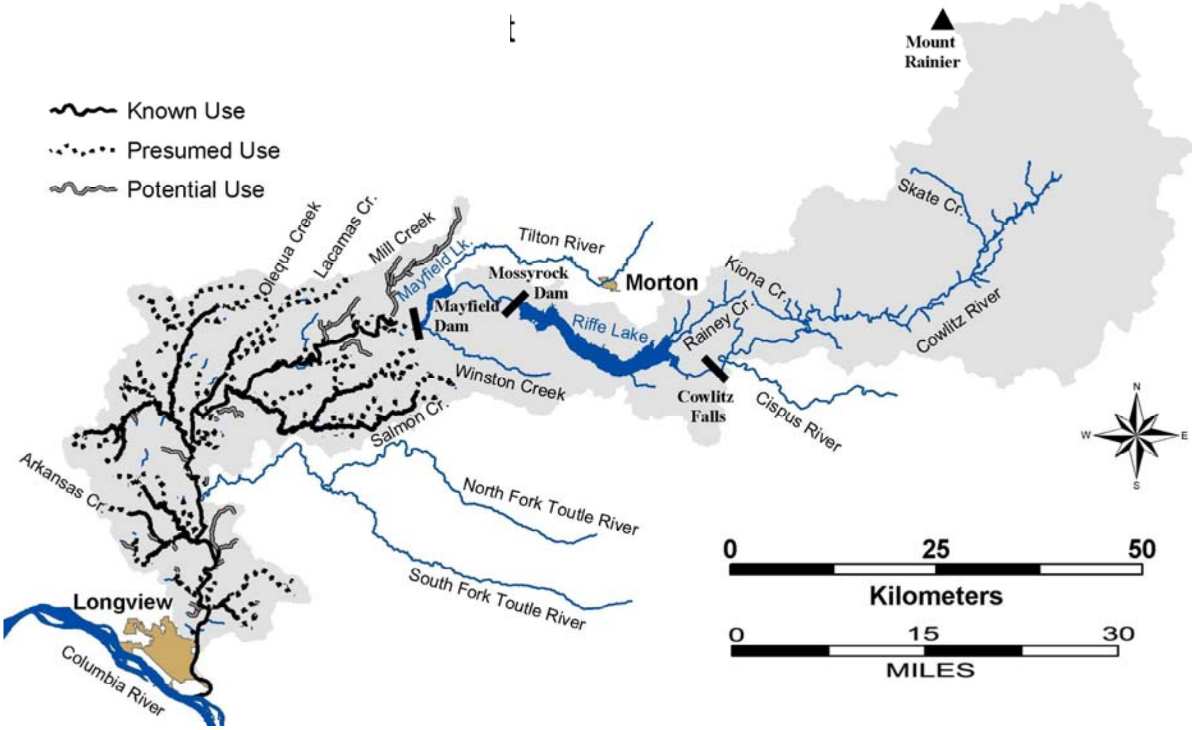
- The Cowlitz Trout Hatchery, located on the mainstem Cowlitz at RM 42, is the only hatchery in the Cowlitz basin producing winter steelhead
- Hatchery winter steelhead have been planted in the Cowlitz River basin since 1957; broodstock from the Cowlitz River and Chambers Creek have been used; an annual average of 180,000 hatchery winter steelhead smolts were released in the Cowlitz River from 1967-1994; smolt release data are displayed from 1980-2001
- Hatchery fish account for the majority of the winter steelhead run to the Cowlitz River basin

Harvest

- No directed commercial or tribal fisheries target Cowlitz winter steelhead; incidental mortality currently occurs during the lower Columbia River spring chinook tangle net fisheries
- Steelhead sport fisheries in the Columbia must release wild winter steelhead which are not marked with an adipose fin clip
- ESA limits fishery impact of Cowlitz wild winter steelhead in the mainstem Columbia and in the Cowlitz River
- Approximately 6.2% of returning Cowlitz River steelhead are harvested in the Columbia River sport fishery
- Wild winter steelhead sport harvest in the Cowlitz River from in the late 1970s and early 1980s ranged from 102-336; wild winter steelhead contribution to the total annual sport harvest was less than 2%
- The Cowlitz River may be the most intensely-fished basin in the Washington sport fisheries; the Cowlitz has been the top winter steelhead river in Washington

8.2.5 Cutthroat Trout—Cowlitz River Subbasin

ESA: Not Listed	SASSI: Depressed 2000

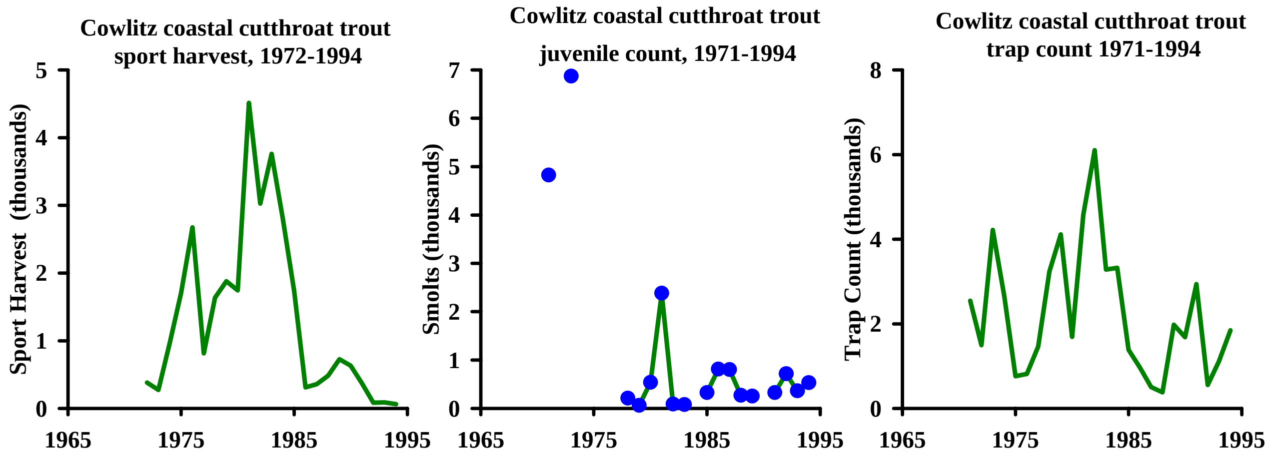


Distribution

- Anadromous forms were historically present throughout the watershed, but are now limited to the area downstream of Mayfield Dam, which block passage
- Adfluvial forms are present in Mayfield, Riffe, and Scanewa Reservoirs
- Resident forms are documented throughout the system and are the only form present upstream of Mayfield Dam

Life History

- Anadromous, adfluvial, fluvial and resident forms are present
- Anadromous river entry is from July through October, with peak entry in August and September
- 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
- Spawn timing at higher elevations is likely later, and may occur as late as June
- Hatchery cutthroat spawn from November to February, due to artificial selection for early spawn timing
- Smolt migration occurs in the spring after juveniles have spend 2 to 3 years in fresh water



Diversity

- Distinct stock based on geographic distribution of spawning areas
- Genetic sampling of ten groups within the Cowlitz system showed little difference among the groups
- Cowlitz collections were significantly different from other lower Columbia samples, except for Elochoman/Skamakowa Creek.

Abundance

- Anadromous counts at Mayfield Dam from 1962 to 1996 ranged from 5458 to 12,324 fish, and averaged 8698
- Outmigrant trapping at Mayfield migrant trap shows a long term declining trend
- Recent years' counts average about 10% of outmigrant counts when sampling began in the early 60s
- Smolt counts have been under 1000 every year since 1978, with the exception of 1982
- No population size data for resident forms

Hatchery

- Cowlitz Trout Hatchery began producing anadromous cutthroat in 1968
- The goal is 115,000 smolts larger than 210 mm to produce a return to the hatchery of 5000 adults

Harvest

- Not harvested in ocean commercial or recreational fisheries
- Angler harvest for adipose fin clipped hatchery fish occurs in mainstem Columbia River summer fisheries downstream of the Cowlitz River
- Cowlitz River sport harvest for hatchery cutthroat can be significant in year of large adult returns.
- Wild cutthroat (unmarked fish) must be released

8.3 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 has significant impacts on fall chinook, chum, winter steelhead and coho in the lower Cowlitz.
- Loss of estuary habitat is moderately important for fall chinook and chum, but is not of great importance for spring chinook, winter steelhead or coho.
- Harvest has moderately high impacts for fall chinook and coho, but has minor impacts on winter steelhead and chum.
- Hatchery impacts are moderately important to all four populations.
- Predation is of moderate to minor importance for each of the lower Cowlitz populations.

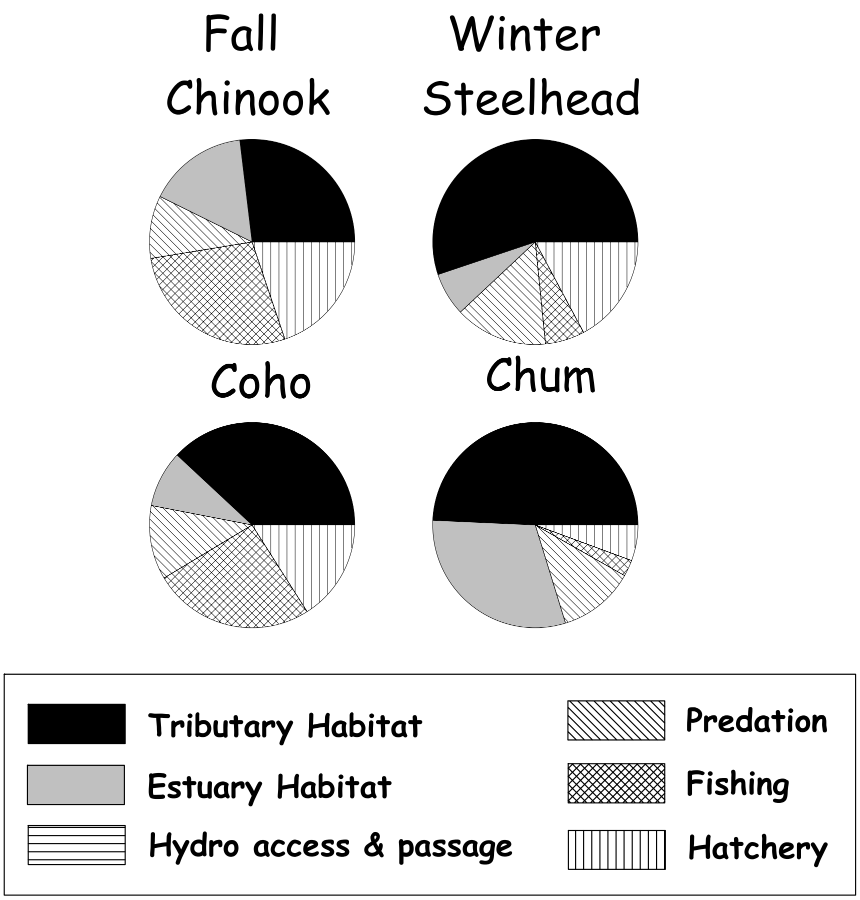


Figure 8-5. Relative index of potentially manageable mortality factors for each species in the Lower Cowlitz subbasin.

8.4 Hatchery Programs

Hatcheries have operated in the Cowlitz River basin since the early 1900s. For example, the Tilton River Hatchery released coho salmon in the Cowlitz River from 1915–21 and a salmon hatchery operated in the upper Cowlitz near the mouth of the Clear Fork until 1949. Three hatcheries currently operate in the basin: the Cowlitz Salmon Hatchery, the Cowlitz Trout Hatchery, and the North Toutle Hatchery (formerly the Green River Hatchery). The three hatcheries coordinate annual production efforts and are collectively referred to as the Cowlitz River Hatchery Complex.

- The Cowlitz Salmon Hatchery, completed in 1967, is approximately two miles downstream of Mayfield Dam. Current production goals are 5 million fall chinook juveniles released in the Cowlitz River, approximately 1.2 million spring chinook smolts (967,000 into the lower Cowlitz, and 100,000 to the Deep River net pens), 300,000 spring chinook fry for release into the upper Cowlitz above Cowlitz Falls Dam, and 3.2 million late-stock coho smolts (Figure 8-6).
- The Cowlitz Trout Hatchery is located on the mainstem Cowlitz at RM 42. Current production goals include 300,000 early run winter steelhead smolts released to the lower Cowlitz River; 352,500 late-run winter steelhead smolts to the lower Cowlitz River; 250,000 fingerlings and 37,500 late-run winter steelhead smolts to the upper Cowlitz and Cispus rivers, and 100,000 late-run winter steelhead fingerlings to the Tilton River; 500,000 summer steelhead smolts in the lower Cowlitz River; 100,000 sea run cutthroat trout fingerlings in the Tilton River; and 160,000 sea-run cutthroat trout fingerlings in the Cowlitz River and Blue Creek (Figure 8-6).

