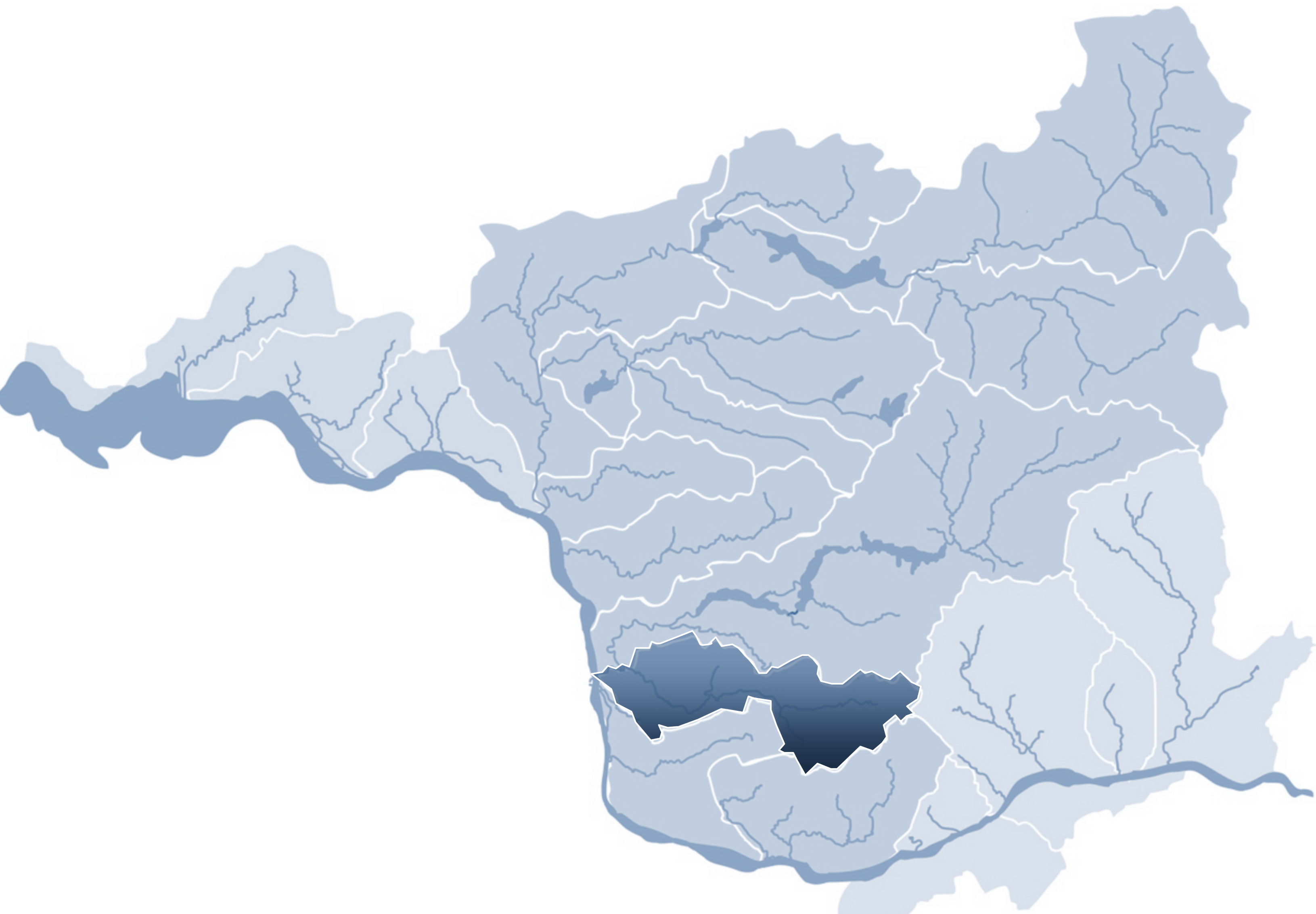
L. EAST FORK LEWIS SUBBASIN



L. EAST FORK LEWIS SUBBASIN

Tables

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L.1. Executive Summary

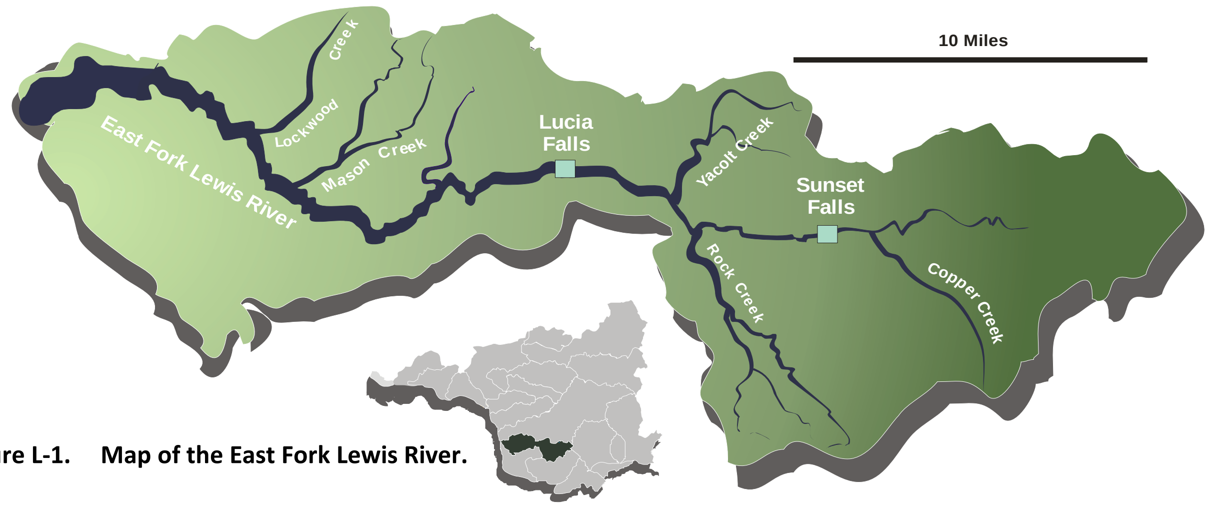


Figure L-1. Map of the East Fork Lewis River.

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

The East Fork Lewis River Basin is part of the Lewis River Subbasin, one of twelve major NPCC subbasins in the Washington portion of the Lower Columbia Region. The East Fork Lewis Basin historically supported thousands of fall Chinook, chum, coho, and winter and summer steelhead. Today, numbers of naturally spawning salmon and steelhead have plummeted to levels far below historical numbers. Chinook, coho and chum have been listed as Threatened under the Endangered Species Act. The decline has occurred over decades and the reasons are many. Freshwater and estuary habitat quality has been reduced by agricultural, mining, and forestry practices. Key habitats have been isolated or eliminated by dredging and channel modifications and diking, filling, or draining floodplains and wetlands. Altered habitat conditions have increased predation. Competition and interbreeding with domesticated or non-local hatchery fish has reduced productivity. Hydropower operations on the Lewis and Columbia Rivers have altered flows, habitat, and migration conditions. Fish are harvested in fresh and saltwater fisheries.

All East Fork Lewis River salmon and steelhead will need to be restored to a high level of viability to meet regional recovery objectives. This means that the populations are productive, abundant, exhibit multiple life history strategies, and utilize significant portions of the subbasin. Many actions, programs, and projects will make necessary contributions to recovery and mitigation in the East Fork Lewis subbasin.

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

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

L.1.1. Key Priorities

Many actions, programs, and projects will make necessary contributions to recovery and mitigation in the East Fork Lewis Basin. The following list identifies the most immediate priorities.