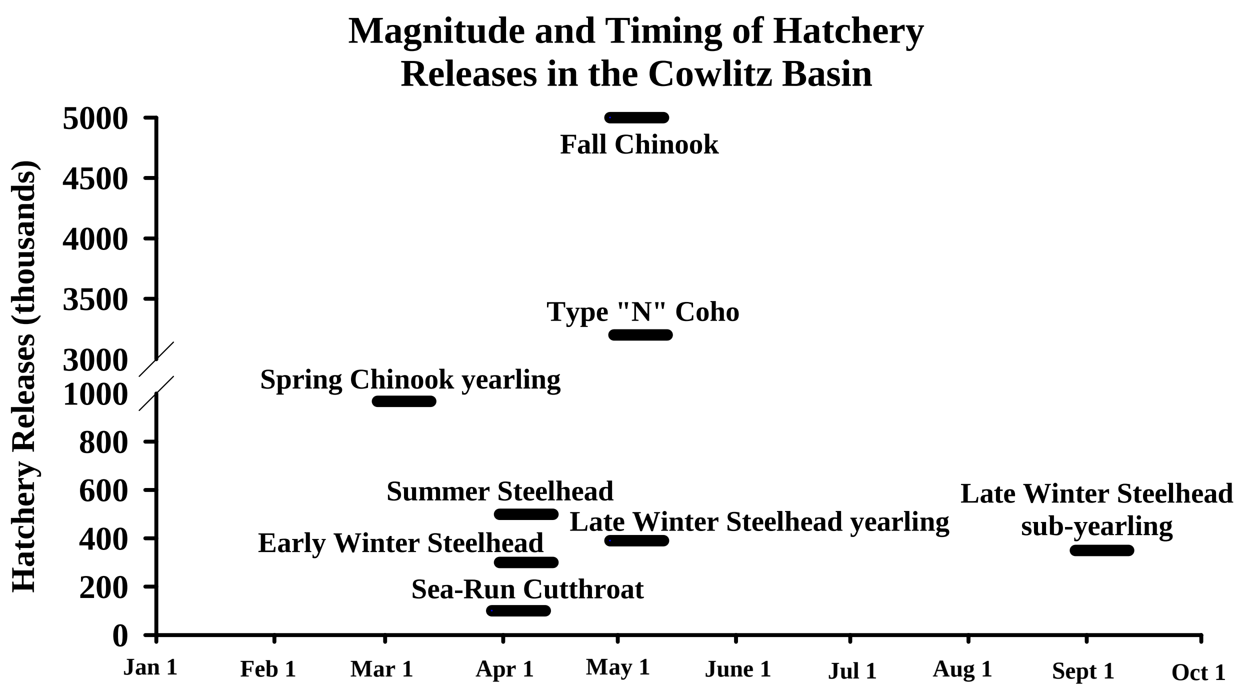


Figure 8-6. Magnitude and timing of hatchery releases in the Cowlitz River basin by species, based 2003 brood production goals.

- The North Toutle Hatchery, on the Green River less than a mile upstream of the confluence with the NF Toutle River, began operations in 1956 and was destroyed in the 1980 Mt. St.

Helens eruption. Rearing ponds near the hatchery site were developed after the eruption and operations were restored in 1985. The rebuilt hatchery resumed collecting broodstock in 1990. Current hatchery release goals are 2.5 million sub-yearling fall chinook, 800,000 early-stock coho smolts, and 50,000 summer steelhead (from Skamania Hatchery) smolts (Figure 8-7). Rearing ponds located at RM 8 on the Coweeman River are used to acclimate winter steelhead for release in the basin. Annual production goals are 14,000 smolts; an additional 6,000 smolts are released directly to the Coweeman River without acclimation at the ponds (Figure 8-7).

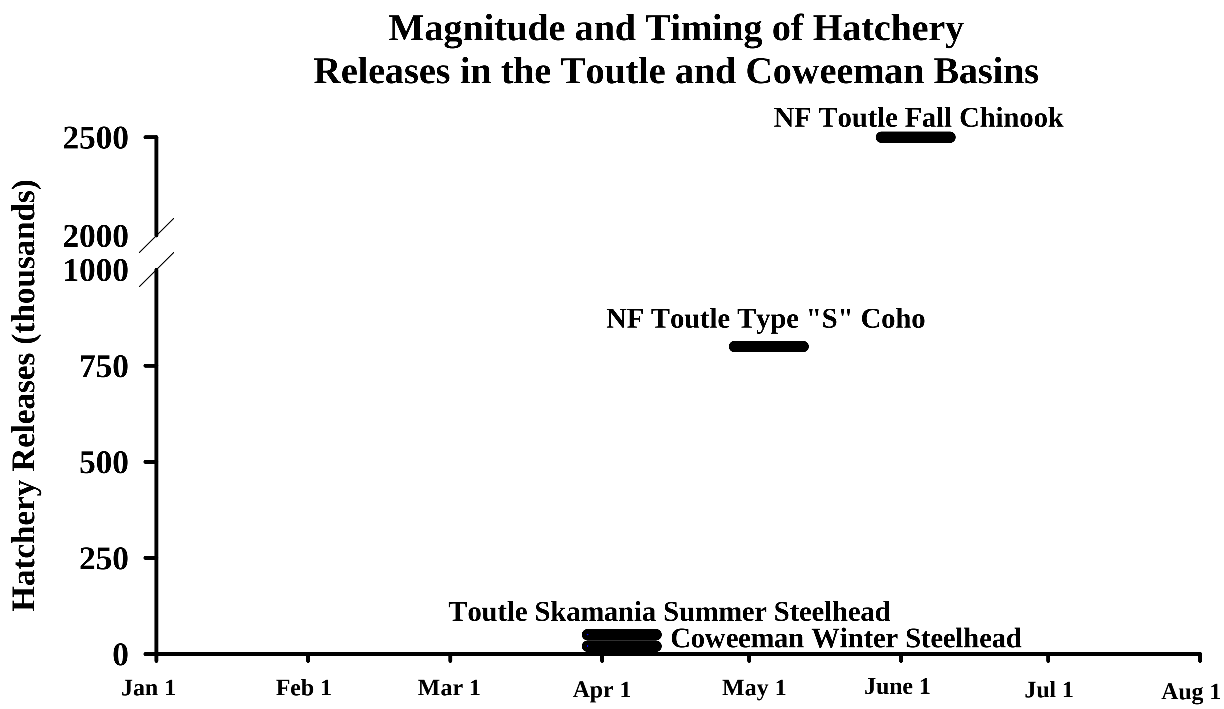


Figure 8-7. Magnitude and timing of hatchery releases in the Toutle and Coweeman River basins by species, based on 2003 brood production goals.

Genetics—Broodstock for fall chinook at the Cowlitz Salmon Hatchery have come almost entirely from native Cowlitz fall chinook, with hatchery fall chinook transfers into the Cowlitz in a few years. There have been no transfers of fall chinook into the Cowlitz since 1990, and past transfers have all come from hatcheries within the Lower Columbia ESU. Genetic analysis from the 1980s indicated that Cowlitz Salmon Hatchery fall chinook were similar to, but distinct from, Kalama Hatchery fall chinook and distinct from other Washington fall chinook stocks in the lower Columbia River.

Fall chinook broodstock at the North Toutle Hatchery have been primarily collected from the Toutle River although there have been been significant transfers made from lower Columbia ESU hatchery stocks, most significantly Spring Creek Hatchery and Kalama Hatchery fall chinook. Specific genetic data is not available for Toutle Fall chinook.

Fall chinook in the Coweeman River basin are considered wild fish with little hatchery influence. Hatchery fall chinook from the Spring Creek, Washougal, and Toutle Hatcheries were released periodically in the Coweeman during 1951–1979, but releases were discontinued in 1980. Since the early 1980s, hatchery-tagged fall chinook have not been recovered in the

Coweeman basin during spawning surveys, indicating the population is not influenced by stray hatchery fish.

Spring chinook broodstock for the Cowlitz Salmon Hatchery has been almost exclusively collected from Cowlitz River native spring chinook (In the late 1960s there were fewer then a million Willamette spring chinook released into the Cowlitz). Genetic analysis in the 1980s indicated that Cowlitz Salmon Hatchery spring chinook were genetically similar to, but distinct from, Kalama Hatchery and Lewis River wild spring chinook and significantly different from other lower Columbia River spring chinook stocks.

Broodstock for the coho salmon hatchery programs has come from native Cowlitz River (Cowlitz Salmon Hatchery) and Toutle River (North Toutle Hatchery) stocks. These stocks also have been used as broodstock for other lower Columbia River coho hatchery programs. Late stock coho salmon (Type N) and early coho salmon (Type S) are informally considered synonymous with Cowlitz River and Toutle River coho stocks, respectively. Columbia River early and late stock coho salmon produced from Washington hatcheries have not been found to be genetically different.

Both early and late winter steelhead hatchery programs exist at the Cowlitz Trout Hatchery. Broodstock for the early winter steelhead has come from a combination of Chambers Creek, Elochoman River, and Cowlitz River winter steelhead. Broodstock for the late-run winter steelhead program has come only from the Cowlitz River late winter steelhead stock. Genetic analysis in the mid-1990s was unable to determine the distinctiveness of Cowlitz basin winter steelhead from other lower Columbia winter steelhead stocks. Broodstock for the summer steelhead hatchery program at the Cowlitz Trout Hatchery and the North Toutle Hatchery originated from Skamania stock. The North Toutle Hatchery continues to receive broodstock from the Skamania Hatchery, while summer steelhead broodstock for the Cowlitz program is collected at the Cowlitz Trout and Salmon hatcheries. Winter steelhead broodstock for smolts acclimated and released from the Coweeman rearing ponds comes from hatchery returns to the Elochoman River Hatchery.

Broodstock for the cutthroat trout program at the Cowlitz Trout Hatchery originated from native Cowlitz River sea-run cutthroat trout with some limited influence from Beaver Creek stocks. Current broodstock collection comes from adults returning to the hatchery.

Interactions—Hatchery fall chinook account for most adults returning to the Cowlitz, Toutle, and Green rivers. Hatchery returns are approximately double the natural escapement in the Cowlitz basin (Figure 8-8 and Figure 8-9). Many natural spawners are expected to be first generation hatchery fish; wild fish abundance is likely low. The Toutle and Green River fall chinook populations are being re-established after the 1980 Mt. St. Helens eruption. Depending on the rebuilding success of these populations, the potential for wild/hatchery fish interactions may increase. The lower Cowlitz River downstream of the Cowlitz Salmon Hatchery barrier dam is an important rearing area for naturally produced fall chinook. Hatchery-origin fall chinook released in the lower Cowlitz may compete with natural-origin fall chinook for food and space; research to study this potential interaction is in progress. Hatchery-origin fall chinook fingerlings released in the lower Cowlitz also may be preyed upon by wild steelhead and cutthroat trout smolts.

Hatchery spring chinook account for most adults returning to the Cowlitz River (Figure 8-8). Hatchery spring chinook are released downstream of the Hatchery Barrier Dam as smolts for the harvest mitigation program and into the upper Cowlitz (upstream of Cowlitz Falls Dam) as subyearlings to supplement the natural reintroduction program. Some predation by hatchery-origin smolts may occur on naturally produced fall chinook, coho, or chum fry. However, the potential for these interactions is minimized by timing the release of hatchery smolts (March) to when the fish are smolted and prepared to quickly emigrate from the river to the Columbia estuary.

Hatchery coho salmon, account for most adults returning to the Cowlitz and Toutle rivers (Figure 8-8 and Figure 8-9). Significant coho production can occur in the upper Cowlitz basin from adults transplanted from the lower river; these fish are usually first generation hatchery fish. The smolt-to-adult survival of naturally produced coho juveniles in the upper Cowlitz has been low in the initial years of the program, so few naturally produced coho adults have been available for transplanting to the upper Cowlitz. Hatchery smolts released in the lower Cowlitz River potentially compete with wild fall chinook, steelhead, and chum salmon for food and space, but competition is limited to smolt migration time through the basin. Migration time is minimized by releasing smolts (in May) when they are prepared to move towards the Columbia estuary.

Hatchery fish account for most winter steelhead adults returning to the Cowlitz and Coweeman rivers (Figure 8-8). In the Toutle River system, the winter steelhead annual return is thought to be primarily comprised of naturally produced fish (Figure 8-9). Potential for interaction between wild and hatchery adults is expected to be low because of relative numbers of natural and hatchery fish and temporal and spatial segregation. Summer steelhead are not expected to reproduce naturally in the Cowlitz River (Figure 8-8) because they are introduced to the basin and there is no intention for a naturally reproducing population. Hatchery summer and winter steelhead smolts are released from the Cowlitz Trout Hatchery and Coweeman rearing ponds in May at a size and stage of smoltification intended to minimize travel time during emigration. Preliminary data suggests that steelhead smolts move downstream rapidly at approximately 20 miles per day so competition with native and non-native species in the lower Cowlitz is considered low. However, steelhead smolts that residualize may actively prey upon spring and fall chinook, coho, and chum fry that are present in the lower Cowlitz River basin. Large releases of hatchery smolts may attract additional predators causing increased predation on wild fish, but conversely, wild fish may benefit from the presence of large numbers of hatchery fish because wild fish usually have better predator avoidance capabilities.

Hatchery sea-run cutthroat trout account for most adults returning to the Cowlitz River (Figure 8-8). A natural population (anadromous and resident below the dams and resident above the dams) exists but is assumed to be relatively small. Hatchery sea run cutthroat trout smolts are released from the Cowlitz Trout Hatchery in April at a target size of 8.3 in (210 mm) FL; trout at this size generally exhibit smolt characteristics and rapidly emigrate. Hatchery cutthroat smolts have the potential to compete for food and space or to prey on juvenile fish in the system, however, competition with native and non-native species in the lower Cowlitz is considered low. Competition with, and predation on, other salmonids is likely greater when cutthroat trout smolts residualize.

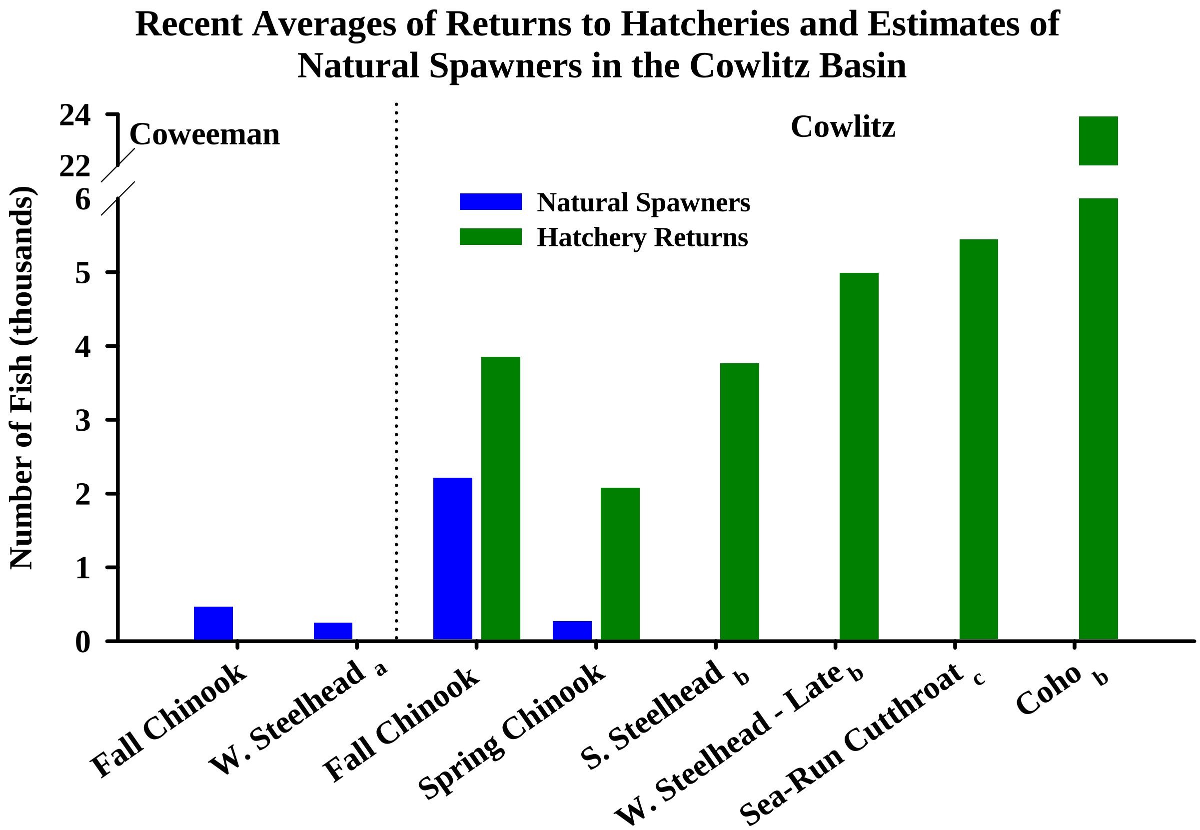


Figure 8-8. Recent average hatchery returns and estimates of natural spawning escapement in the Cowlitz River basin by species.

The years used to calculate averages varied by species, based on available data. The data used to calculate average hatchery returns and natural escapement for a particular species and basin were derived from the same years in all cases. All data were from the period 1992 to the present. Calculation of each average utilized a minimum of 5 years of data.

[a] There is no hatchery facility in the basin to enumerate and collect returning adult hatchery fish. All hatchery fish released in the basin are intended to provide harvest opportunity.

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

[c] Although a natural population of this species exists in the basin based on populations identified in WDFW's 2002 SASSI report, escapement surveys have not been conducted and the stock status is unknown.

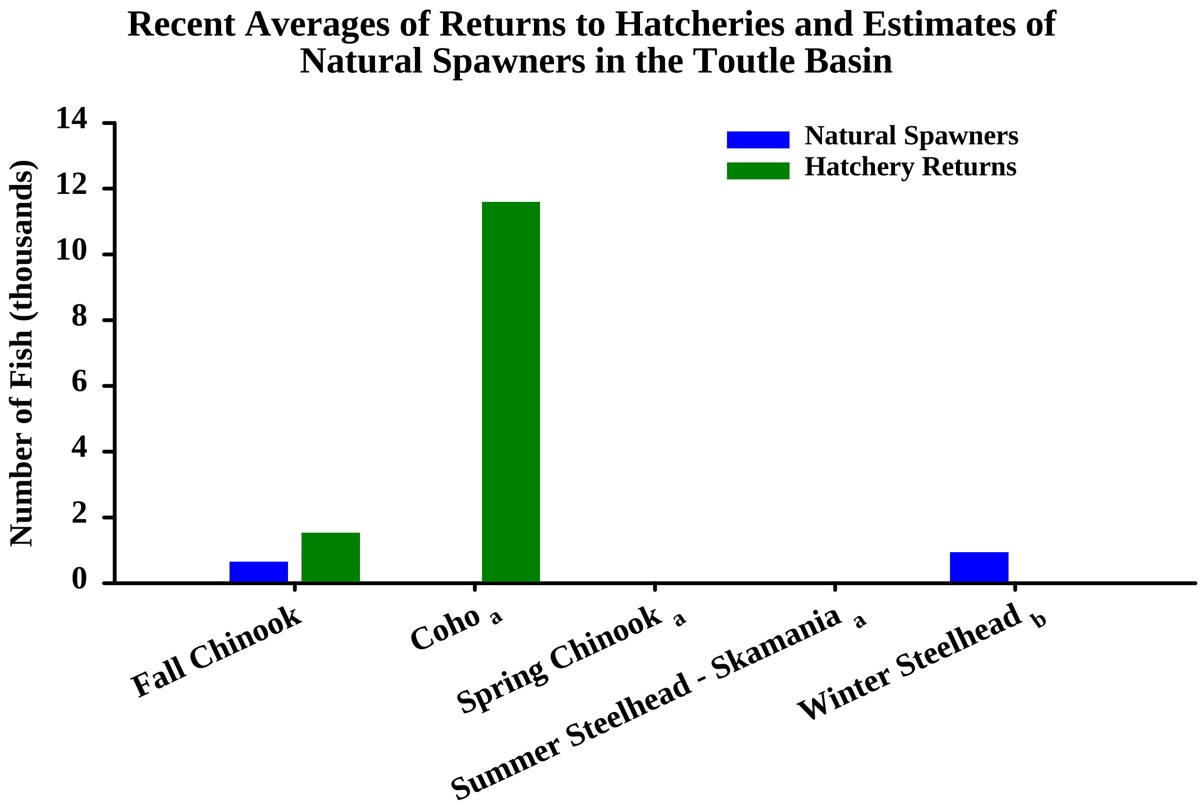


Figure 8-9. Recent average hatchery returns and estimates of natural spawning escapement in the Toutle River basin by species.

The years used to calculate averages varied by species, based on available data. The data used to calculate average hatchery returns and natural escapement for a particular species and basin were derived from the same years in all cases. All data were from the period 1992 to the present. Calculation of each average utilized a minimum of 5 years of data.

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

[b] Data may exist but was not obtained by the time of publication of this report.

Water Quality/Disease—Water for the Cowlitz Salmon Hatchery comes from three sources. The majority of water is supplied from the Cowlitz River, with an average 75,000 gpm available to the rearing ponds and 15,000 gpm available for the fish separator and ladder. Two separate well systems provide 1,000 and 700 gpm, respectively, between August and April and generally are used for egg incubation and early fry rearing. During incubation, salmon *Saprolegniasis* (fungus) is the primary concern and requires daily formalin treatments at 1:600 for 15 minutes. Excessive gas in the incubation effluent is variable and may be associated with periodic increases in yolk coagulation in eggs and fry. Water flow to fry is kept below 6 gpm to reduce or eliminate Bacterial Cold Water Disease (BCWD). A fish pathologist routinely checks for Infectious Hematopoeitic Necrosis Virus (IHNV) and Bacterial Kidney Disease (BKD). All equipment in the rearing ponds is sanitized with an iodine solution after each use.

Water for the Cowlitz Trout Hatchery also comes from three sources. Nine shallow wells on either side of the river provide up to 5 cfs. The well water is generally used for initial rearing and for water temperature regulation throughout the facility. The north well has had some bacteria and gas problems, is not used, and may be abandoned. An ozone plant operates from

May to December to disinfect up to 20 cfs of Cowlitz River water; the ozone plant removes pathogens (primarily *Ceratomyxa shasta*) present in the river water. Untreated river water up to 50 cfs is available when the ozone plant is not in operation. All water entering the facility is stored in basins, where it flows to the fish rearing ponds via gravity. Because of a limited water supply, all water is reused in the lower rearing ponds and some may be used three times without treating. Hatchery staff follows protocols in the Fish Health Manual to reduce the occurrence of disease. During incubation, diseases that occur include BCWD and *Trichodina*. Rearing fish are routinely examined by hatchery staff and a fish health specialist; treatments are prescribed accordingly.

Water for the North Toutle Hatchery comes from the Green River; the hatchery has a water right totaling 26,031 gpm. A rearing site associated on the South Fork Toutle River utilizes 3-4 cfs directly from the river. Rearing ponds at the facility are sanitized with chlorine at 20 parts per million before being stocked with fry. Equipment used at the rearing ponds is routinely disinfected with an iodine solution. Fish are monitored throughout the rearing phase by WDFW pathologists.

Water for the Coweeman rearing ponds comes directly from tributary creeks of the Coweeman River. Operations of the acclimation ponds are not subject to NPDES requirements, thus discharge water quality parameters are not monitored. Fish health is monitored daily and the area fish health specialist conducts monthly visits and advises disease treatment. Sanitizing rearing pond equipment is done according to the Fish Health Manual.

Mixed Harvest—The purpose of the fall chinook hatchery program at the Cowlitz Salmon Hatchery is to mitigate for losses resulting from hydroelectric development in the basin. Historically, exploitation rates of hatchery and wild fall chinook likely were similar. Fall chinook are an important target species in ocean and Columbia River commercial and recreational fisheries, as well as in Cowlitz River recreational fisheries. CWT data analysis of the fall chinook 1989–1994 brood years from the Cowlitz Salmon and North Toutle hatcheries indicate a 33% and 41% exploitation rate, respectively, leaving 67% and 59% of the respective adult return for escapement. Exploitation of wild fish during the same period likely was similar. Hatchery and wild fall chinook harvest rates remain similar and are now constrained by ESA harvest limitations.

At the Cowlitz Salmon Hatchery, the spring chinook program mitigates for salmon lost as a result of hydroelectric development in the basin. The program provides fish for harvest while minimizing adverse effects on ESA-listed fish. Historically, exploitation rates of hatchery and wild spring chinook were likely similar. Spring chinook are an important target species in Columbia River commercial and recreational fisheries, as well as tributary recreational fisheries. CWT data analysis of the 1989–1994 brood years from the Cowlitz Salmon Hatchery indicate a 40% exploitation rate on spring chinook; 60% of the adult return was accounted for in escapement. Most of the harvest occurred in the Cowlitz River sport fishery. Exploitation of wild fish during the same period likely was similar. Selective fisheries targeting hatchery spring chinook have been implemented in recent years in the mainstem Columbia sport and commercial fisheries and in the Cowlitz River sport fishery. Regulations allowing retention of hatchery fish and requiring release of wild fish increase opportunity to catch hatchery fish and significantly decrease impacts to wild fish. The selective fishery program enables the spring chinook reintroduced into the upper Cowlitz to pass through the fisheries.

Mitigating for late run coho salmon lost as a result of hydroelectric development is a goal of the Cowlitz Salmon Hatchery coho salmon program. The program provides fish for harvest while minimizing adverse effects on ESA-listed fish. All hatchery smolts are adipose fin-clipped to allow for selective harvest. Ocean and Columbia River sport and commercial fisheries and Cowlitz River sport fisheries benefit from this program. Historically, naturally produced coho from the Columbia River were managed like hatchery fish and subjected to similar exploitation rates. Ocean and Columbia River combined harvest of Columbia River-produced coho ranged from 70% to over 90% during 1970–1983. To protect several wild coho stocks, ocean fisheries were limited beginning in the mid-1980s and Columbia River commercial fisheries were temporally adjusted in the early 1990s. With the advent of selective fisheries for marked hatchery fish, exploitation of wild coho has been reduced, while hatchery fish can be harvested at higher rates. Currently, Cowlitz wild coho benefit from ESA harvest restrictions placed on Oregon Coastal natural coho (federal listing) in ocean fisheries and Oregon Lower Columbia natural coho (state listing) in Columbia River fisheries.

At the Cowlitz Trout Hatchery, the early and late winter steelhead hatchery programs mitigate for winter steelhead lost as a result of hydroelectric development in the basin; the program provides fish for harvest while minimizing adverse effects on ESA-listed fish. Fisheries that benefit include lower Columbia and Cowlitz River sport fisheries; approximately 6.2% of the returning Cowlitz Trout Hatchery steelhead are harvested in the lower Columbia River sport fishery and about 70% are harvested in the Cowlitz River sport fishery. Prior to selective fishery regulations, exploitation rates of wild and hatchery winter steelhead likely were similar. Mainstem Columbia River sport fisheries became selective for hatchery steelhead in 1984 and Washington tributaries became selective during 1986–1992 (except the Toutle in 1994). Current selective harvest regulations in the lower Columbia and tributary sport fisheries have targeted hatchery steelhead and limited harvest of wild winter steelhead to less than 10% (estimated at 6% for the Cowlitz tributary sport fishery). In the Cowlitz River, winter steelhead originating from the upper Cowlitz are marked with a right ventral fin clip and are protected from harvest in the lower Cowlitz fishery. Ventral fin-clipped fish that return to either of the Cowlitz River hatcheries are transported to the upper Cowlitz River to provide harvest opportunity for anglers and spawners for the reintroduction program.

The Coweeman rearing ponds provide winter steelhead for tributary sport harvest opportunity. Sport fisheries in the Coweeman, lower Cowlitz, and lower Columbia rivers benefit from this program. Selective fishery regulations allow for protection of wild winter steelhead while maximizing harvest rates on Coweeman hatchery winter steelhead. The Coweeman tributary fishery harvest rate for hatchery winter steelhead is estimated to be 30% with a 4% mortality impact estimated for wild winter steelhead.

At the Cowlitz Trout Hatchery and the North Toutle Hatchery, the summer steelhead hatchery programs mitigate for steelhead lost as a result of hydroelectric development in the basin and provide harvest opportunity. Summer steelhead are introduced to the basin; there is no intention of trying to develop a self-sustaining population of summer steelhead. Fisheries that benefit include tributary and lower Columbia River recreational fisheries. Selective fishing regulations and the differences in the timing of runs focus harvest on hatchery summer steelhead and minimize effects to wild steelhead.

The Cowlitz Trout Hatchery's sea-run cutthroat trout program mitigates for losses resulting from hydroelectric development in the basin and provides harvest opportunity. These fish contribute to the tributary sport fishery; harvest effects on wild fish should be minimal because of the differences in the timing of runs of cutthroat trout and regulations about minimum size, bag limit, and wild cutthroat trout release.

Passage—At the Cowlitz Salmon Hatchery, the adult collection facility is a barrier dam across the entire width of the river that prevents upstream migration of all returning salmonids. Returning adults enter through a fish ladder into a sorting, transfer, and holding facility. Fish to be retained for broodstock are directed to the holding facilities, while fish to be transported and released in the upper watershed are directed toward transfer facilities. If fish are able to bypass collection, Mayfield Dam—with no fish passage facilities—is approximately two miles upstream.