1. Protect Intact Forests in Headwater Basins

Headwater tributaries of the upper mainstem and upper Rock Creek basins, which are dominated by state and federal timber lands, are heavily forested with relatively intact landscape conditions that support functioning watershed processes. Streams are relatively unaltered, road densities are low, and riparian areas and uplands are characterized by mature forests. Much of this area is still recovering from large fires in the early 1900s. Protection of intact landscape conditions will be necessary to allow continued ecosystem recovery and to support healthy downstream habitat. Existing legal designations and management policy are expected to continue to offer protection to these lands.

2. Restore Lowland Floodplain Function, Riparian Function and Stream Habitat Diversity

The lower mainstem Lewis below Lewisville Park (river mile 14), and especially below Daybreak Park (river mile 10), flows through a broad, alluvial valley that historically was an active floodplain and channel migration zone (CMZ) with diverse riparian forests. Channel modifications over the years have dramatically altered natural channel migration and floodplain processes in order to facilitate and protect rural residential development, agricultural land, and gravel mining operations. Levee construction, bank stabilization, and riparian vegetation removal have heavily impacted fish habitat in these areas. Streamside gravel mining operations have had a particularly high impact on the mainstem valley below Daybreak Park, where the stream has avulsed into gravel ponds, abandoning once productive spawning habitat. There are current plans to expand gravel mining and processing operations in the historical floodplain, activities that are being managed through the NMFS Habitat Conservation Planning process. Throughout the lower river, removing or modifying channel control and containment structures to reconnect the stream and its floodplain/CMZ, where this is feasible and can be done without increasing risks of substantial flood damage, will restore normal habitat-forming processes to reestablish habitat complexity, off-channel habitats, and conditions favorable to fish spawning and rearing. These improvements will be particularly beneficial to chum, fall Chinook, and coho. Partially restoring normal floodplain function will also help control downstream flooding and provide wetland and riparian habitats critical to other fish, wildlife, and plant species. Existing floodplain function and riparian habitats will be protected through local land use ordinances, partnerships with landowners, and the acquisition of land, where appropriate. Restoration will be achieved by working with willing landowners, non-governmental organizations, conservation districts, and state and federal agencies.

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

The human population in the basin is relatively low, but it is projected to grow by at least one third in the next twenty years. The local economy is also in transition with reduced reliance on forest products and farming. Population growth will primarily occur in lower river valleys and along the major stream corridors. This growth will result in the conversion of forestry and agricultural land uses to residential uses, with potential impacts to habitat conditions. Land-use changes will provide a variety of risks to terrestrial and aquatic habitats. Careful land-use planning will be necessary to protect and restore natural fish populations and habitats and will also present opportunities to preserve the rural character and local economic base of the basin.

4. Manage Forest Lands to Protect and Restore Watershed Processes

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

5. Restore Passage at Culverts and Other Barriers

There are several culverts and other barriers that limit fish passage in the East Fork Lewis Basin. Many of these barriers occur on rural residential and agricultural land on mainstem tributaries in the lower basin and a few potential barriers are located on upper basin forest lands. Although no single barrier accounts for a significant percentage of blocked habitat, correction of passage obstructions could provide access to as many as 30 miles of stream. Further assessment and prioritization of passage barriers is needed.

6. Address Immediate Risks with Short-term Habitat Fixes

Restoration of normal watershed processes that allow a basin to restore itself over time has proven to be the most effective strategy for long term habitat improvements. However, restoration of some critical habitats may take decades to occur. In the near term, it is important to initiate short-term fixes to address current critical low numbers of some species. Examples in the East Fork Lewis Basin include building chum salmon spawning channels and constructing coho overwintering habitat such as alcoves, side channels, and log jams. Benefits of structural enhancements are often temporary but will help bridge the period until normal habitat-forming processes are reestablished.

7. Align Hatchery Priorities with Conservation Objectives

Hatcheries throughout the Columbia basin historically focused on producing fish for fisheries as mitigation for hydropower development and widespread habitat degradation. Emphasis of hatchery production without regard for natural populations can pose risks to natural population viability. Hatchery priorities must be aligned to conserve natural populations, enhance natural fish recovery, and avoid impeding progress toward recovery while continuing to provide some fishery mitigation benefits. There are no hatcheries operating in the East Fork Lewis Basin. Skamania hatchery winter and summer steelhead are released in to the East Fork Lewis to provide harvest opportunity.

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

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

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

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

L.2. Background

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

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

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

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

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

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

L.3. Assessment

L.3.1. Subbasin Description

Topography & Geology

The East Fork Lewis River has its headwaters in Skamania County and flows generally west, with most of the basin lying within Clark County. It enters the mainstem (North Fork) Lewis at approximately river mile 3.5, about 4,000 feet downstream of the I-5 Bridge. The basin covers an area of approximately 150,635 acres (235 mi^2). The East Fork has its source near Green Lookout Mountain in the Gifford Pinchot National Forest. Elevation ranges from near sea level at the mouth to 4,442 feet. The headwaters are very steep, with narrow valleys, and are dominated by bedrock and boulder substrates. Copper Creek and upper Rock Creek are the two largest tributaries in the upper basin. Lucia Falls at RM 21.3 blocks passage of anadromous fish except steelhead and an occasional Chinook and coho. Upstream migration for steelhead was essentially blocked at Sunset Falls (RM 32.7) until 1982 when the falls were notched, lowering the falls from 13.5 to 8 feet; approximately 12% of the steelhead run now spawns above Sunset Falls. Below Lucia Falls, the river flows through a narrow valley, forming a canyon in places, until it opens up around RM 14 into a broad alluvial valley. Stream gradient dramatically drops off within this reach causing large sediment aggradations. Extensive meandering, braiding, and channel shifting occurs in the lower river, particularly between RM 6 and RM 10. Backwater effects from the Columbia extend up to RM 6.

The East Fork Lewis basin has developed from volcanic, glacial, and erosional processes. Glaciation has shaped the valleys in upper portions of the basin as recently as 13,000 years ago. Oversteepened slopes as a result of glaciation, combined with the abundance of ash, pumice, and weathered pyroclastic material, have created a relatively high potential for surface erosion throughout the basin.

Climate

The climate is typified by mild, wet winters and warm, dry summers. Mean annual precipitation is 52 inches at Battle Ground, which is along the lower river (WRCC 2003). Precipitation in the upper basin is considerably greater. Although most of the basin is rainfall dominated, much of the upper basin receives abundant snowfall, with a significant portion of the upper basin in the rain-on-snow zone. The basin is subject to winter freshets and flooding.

Land Use, Ownership, and Cover

The bulk of the land is forested and a large percentage is managed as commercial forest. Agricultural and residential activities are found in valley bottom areas. Recreation uses and residential development have increased in recent years. The population in the basin was approximately 24,400 persons in 2000 (LCFRB 2001). Most of the land is private (63%), with about 20% of the basin area lying within the Gifford Pinchot National Forest. Stand replacement fires, which burned large portions of the basin between 1902 and 1952, have had lasting effects on basin hydrology, sediment transport, soil conditions, and riparian function. The largest of these fires was the Yacolt Burn in 1902. Subsequent fires followed in 1927 and 1929. Severe flooding in 1931 and 1934 likely was exacerbated by the effect of the fires on vegetation and soils. The State of Washington owns, and the Washington State Department of Natural Resources (DNR) manages the beds of all navigable waters within the subbasin.

Any proposed use of those lands must be approved in advance by the DNR. A breakdown of land ownership and land cover/land use in the EF Lewis basin is presented in Figure L-2 and Figure L-3.

Development Trends

Rural residential development is widespread in the lower portion of the basin and is expected to increase. The population in the basin was approximately 24,400 persons in 2000 (LCFRB 2001). The population of the basin is expected to more than double by 2020. Continued population growth will increase pressures for conversion of forestry and agricultural land uses to residential uses, with potential impacts to habitat conditions.