At the Cowlitz Trout Hatchery, the adult collection facility consists of a weir and fish ladder in Blue Creek and upstream migration in the mainstem Cowlitz River is unimpeded. Fish are hand-sorted and retained in adult holding ponds if they are needed for broodstock. Fish exceeding broodstock needs are transferred back to the river, or to the Cowlitz Salmon Hatchery, via specialized fish tanker trucks.

At the North Toutle Hatchery, the adult collection facility is a temporary weir for collecting coho salmon and fall chinook. The weir is installed and removed annually and only effects fish passage during the time of adult coho and fall chinook collection.

There are no adult collection facilities at the Coweeman rearing ponds. Hatchery programs at this facility obtain broodstock from other hatchery facilities.

Supplementation—The Cowlitz Salmon Hatchery spring chinook program is partly intended to restore natural spawning populations of spring chinook in the upper Cowlitz River basin. Current production goals are 300,000 fingerling spring chinook for annual release. As well, hatchery-origin adult returns in excess of annual broodstock needs are transported above Cowlitz Falls Dam as part of the reintroduction program. Reintroduction efforts have been challenged by low success in collecting emigrating juveniles to pass through the hydro system.

This hatchery's late stock coho salmon (Type-N) program also provides for restocking of the upper Cowlitz basin. Annual production goals depend on the availability of adults for natural spawning in the upper basin. If insufficient adults are available, the release goal is 1 million fry annually in the upper Cowlitz. Reintroduction efforts indicate good production capabilities in tributaries above the dams. Although coho smolt collection at the hydroelectric facility has been more successful then chinook, reintroduction efforts are also challenged in passing juveniles through the system.

The Cowlitz Trout Hatchery has an annual goal of restoring natural spawning late-run winter steelhead populations in the upper Cowlitz and Tilton River basins. Current annual release goals are 350,000 fingerlings and 37,500 smolts in the upper watershed. Juvenile downstream migrant passage is better at the hydro-facility then for chinook, and similar to coho.

8.5 Fish Habitat Conditions

8.5.1 Passage Obstructions

The hydropower system blocks upstream passage and has flooded many miles of stream habitat. Now, 100 percent of fall chinook and 60 percent of steelhead spawning in the Cowlitz River mainstem occurs in the lower basin (Mobrand Biometrics 1999). The Cowlitz River Barrier Dam (RM 49.5) blocks most anadromous fish and the Mayfield Dam presents a complete barrier. Some stocks are collected at the Barrier Dam and passed into upper basin streams. A notable passage barrier is a hydroelectric dam on Mill Creek (confluence near the Barrier Dam) that blocks approximately 5.2 miles of anadromous habitat. Culverts, floodgates, inadequate fish ladders, and dams present passage barriers to anadromous fish in many of the smaller tributaries to the lower mainstem Cowlitz. A full description can be found in the limiting factors analysis (Wade 2000).

8.5.2 Stream Flow

Runoff is predominantly generated by rainfall, with a portion of spring flows coming from snowmelt in the upper elevations and occasional winter peaks from rain-on-snow events. Flow in the mainstem is regulated in large part by the hydropower system. Mayfield Dam (RM 52) is operated by Tacoma Power and has a relatively small (133,764 acre-foot) capacity. Behind Mayfield Dam, Mayfield Lake provides little flood storage capacity and flows from Mayfield Dam are largely in response to the regulation of flows through Mossyrock Dam upstream.

Flood flows in the lower mainstem have been substantially reduced due to flow regulation at the dams. Low summer flows have increased due to flow releases designed to protect the fishery resource in the lower river. In general, average summer, fall, and winter flows have increased and average spring flows have decreased since Mayfield Dam came online in 1956 (Figure 8-10). This altered streamflow regime is believed to have improved conditions for some anadromous fish that spawn in the lower river but it is also believed to improve conditions for the intermediate host of the salmonid parasite, Ceratomyxa Shasta (Mobrand Biometrics 1999).

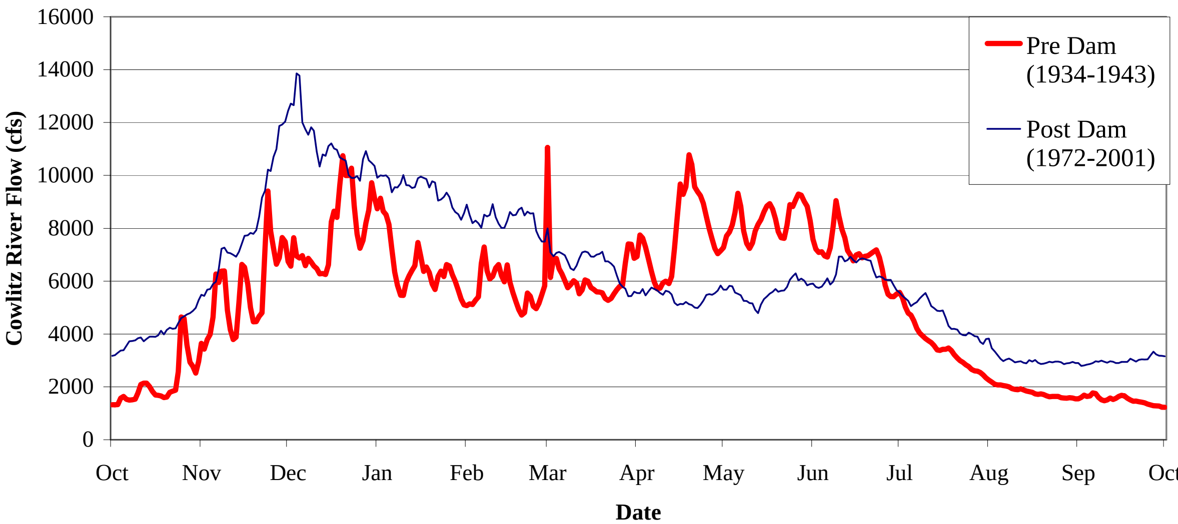


Figure 8-10. Lower Cowlitz River flow pre and post Mayfield Dam (1956). Values are average daily flows. Hydropower operations have altered the annual streamflow regime. Data are from USGS Stream Gage #14238000; Cowlitz River Below Mayfield Dam, Wash.

The Integrated Watershed Assessment (IWA), which is presented in greater detail later in this chapter, indicates that runoff conditions are 'impaired' throughout the basin, with only a couple of exceptions where conditions are 'moderatly impaired'. These ratings are consistent with a peak flow assessment conducted by Lewis County GIS (2000) that identified the entire lower Cowlitz basin as 'impaired' with regards to an elevated risk of peak flow volumes. Hydrologic impairment is related to a number of factors. Much of the developed land in the lower basin has high watershed imperviousness, which contributes to degraded runoff conditions. Other areas have immature forest stands and high forest road densities, which creates a risk of increased peak flow volumes.

Analysis of low flows in Ostrander Creek and several other smaller tributaries to the Cowlitz using the Toe-Width method indicated that flows were below optimal levels in the fall for spawning and rearing (Caldwell et al. 1999). It is believed that low flows are responsible for low production in these streams (Wade 2000).

Based on the population projections and the estimated total groundwater use in the subbasin, the current and future projected groundwater withdrawal appears to be much less than the groundwater available in the basin (LCFRB 2001).

8.5.3 Water Quality

The lower Cowlitz (RM 4.9) was placed on Washington State's 303(d) list for impaired water bodies in 1996 for exceedances of pH, water temperature, and fecal coliform standards. The 1998 list only included this reach as having an exceedance of arsenic levels (WDOE 1998). Elevated dissolved gas levels in the mainstem below the dams have been measured during high flow events (Harza 1999a as cited in Wade 2000). The lead standard was exceeded in one sample collected at Cowlitz River at Toledo (USEPA, STORET database). Several exceedances of temperature and fecal coliform have occurred on Cowlitz tributaries. Pesticide and herbicide chemicals have been detected on Olequa Creek (Wade 2000). A TMDL study was initiated on Salmon Creek in 1999 for fecal coliform, temperature, and turbitity.

8.5.4 Key Habitat

Most of the lower mainstem Cowlitz (up to RM 17) and the lower 4 miles of the Coweeman are tidally influenced and contain pool habitat of low quality due to channelization. Diking, placement of dredge spoils, and transportation corridors have eliminated the bulk of the side-channel habitat on the lower Cowlitz and the lower reaches of tributaries (Wade 2000). Gravel mining has eliminated historical side channel habitat at various sites along the mainstem from RM 20 – 50. Exposed gravel bars along the channel have decreased since 1939. Measures of pool habitat in the mainstem below the Barrier Dam ranged from 3% (10,000 cfs) to 17% (2,140 cfs) (Harza 2000). Stream surveys conducted by the Cowlitz Conservation District in the 1990s identified low pool frequencies in 7 tributaries between RM 20 and 50 (Wade 2000).

8.5.5 Substrate & Sediment

The eruption of Mount St. Helens added an enormous amount of fine sediments to the lower mainstem Cowlitz channel and floodplain. Spawning size gravel is limited in the mainstem from Mayfield Dam to the Cowlitz Trout Hatchery due to transport capacity exceeding input. The opposite occurs between the I-5 Bridge and the Trout Hatchery, resulting in large accumulations of gravels and transport to downstream reaches (Harza 1999). There are excessive quantities of substrate fines below the Barrier Dam due to land-use activities in the lower basin (Mobrand Biometrics 1999). The limiting factors TAG identified numerous problems with substrate fines in tributary streams. A detailed description can be found in the WRIA 26 Limiting Factors Analysis (Wade 2000).

Sediment supply conditions were evaluated as part of the IWA watershed process modeling, which is presented in greater detail later in this chapter. IWA model results estimate 'moderately impaired' sediment supply conditions throughout the basin. Exceptions include the lowermost subwatersheds, which are 'impaired', and the Little Salmon Creek, Skook Creek, and portions of the upper Lacamas Creek drainage, which rate as 'functional'. Sediment supply impairments are related to road and vegetative cover conditions. Road densities in the lower Cowlitz basin are consistently greater than 4 mi/mi^2 and are greater than 7 mi/mi^2 in some areas. Approximately 31% of anadromous stream channels have stream-adjacent roads (Lewis County GIS 2000).

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.

8.5.6 Woody Debris

The lower 20 miles of the Cowlitz mainstem and most of the smaller tributaries have low quantities of stable LWD due to scour from past splash damming and/or active removal. Given its large size, this reach may never have been able to retain LWD (Wade 2000). However, the lower mainstem above the Toutle and Coweeman Rivers historically contained large log jams (Mobrand Biometrics 1999). An analysis of historical aerial photographs revealed many accumulations of logs along channel margins in 1939, attributed to upstream harvest practices and subsequent flood deposition. A lack of wood observed in 1960s photos was attributed to removal for fish habitat improvement and a lack of recruitment potential due to harvest. A slight increase in in-stream wood observed on 1996 photos is assumed to be the result of discontinued stream cleaning practices and increased recruitment due to the re-growth of riparian forests (Harza 2000). Stream surveys and observations in the Cowlitz tributaries between RM 20 and 52 have identified a general lack of in-stream LWD.

8.5.7 Channel Stability

Bank stability is generally good along the lower Cowlitz mainstem though erosion of dredge spoils may be a concern in some areas. Bank stability problems have been observed from RM 20 – 25, however, overall stability may have been enhanced along the lower mainstem due to hydropower regulation (Mobrand Biometrics 1999). Bank stability problems in the small lower Cowlitz tributaries are identified in the limiting factors analysis. Many of these are related to cattle impacts (Wade 2000).

8.5.8 Riparian Function

Riparian forests along the lower 20 miles of the Cowlitz River and within the lower reaches of the smaller tributaries have been severely degraded through industrial and commercial development. Agriculture and forestry activities have also impacted riparian areas. Riparian forests on the Cowlitz River from RM 20 – 52 lack mature forests and adequate buffer widths (Wade 2000). An aerial photo analysis on this reach revealed that coniferous cover types currently make up less of the riparian forest than they did historically. Gravel bars currently have more vegetative cover compared to conditions in 1939, possibly due to reduction of flood flows by upstream dams. Another change since 1939 is a decrease in the meadow/grasslands cover type, likely related to current agriculture, shrub encroachment, and residential uses (Harza 2000).

According to IWA watershed process modeling, which is presented in greater detail later in this chapter, about half of the subwatersheds in the lower Cowlitz basin are ‘impaired’ and half are ‘moderately impaired’. One subwatershed, located in the headwaters of Cedar Creek (Salmon Creek tributary), was rated as ‘functional’. The greatest impairment occurs in the lower basin that has experienced widespread development. Impaired areas are also located along Olequa and Lacamas Creeks, which have received impacts related to agriculture, grazing, residential development, and forestry activities.

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.

8.5.9 Floodplain Function

The lower 20 miles of the Cowlitz has experienced severe loss of floodplain connectivity due to dikes, riprap, and/or deposited dredge spoils originating from the Mount St. Helens eruption. Only the Sandy River Bend area near Castle Rock retains connected floodplain habitat. Floodplain loss in the lower reaches of many of the smaller tributaries is a result of I-5, the railroad corridor, and the placement of dredge spoils (Wade 2000).

The mainstem Cowlitz between RM 20 and RM 52 (Mayfield Dam) has scattered areas with bank revetments, though floodplain connection is generally in good shape. However, there has been a decrease in total square feet of habitat per mile from 1936 to 1996 (Mobrand Biometrics 1999). Channel incision, diking, dredging, bank hardening, and various types of development have disconnected floodplains from channels in several tributaries to this reach. A detailed description is given in the limiting factors analysis (Wade 2000).

8.6 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 Lower Cowlitz River fall Chinook, chum, coho, and winter steelhead. 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.

8.6.1 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 Lower Cowlitz basin for fall chinook, chum, coho and winter steelhead. Model results indicate the largest proportional decrease in adult productivity has occurred with winter steelhead, though results are similar for both chum and coho (Table 8-1). The estimated proportional changes in adult abundance vary depending on the species, with chum experiencing a dramatic 96% decline from historical numbers (Figure 8-11). This can be attributed to severe degradation of the historically available chum habitat in the lower river. Winter steelhead, coho, and fall chinook declines have also been severe, with respective declines in abundance of 89%, 76%, and 64% (Figure 8-11). Diversity (as measured by the diversity index) has declined for all species (Table 8-1), with winter steelhead and chum diversity declining by 77% and 56%, respectively.

Smolt productivity has also declined from historical levels for each species in the lower Cowlitz basin (Table 8-1). For fall chinook and chum, smolt productivity has decreased by 57% and 44% respectively. For both coho and winter steelhead the decrease was estimated as approximately 75% and 83%, respectively. Smolt abundance in the lower Cowlitz has declined most dramatically for chum, with an estimated 94% decrease from historical levels (Table **8-1**).

Current fall chinook, coho, and winter steelhead smolt abundance levels are modeled at approximately 20-40 % of historical numbers (Table 8-1).

In all cases, model results indicate that restoration of PFC conditions would produce substantial benefits. Chum and winter steelhead would see the greatest proportional benefit in adult returns. Current winter steelhead returns would increase by an estimated 582%, and current chum return would increase by an estimated 639% (Table 8-1). Changes in smolt abundance due to restoration of PFC are similar to the adult trends, with all species greatly benefiting from the restoration (Table 8-1).

Table 8-1. Lower Cowlitz— 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	8,873	20,865	24,356	5.9	11.0	14.5	0.65	1.00	1.00	1,484,327	3,049,618	3,809,863	551	998	1,295
Chum	6,239	46,130	166,140	1.9	6.7	9.8	0.44	1.00	1.00	3,080,762	21,871,960	48,310,830	582	883	1,042
Coho	4,144	15,655	17,626	4.2	12.4	17.1	0.81	0.96	1.00	83,989	338,523	381,605	91	264	359
Winter Steelhead	198	1,352	1,727	2.3	10.0	26.1	0.23	0.39	1.00	3,913	25,618	17,101	45	193	271

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

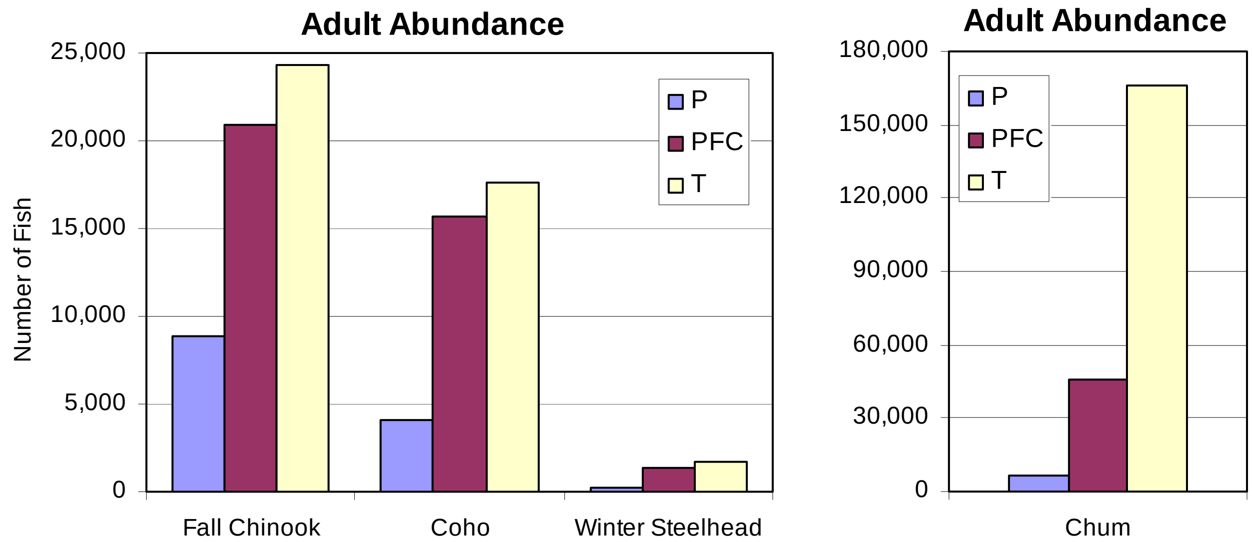


Figure 8-11. Adult abundance of Lower Cowlitz fall chinook, coho, winter steelhead and chum based on EDT analysis of current (P or patient), historical (T or template), and properly functioning (PFC) habitat conditions.

8.6.2 Restroration and Preservarion 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.

Winter steelhead make extensive use of the available lower Cowlitz habitats, reaching well into Olequa, Lacamas, Salmon, Arkansas, Delameter, and Monahan Creeks. In contrast, fall chinook use primarily only mainstem habitats from the mouth to the barrier dam. Chum and coho also use mostly mainstem habitats but will make some use of the lower reaches of tributary habitats. See Figure 8-12 for a map of EDT reaches within the Lower Cowlitz basin.

High priority reaches for fall chinook include the two middle Cowlitz reaches, Mid Cowlitz 3 and Mid Cowlitz 4 (Figure 8-13). These reaches, along with most other important fall chinook reaches, show a strong preservation emphasis. Important reaches for chum include mainstem reaches (Lower Cowlitz 1, and Mid Cowlitz 6 and 7), as well as tributary reaches (Lacamas Cr 1, Olequa Cr 1, and Salmon Cr 1 and 2) (Figure 8-14). These high priority reaches show mixed recovery emphases, with reach Lower Cowlitz 1 having the largest restoration potential of any reach modeled for chum.

For coho, high priority reaches are spread throughout the basin (Figure 8-15). The majority of these important reaches are located in tributaries, such as Olequa Creek, Lacamas Creek, Salmon Creek, and Stillwater Creek. The vast majority of reaches modeled for coho show a restoration recovery emphasis, with reaches Olequa Cr 7 and Arkansas Cr 1 having the largest restoration potential of any reach modeled for coho.

High priority reaches for winter steelhead are located in mainstem areas (Mid Cowlitz 6 and 7) and tributaries (Olequa Cr 2-4, Stillwater Cr 5 and Salmon Cr 2) (Figure 8-16). The importance of these reaches is primarily for juvenile rearing though some limited spawning occurs here. As with coho, the vast majority of reaches modeled for winter steelhead show a restoration recovery emphasis, with Olequa Cr 2 and 3 having the largest restoration potential of any reach modeled for steelhead.

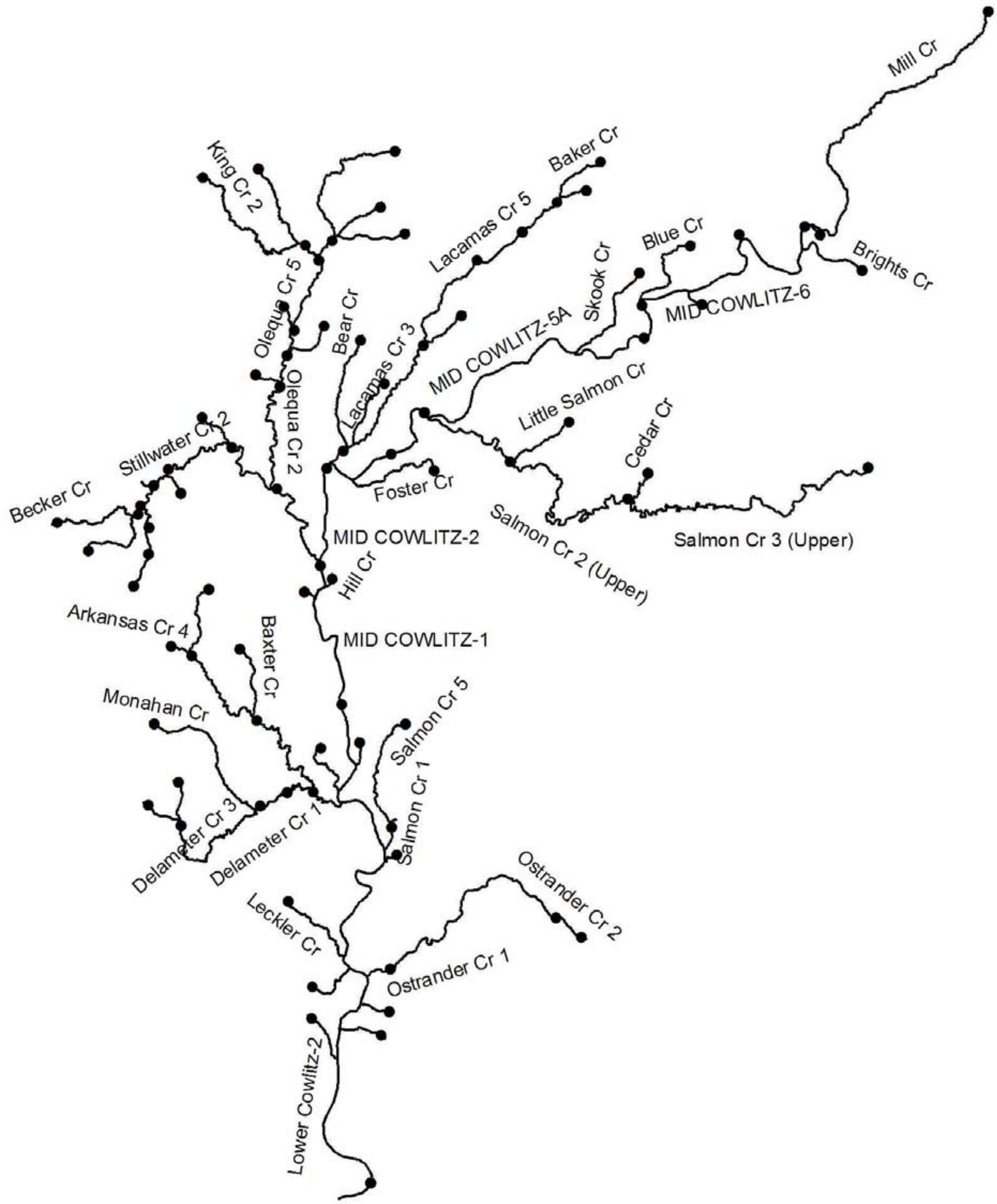


Figure 8-12. Lower Cowlitz basin EDT reaches. Some reaches not labeled for clarity.

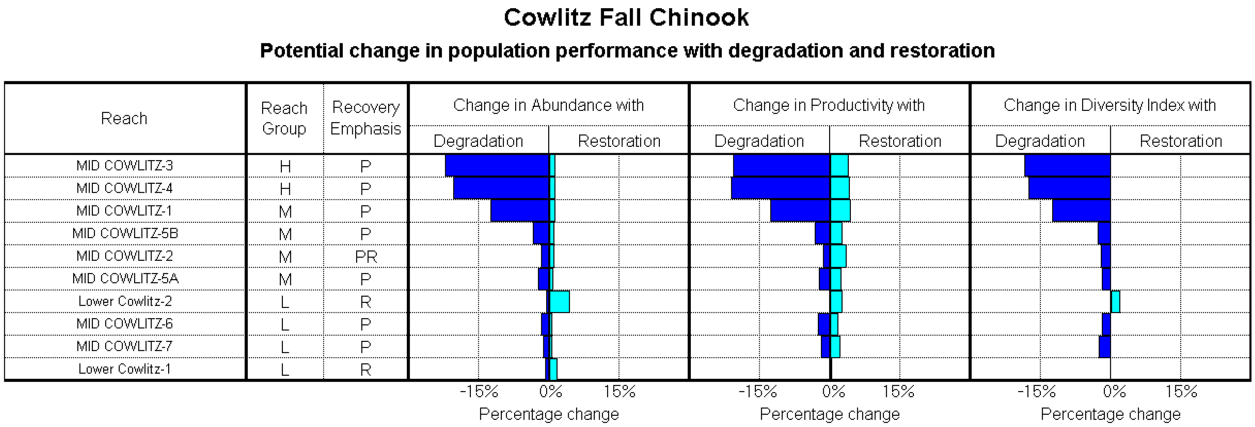


Figure 8-13. Lower Cowlitz fall chinook ladder diagram. The rungs on the ladder represent the reaches and the three ladders contain a preservation value and restoration potential based on abundance, productivity, and diversity. The units in each rung are the percent change from the current population. For each reach, a reach group designation and recovery 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.

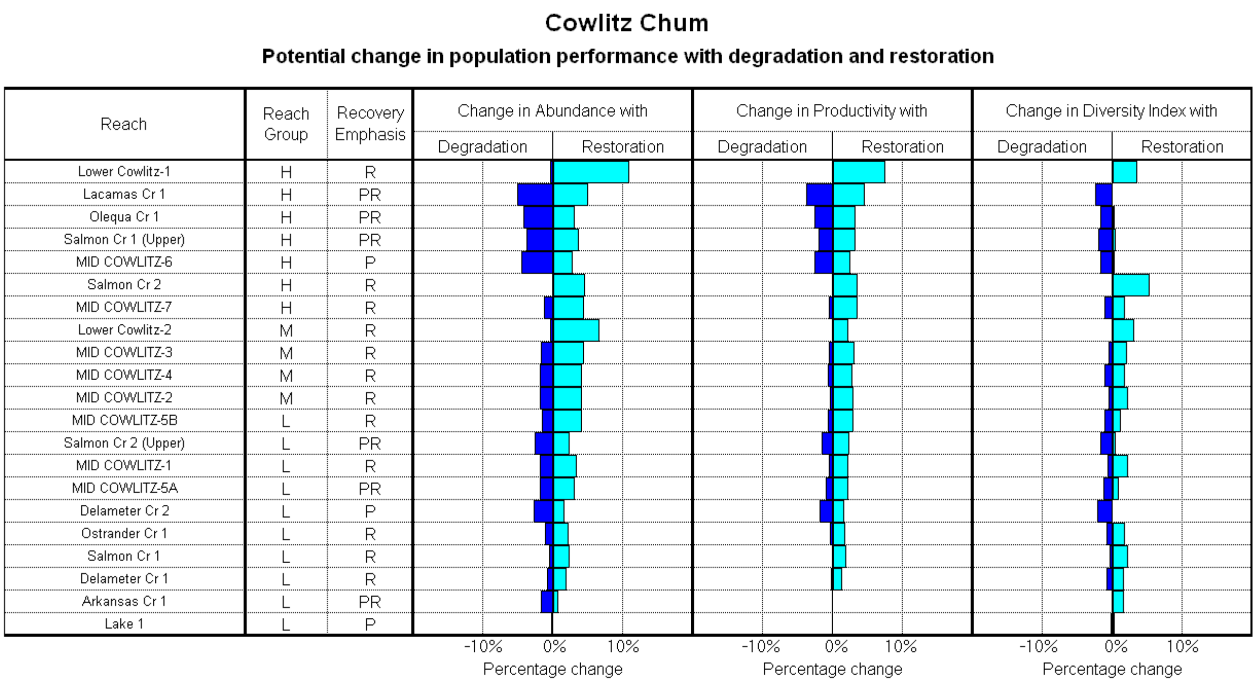


Figure 8-14. Lower Cowlitz subbasin chum ladder diagram.

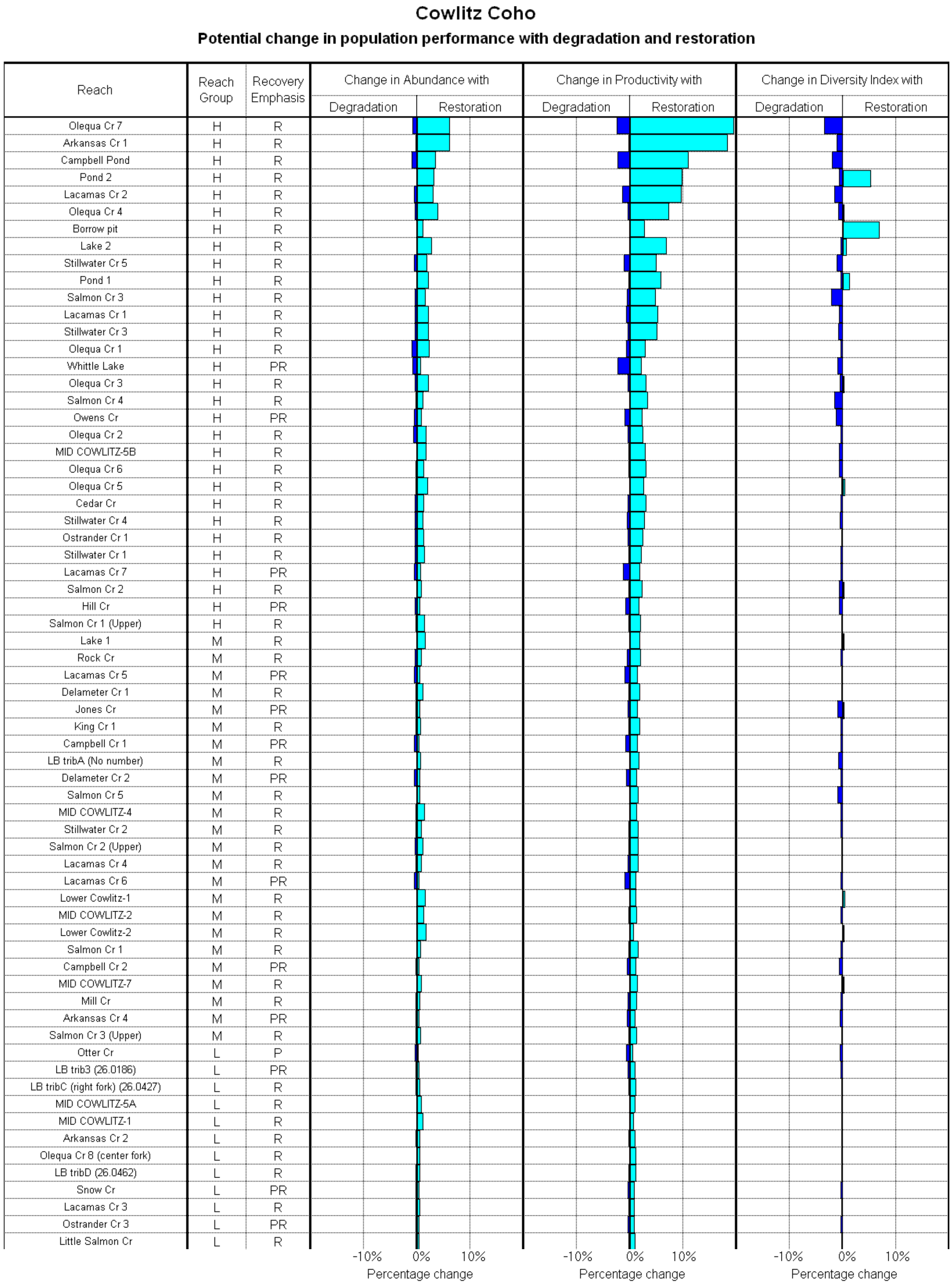


Figure 8-15. Cowlitz River subbasin coho ladder diagram. Some low priority reaches are not included for display purposes.

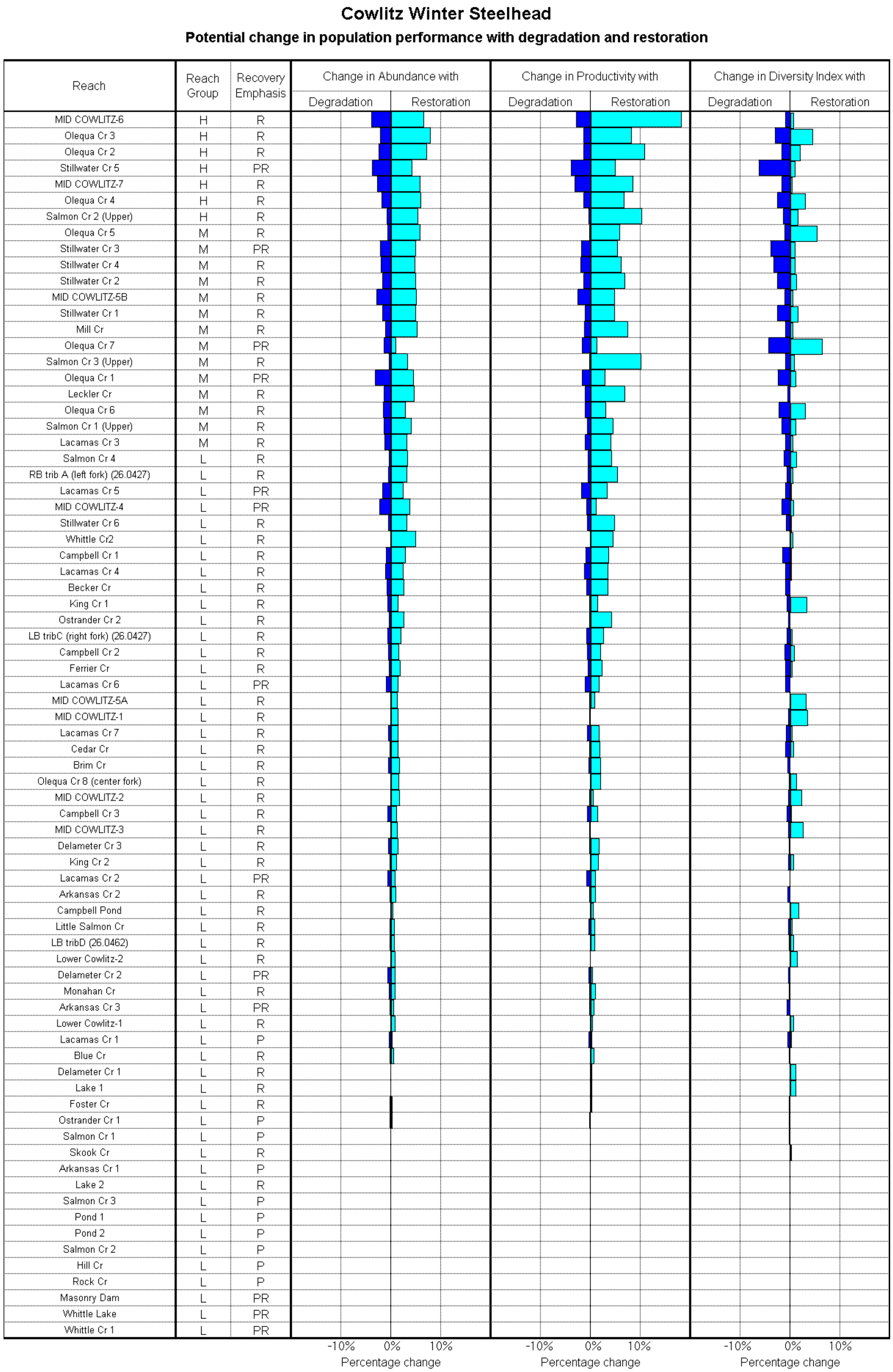


Figure 8-16. Cowlitz River subbasin winter steelhead ladder diagram.

8.6.3 *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 habitat factor analysis for winter steelhead identified numerous impacts to current population performance. High impact attributes in steelhead stream reaches include habitat diversity, temperature, sediment, flow, and channel stability (Figure 8-17). Habitat diversity is low due to degraded riparian areas, low LWD levels, and incised channels. There is a risk of increased peak flow due to upper basin timber harvest, roads, and an increase in impervious surfaces due to residential and agricultural development. Low flows have been identified as a problem for summer rearing (Caldwell et al. 1999). Sediment contributions stem from high road densities and agriculture/grazing practices. Degraded riparian areas affect temperature, food, and channel stability.

For the fall chinook population, primary habitat impacts are due to sediment, channel stability, and habitat diversity (Figure 8-18). The channel is severely channelized by dikes, which have served to simplify and limit available habitat. Riparian areas are in poor condition and LWD levels are low. Historically, large log jams may have been present in the lower mainstem. Stream cleanouts in the 1960s, reduced recruitment due to riparian harvest, and intercepted transport from upstream due to the dams has significantly reduced LWD levels.

High priority reaches for chum have also been negatively impacted by habitat degradation. In these reaches, habitat diversity, key habitat and sediment have had the greatest impact (Figure 8-19). Loss of habitat diversity is related to increased bed scour as a result of confinement, degraded riparian areas, and a lack of LWD. Key habitat has been reduced due to the dramatic reduction in historically available side-channels. Sediment input is a major factor and primarily stems from sediments originating from the 1980 Mount St. Helens eruption that are delivered via the Toutle River. These same conditions also serve to increase the risk of elevated peak flows. Furthermore, silvaculture, agriculture, and residential development have impacted riparian zones and LWD recruitment rates.

Coho habitat in the lower Cowlitz subbasin has been affected by a variety of factors. These impacts include loss of habitat diversity, increased sediment, loss of key habitat, reduced channel stability and an altered temperature regime (Figure 8-20). The causes of these impacts are the same as those mentioned above.

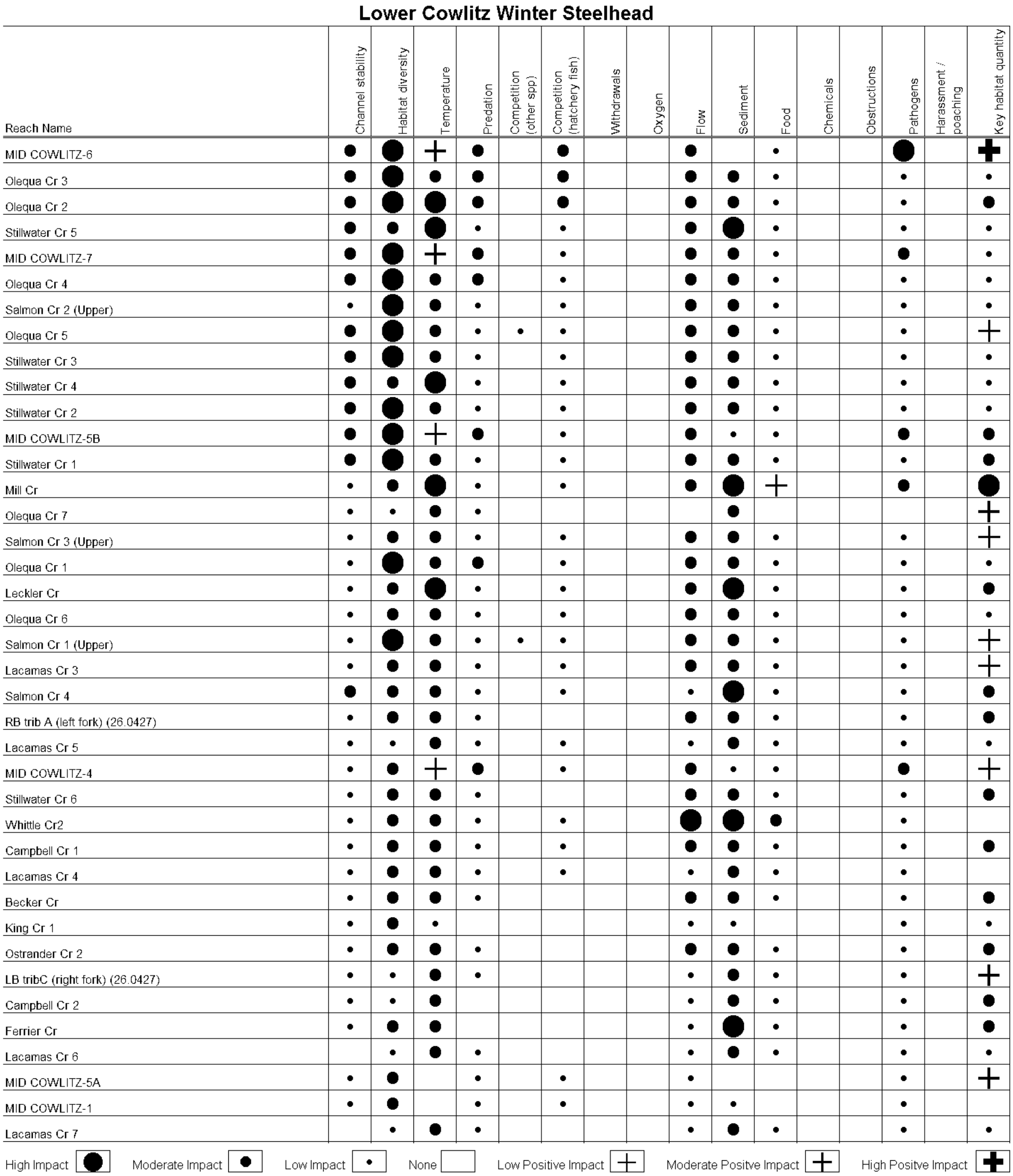


Figure 8-17. Lower Cowlitz winter steelhead habitat factor analysis diagram. Diagram displays the relative impact of habitat factors in specific reaches. The reaches are ordered according to their restoration and preservation rank, which factors in their potential benefit to overall population abundance, 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.

Lower Cowlitz 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
MID COWLITZ-3	Moderate	Moderate		Low		Low			Low	High	Low			Low	Low	Moderate Positive
MID COWLITZ-4	Moderate	Moderate		Low		Low			Low	Moderate	Low			Low	Low	Moderate Positive
MID COWLITZ-1	Moderate	Moderate		Low		Low			Low	High	Low			Low	Low	High Positive
MID COWLITZ-5B	Moderate	Moderate	Low Positive	Low					Low	Low	Low			Low	Low	Low
MID COWLITZ-2	Moderate	Moderate		Low		Low			Low	High	Low			Low	Low	Moderate Positive
MID COWLITZ-5A	Moderate	Moderate		Low					Low	Low	Low			Low	Low	Moderate Positive
Lower Cowlitz-2	High	High	Low	Low	Low	Low			Moderate	High	Low			Low	Low	High Positive
MID COWLITZ-6	Moderate	Low		Low					Low		Low			Low		Moderate Positive
MID COWLITZ-7	Moderate	Moderate							Low	Moderate	Low			Low		Low Positive
Lower Cowlitz-1	Moderate	Moderate	Low	Low	Low	Low			Low	Low	Low			Low	Low	Moderate Positive

High Impact | Moderate Impact | Low Impact | None | Low Positive Impact | Moderate Positve Impact | High Positve Impact

Figure 8-18. **Lower Cowlitz fall chinook habitat factor analysis diagram.**

Lower Cowlitz 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
Lower Cowlitz-1	Moderate	High		Low	Low				Moderate	Moderate	Low			Low	Moderate	High
Lacamas Cr 1	Moderate	High		Low	Low				Moderate	Moderate	Moderate					Moderate
Olequa Cr 1	Low	Moderate		Low					Low	Moderate	Low					Moderate
Salmon Cr 1 (Upper)	Low	Moderate			Low				Low	Moderate	Low					Moderate
MID COWLITZ-6	Low	Moderate		Low					Low		Low			Low	Low	
Salmon Cr 2	Low	High							Low	Low	Low				Low	Moderate
MID COWLITZ-7	Low	High		Low					Moderate	Low	Low			Low	Low	Moderate
Lower Cowlitz-2	Moderate	High		Low	Low				Moderate	Moderate	Low			Low	Low	High
MID COWLITZ-3	Low	Moderate		Low					Low	Moderate	Low			Low	Low	Moderate
MID COWLITZ-4	Low	Moderate		Low					Low	Low	Low			Low	Low	Moderate
MID COWLITZ-2	Low	High		Low					Low	Moderate	Low			Low	Low	Moderate
MID COWLITZ-5B	Low	Moderate		Low					Low	Low	Low			Low	Low	Moderate
Salmon Cr 2 (Upper)	Low	Moderate							Low	Moderate	Low					Low
MID COWLITZ-1	Low	Moderate		Low					Low	Moderate	Low			Low	Low	Moderate
MID COWLITZ-5A	Low	Moderate		Low					Low	Low	Low			Low	Low	Moderate
Delameter Cr 2	Low	Moderate							Low	Moderate	Low					Low
Ostrander Cr 1	Low	Moderate							Low	Moderate	Low					Moderate
Salmon Cr 1	Low	Moderate							Low	Low	Low					Moderate
Delameter Cr 1	Low	Moderate							Low	Low	Low				Low	Moderate
Arkansas Cr 1	Low	Low							Low		Low					Low
Lake 1																

High Impact | Moderate Impact | Low Impact | None | Low Positive Impact | Moderate Positve Impact | High Positve Impact

Figure 8-19. **Lower Cowlitz chum habitat factor analysis diagram.**

Lower Cowlitz Coho

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
Olequa Cr 7	High	High	High	Moderate		Moderate			Moderate	High	Moderate					High
Arkansas Cr 1	High	High	High	Low	Low	Low		Low	Moderate	High	Moderate					High
Campbell Pond	High	High	High	Low		Low			Moderate	High	Moderate					High
Pond 2	Moderate	High	High	Low	Low	Low			Moderate	High	Moderate					Moderate
Lacamas Cr 2	High	High	Moderate	Low		Moderate			Moderate	High	Low			Low		Moderate
Olequa Cr 4	Moderate	High	Moderate	Moderate		Moderate			Moderate	Moderate	Moderate			Low		High
Borrow pit	Moderate	Moderate	Moderate			Low			Moderate	High	Low					Low Positive
Lake 2	High	High	Moderate		Low	Low			Moderate	Moderate	Moderate					High
Stillwater Cr 5	Moderate	Moderate	Moderate			Low			Moderate	Moderate	Low					Moderate
Pond 1	Low	High	Moderate		Low	Low			Moderate	High	Moderate					High Positive
Salmon Cr 3	Moderate	Moderate	Moderate	Low		Low			Moderate	Moderate	Moderate			Low		Low Positive
Lacamas Cr 1	Moderate	Moderate	Moderate	Low	Low	Moderate			Moderate	Moderate	Moderate			Low		Moderate
Stillwater Cr 3	Moderate	High	Moderate			Low			Moderate	Moderate	Low					Low
Olequa Cr 1	Moderate	High	Moderate	Moderate		Low			Moderate	Moderate	Low			Low		Low
Whittle Lake		Moderate	Low						Low	Moderate	Low					
Olequa Cr 3	Moderate	High	Moderate	Low		Low			Moderate	Moderate	Moderate			Low		Moderate
Salmon Cr 4	Moderate	Moderate	Moderate	Low		Low			Moderate	Moderate	Low					Low Positive
Owens Cr	Moderate	Moderate	Low						Low	High	Low					Moderate
Olequa Cr 2	Moderate	High	Moderate	Low		Low			Moderate	Moderate	Low			Low		Moderate
MID COWLITZ-5B	Moderate	High	Low Positive	Low		Low			Low	Low	Low			Moderate		High
Olequa Cr 6	Moderate	Moderate	Moderate	Low		Low			Low	Moderate	Low					Moderate
Olequa Cr 5	Moderate	High	Moderate	Low	Low	Low			Moderate	Low	Low					High
Cedar Cr	Moderate	Moderate	Moderate						Low	Moderate	Low					Moderate
Stillwater Cr 4	Moderate	Moderate	Moderate						Low	Moderate	Low					Low
Ostrander Cr 1	Moderate	Moderate	Moderate			Low			Moderate	High	Moderate					Moderate
Stillwater Cr 1	Moderate	High	Moderate						Moderate	Low	Low					Low
Lacamas Cr 7	Moderate	Low	Moderate						Low	Moderate	Low			Low		Moderate
Salmon Cr 2	Moderate	Moderate	Low						Low	Moderate	Low					Low Positive
Hill Cr	Moderate	Low	Low						Low	Moderate	Low					Low
Salmon Cr 1 (Upper)	Moderate	High	Moderate		Low	Low			Moderate	Moderate	Moderate			Low		Moderate
Lake 1	Moderate	High	Moderate		Low	Low			Moderate	Moderate	Low					Moderate
Rock Cr	Moderate	Moderate	Low						Low	High	Low					High
Lacamas Cr 5	Low	Low	Moderate	Low		Low			Low	Moderate	Low			Low		Low
Delameter Cr 1	Moderate	Moderate	Moderate		Low	Low			Low	Moderate	Low					Low
Jones Cr	Moderate	Moderate	Low						Low	Moderate	Low					Moderate
King Cr 1	Moderate	Moderate	Low						Low	Moderate	Low					Moderate
Campbell Cr 1	Low	Low	Low						Low	Moderate	Low					High Positive
LB tribA (No number)	Moderate	Moderate	Low						Low	Moderate	Low					Moderate
Delameter Cr 2	Low	Low	Low						Low	Moderate	Low					Low Positive
Salmon Cr 5	Moderate	Moderate	Low			Low			Low	Moderate	Low					Low Positive
MID COWLITZ-4	Moderate	High		Low		Low			Low	Low	Low			Moderate		Moderate
Stillwater Cr 2	Low	Moderate	Low						Low	Low	Low					Low
Salmon Cr 2 (Upper)	Moderate	Moderate	Moderate	Low		Low			Low	Moderate	Low					Low Positive
Lacamas Cr 4	Low	Moderate	Low	Low		Low			Low	Low	Low					Moderate
Lacamas Cr 6	Low	Low	Moderate						Low	Moderate	Low					Low
Lower Cowlitz-1	Low	High	Low	Low		Low			Low	Low	Low			Low		Moderate
MID COWLITZ-2	Low	High		Low		Low			Low	Low	Low			Moderate		Moderate

High Impact | Moderate Impact | Low Impact | None | Low Positive Impact | Moderate Positve Impact | High Positve Impact

Figure 8-20. Lower Cowlitz coho habitat factor analysis diagram. Some low priority reaches are not included for display purposes.

8.7 Integrated Watershed Assessment (IWA)

The lower Cowlitz watershed, which encompasses a total of 483 square miles, is divided into 40 subwatersheds for the IWA. The upstream end of the lower Cowlitz watershed terminates at Mayfield Dam. Upstream of the dam are the Mayfield-Tilton, Riffe Lake, Cispus River, and Upper Cowlitz watersheds. These seven watersheds comprise the Cowlitz River subbasin. The subbasin is predominantly rain dominated, with little area within the rain-on-snow zone. The subbasin is almost entirely privately owned, with urban, residential, and agricultural development in the lower elevations and private commercial timber land in the middle and upper elevations.

8.7.1 Results and Discussion

IWA results were calculated for all subwatersheds in the lower Cowlitz watershed. IWA results are calculated at the local level (i.e., within 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). These results are shown in Table 8-2 Very few subwatersheds are rated as functional for any of the processes evaluated using the local- and watershed-level IWA analyses. Based on the local level analysis, 38 of the subwatersheds (95%) were determined to be hydrologically impaired and 2 were rated as moderately impaired (Cedar and Mill Creek). When upstream effects are considered, an estimated 33 and 5 subwatersheds were found to be impaired and moderately impaired, respectively. A reference map showing the location of each subwatershed in the basin is presented in Figure 8-21. Maps of the distribution of local and watershed level IWA results are displayed in Figure 8-22.

Table 8-2. IWA results for the lower Cowlitz watershed

Subwatershed[a]	Local Process Conditions[b]			Watershed Level Process Conditions[c]		Upstream Subwatersheds[d]
	Hydrology	Sediment	Riparian	Hydrology	Sediment	
80407						TOUTLE
80201	I	M	I	I	M	none, east Willapa
80203	I	I	I	I	M	east Willapa
70606, 80201, 80202, 80203	I	I	I	I	M	60101, 60102, 60103, 60104, 60201, 60202, 60301, 60302, 60303, 60304, 60305, 60401, 60402, 60403, 60404, 60405, 60406, 60407, 60408, 70101, 70102, 70103, 70104, 70105, 70201, 70202, 70203, 70204, 70205, 70501, 70502, 70503, 70504, 70505, 70601, 70605, 80202
80201						60101, 60102, 60103, 60104, 60201, 60202, 60301, 60302, 60303, 60304, 60305, 60401, 60402, 60403, 60404, 60405, 60406, 60407, 60408, 70101, 70102, 70103, 70104, 70105, 70201, 70202, 70203, 70204, 70205, 70501, 70502, 70503, 70504, 70505, 70601, 70605, 70606
80202	I	M	I	I	M	none
80203	I	I	I	I	M	none
70504	I	M	I	I	M	70501, 70502, 70503, 70505
70501	I	M	M	I	M	none
70501--70502	I	M	I	I	M	70501
70502	I	M	I	I	M	70501
70503	I	I	M	I	I	none
70504						
70505	I	M	M	I	M	70503
70601	I	M	M	I	M	none
70605	I	M	M	I	M	60101, 60102, 60103, 60104, 60201, 60202, 60301, 60302, 60303, 60304, 60305, 60401, 60402, 60403, 60404, 60405, 60406, 60407, 60408, 70101, 70102, 70103, 70104,70105, 70201, 70202, 70203, 70204, 70205, 70501, 70502, 70503, 70504, 70505, 70601
70606	I	I	I	I	M	60101, 60102, 60103, 60104, 60201, 60202, 60301, 60302, 60303, 60304, 60305, 60401, 60402, 60403, 60404, 60405, 60406, 60407, 60408, 70101, 70102, 70103, 70104, 70105, 70201, 70202, 70203, 70204, 70205, 70501, 70502, 70503, 70504, 70505, 70601, 70605

Subwatershed[a]	Local Process Conditions[b]			Watershed Level Process Conditions[c]		Upstream Subwatersheds[d]
	Hydrology	Sediment	Riparian	Hydrology	Sediment	
70605, 70606	I	I	I	I	M	60101, 60102, 60103, 60104, 60201, 60202, 60301, 60302, 60303, 60304, 60305, 60401, 60402, 60403, 60404, 60405, 60406, 60407, 60408, 70101, 70102, 70103, 70104, 70105, 70201, 70202, 70203, 70204, 70205, 70501, 70502, 70503, 70504, 70505, 70601, 70605
70104	I	M	M	I	M	70105
70104, 70105	I	M	M	I	M	70105
70103	I	M	M	I	M	70101, 70102, 70104, 70105, 70201, 70202, 70203, 70204, 70205
70102	I	M	I	I	M	70101
70101	I	M	M	I	M	none
70201	I	M	I	I	M	none
70202	I	M	I	I	M	none
70203	I	M	I	I	M	none
70204	I	M	I	I	M	70201, 70202, 70203
70205	I	M	I	I	M	70201, 70202, 70203, 70204
60408	I	M	I	I	M	60101, 60102, 60103, 60104, 60201, 60202, 60301, 60302, 60303, 60304, 60305, 60401, 60402, 60403, 60404, 60405, 60406, 60407
60401	I	F	I	I	F	none
60402	I	M	M	I	M	none
60403	I	F	M	M	M	60101, 60102, 60103, 60104, 60402
60404	M	F	I	M	F	none
60405	I	M	M	I	F	60401
60406	I	M	M	I	F	60401, 60405, 60404
60202	I	M	M	I	M	60201
60103	I	M	M	I	M	60104
60303	I	F	M	I	M	none
60302	I	M	M	I	M	60201, 60202, 60304, 60305
60301, 60304	I	M	M	I	M	60305
60304	I	M	M	I	M	60305
60305	I	M	M	I	M	none

Subwatershed[a]	Local Process Conditions[b]			Watershed Level Process Conditions[c]		Upstream Subwatersheds[d]
	Hydrology	Sediment	Riparian	Hydrology	Sediment	
60403, 60407	I	M	I	I	M	60101, 60102, 60103, 60104, 60201, 60202, 60301, 60302, 60303, 60402, 60403
60102	I	M	M	M	M	60103, 60104, 60402
60101, 60102	I	M	M	M	M	60103, 60104, 60402
60101	I	M	M	M	M	60103, 60104
60201	M	M	F	M	M	none
60104	I	M	M	I	M	none
80101	I	M	M	I	M	none
80102	I	M	M	I	M	80101

Notes:

[a] LCFRB subwatershed identification code abbreviation. All codes are 14 digits starting with 170800010#####.

[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.

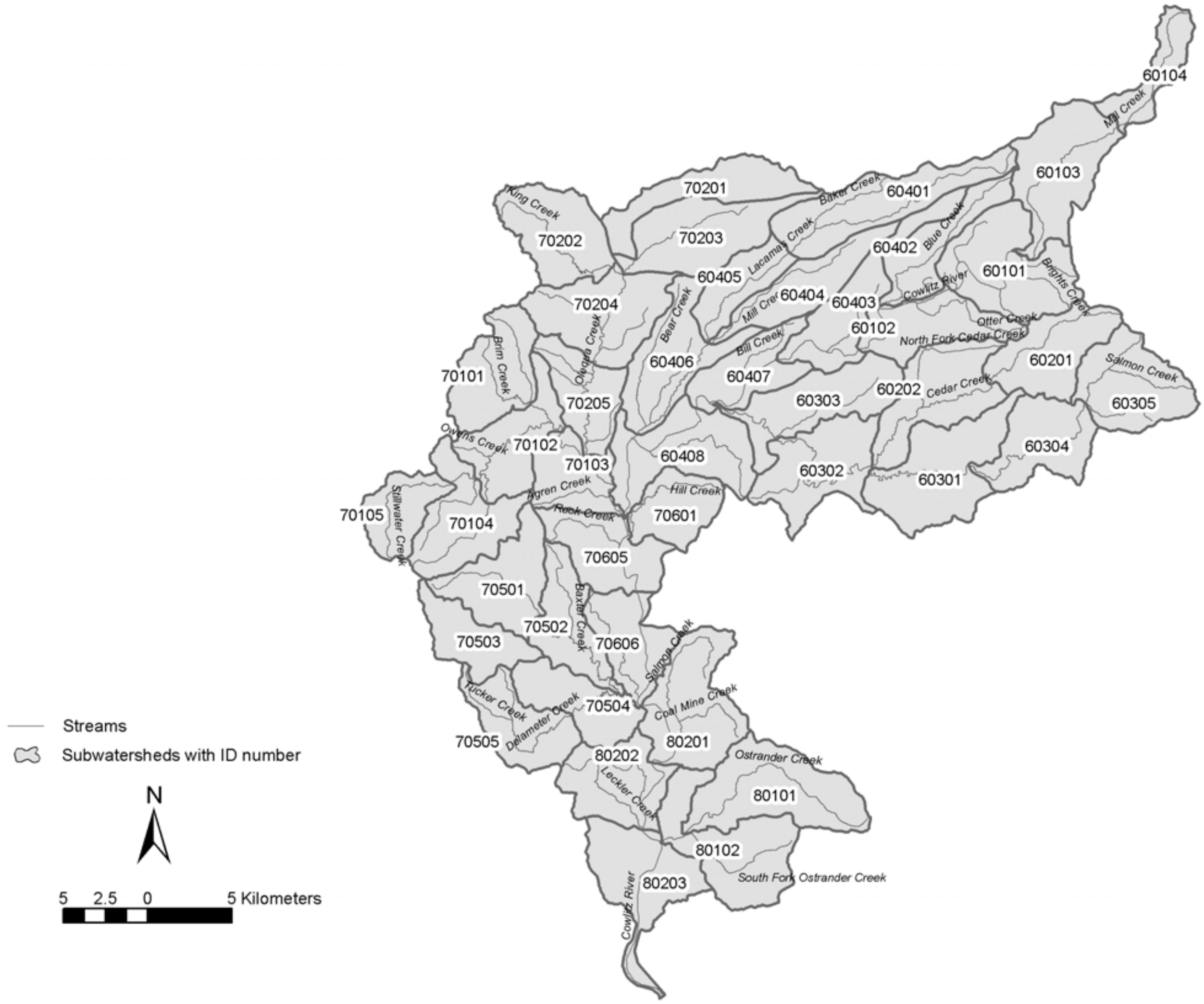


Figure 8-21. Map of the lower Cowlitz basin showing the location of the IWA subwatersheds

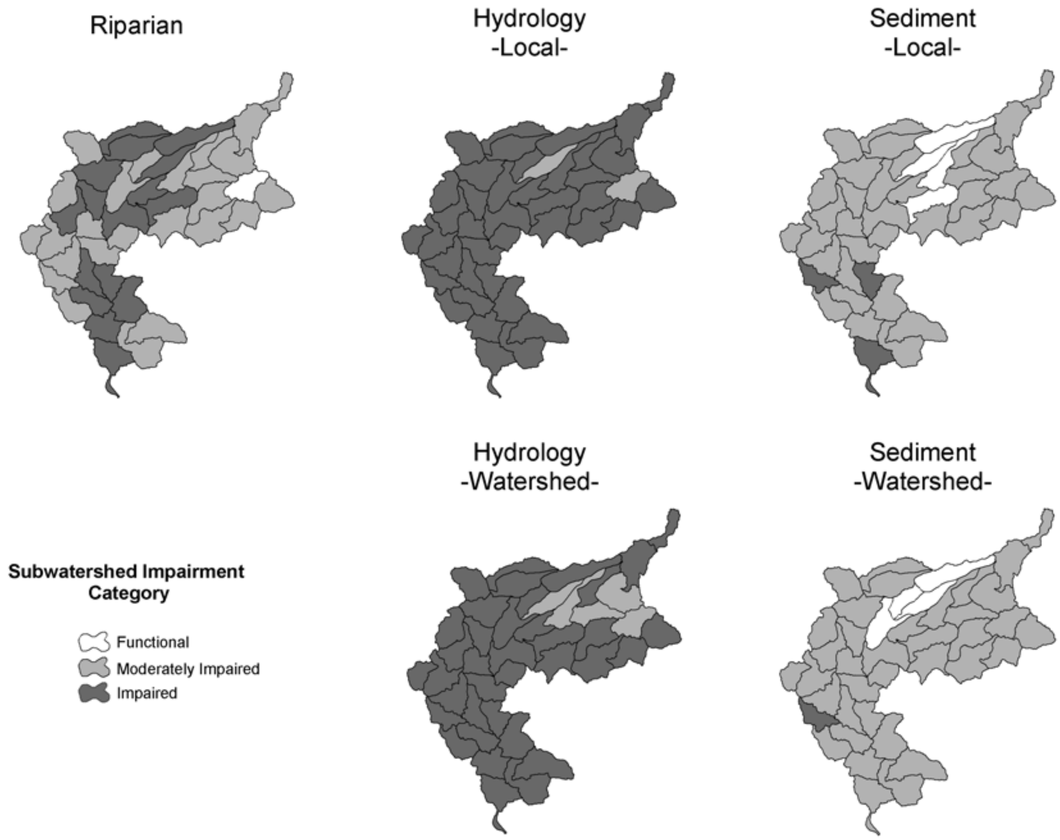


Figure 8-22. IWA subwatershed impairment ratings by category for the lower Cowlitz basin

Most subwatersheds are rated moderately impaired for sediment conditions. Sediment conditions were rated as impaired in three subwatersheds and functional in four. The four subwatersheds rated as functional are located in tributary subwatersheds, notably Little Salmon Creek, Skook Creek, Mill Creek and the Lacamas Creek drainage. Riparian conditions are mixed, but generally degraded with only one subwatershed rated functional and the remainder rated moderately impaired or impaired.

8.7.1.1 Hydrology

Local level hydrologic conditions in the lower Cowlitz watershed are impaired in virtually all subwatersheds, with only two moderately impaired subwatersheds located off the upper mainstem. The lower mainstem of the Cowlitz River has undergone extensive agricultural and residential development. Population centers in the subbasin consist primarily of small rural towns, with the larger towns of Castle Rock, Kelso, and Longview situated along the lower river. The hydrologic impacts of development include increased magnitude, frequency, and intensity of storm runoff, reduced ground water recharge, and lower stream flows during summer baseflow periods. These effects stem from vegetation removal, an increase in the quantity of impervious surfaces, and an increase in the channel network. Thirty-nine of 40 subwatersheds have less than 50% of total area in hydrologically mature forest cover. It should be noted, however, that much of this area is in what was once lowland prairie, and sparse tree cover is a natural condition in some areas. In the mainstem Cowlitz, impacts to streamflow may be overshadowed by the effects of hydro-regulation.

Watershed level results for hydrologic condition are generally similar, with the exception that hydrologic conditions rated as impaired at the local level in three subwatersheds become moderately impaired at the watershed level, due to the influence of upstream contributing subwatersheds. When considering these results it is important to note that the IWA does not explicitly consider the effects of the dams on streamflows within mainstem Lower Cowlitz subwatersheds. The three subwatersheds with improved hydrology ratings at the watershed level are in the Cowlitz mainstem below Mayfield Dam. Given the expected influence of dam operations on mainstem hydrology, the IWA watershed level rating does not accurately represent the effects of upstream influences. For the purpose of the IWA analysis, watershed level effects are calculated as though the watershed terminates at the dam.

8.7.1.2 Sediment

Most subwatersheds are rated as moderately impaired for local sediment supply conditions. Four adjacent subwatersheds (60303, 60403, 60404, and 60401) are rated as locally functional for sediment. A few subwatersheds in the lower portion of the basin, including the mouth subwatershed, are rated impaired. The remainder are moderately impaired. Based on geology type and slope class, subwatersheds rated as functional for sediment were found to have natural erodability ratings in the low-to-intermediate range, ranging from 37 to 43 on a scale of 0 to 126. Road densities are generally moderate to high and streamside road densities are mostly moderate in these subwatersheds.

Locally functional and impaired sediment ratings in two subwatersheds, respectively, become moderately impaired at the watershed level. This implies that hydrologic and sediment conditions in these subwatersheds are potentially affected by upstream as well as local conditions. However, when considering these results it is important to note that the IWA does not explicitly consider the effects of the dams on streamflows within mainstem Lower Cowlitz subwatersheds. Two subwatersheds with changing sediment ratings are located along the lower Cowlitz mainstem, which is affected both by the effect of dams (which capture sediment from the upper subbasin) and the influence of undammed tributaries within the Coweeman and Toutle River watersheds.

8.7.1.3 Riparian

Riparian conditions are rated as moderately impaired or impaired, with only one subwatershed, Cedar Creek (60201), rated as functional. Moderately impaired conditions are present in 23 subwatersheds and the remaining 16 subwatersheds are rated as impaired. Generally, riparian conditions in the Puget Trough subwatersheds in the more northern and eastern portion of the watershed are better than the Willapa Hills subwatersheds to the west and south.

Riparian forests along the lower 20 miles of the Cowlitz and within the lower reaches of the smaller tributaries have been severely degraded through industrial and commercial development. Agriculture and forestry activities have also impacted riparian areas (Wade 2000).

8.7.2 Predicted Future Trends

8.7.2.1 Hydrology

Due to the low forest cover within the forested subwatersheds and the low percentage of forested subwatersheds, hydrologic conditions in the lower Cowlitz watershed are predicted to remain unchanged (i.e., impaired) over the next 20 years unless specific actions are taken to ameliorate the problem. Conditions in the mainstem are generally driven by hydropower operations, and are determined to a lesser extent by tributary conditions. Hydropower operations may be modified in the future to benefit salmon recovery, but for the purpose of this analysis these operations are predicted to remain constant over this period.

8.7.2.2 Sediment

Sediment conditions are generally rated as moderately impaired to impaired throughout the lower Cowlitz basin, with the exception of the Mill Creek tributary to Lacamas Creek (functional). The watershed is characterized by a broad array of land uses, ranging from agriculture and timber to urban and industrial development, and also contains the developing I-5 corridor.

Land uses in tributary watersheds are generally predicted to continue, and may in some cases shift towards residential and urban development along the I-5 corridor. Based on the trajectory of predominant land uses, sediment conditions in tributary drainages are predicted to trend towards increasing degradation. These impacts may be mitigated to some degree by improved forestry and road management practices on public and private timberlands, and improved stormwater controls. Nevertheless, the predicted overall trend is toward increasing degradation in tributary drainages.

Sediment conditions in the mainstem Cowlitz are determined by the presence of major dams, sediment delivery from tributary drainages, and significantly, from tributary watersheds such as the Toutle and Coweeman Rivers. Of particular note, the Toutle River watershed was heavily impacted with sediment from the Mt. St. Helens eruption in 1980. Sediment delivery from the Toutle River watershed is a consistent management challenge in the lower Cowlitz mainstem. The trend in sediment conditions in the mainstem is expected to remain constant in subwatersheds above the confluence with the Toutle, and to degrade over the next 20 years in mainstem reaches downstream of the Toutle.

8.7.2.3 Riparian Condition

Riparian forests along the lower 20 miles of the Cowlitz and within the lower reaches of the smaller tributaries have been severely degraded through industrial and commercial development. Riparian conditions are rated functional in Cedar Creek (60201), moderately impaired in 23 subwatersheds, and impaired in the remaining 14 subwatersheds. Conditions in middle and upper tributary subwatersheds are generally predicted to remain stable over the next 20 years, trending towards gradual improvement as regrowth in degraded watersheds proceed.

Riparian conditions along the lower mainstem and in lower tributary drainages are expected to trend downward over the next 20 years, as development pressure around the towns of Castle Rock, Longview, and Kelso increase. Channelization and bank modifications along the mainstem futher limit the potential for riparian recovery in many areas.

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