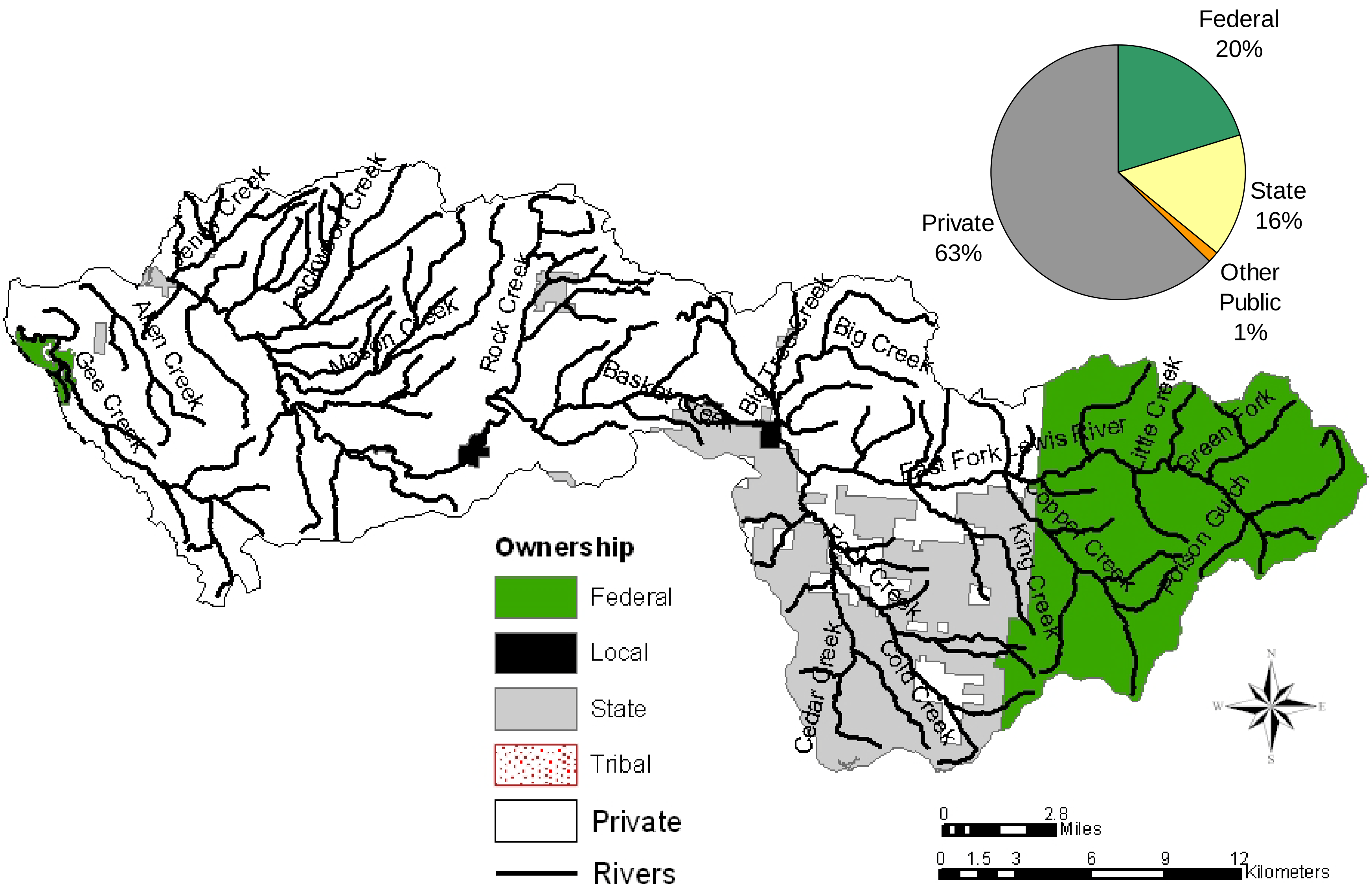


Figure L-2. Landownership within the East Fork Lewis River basin. Data is WDNR data that was obtained from the Interior Columbia Basin Ecosystem Management Project (ICBEMP). (Note: map and pie chart do not reflect 2000+ acres owned by Clark County along the lower East Fork.)

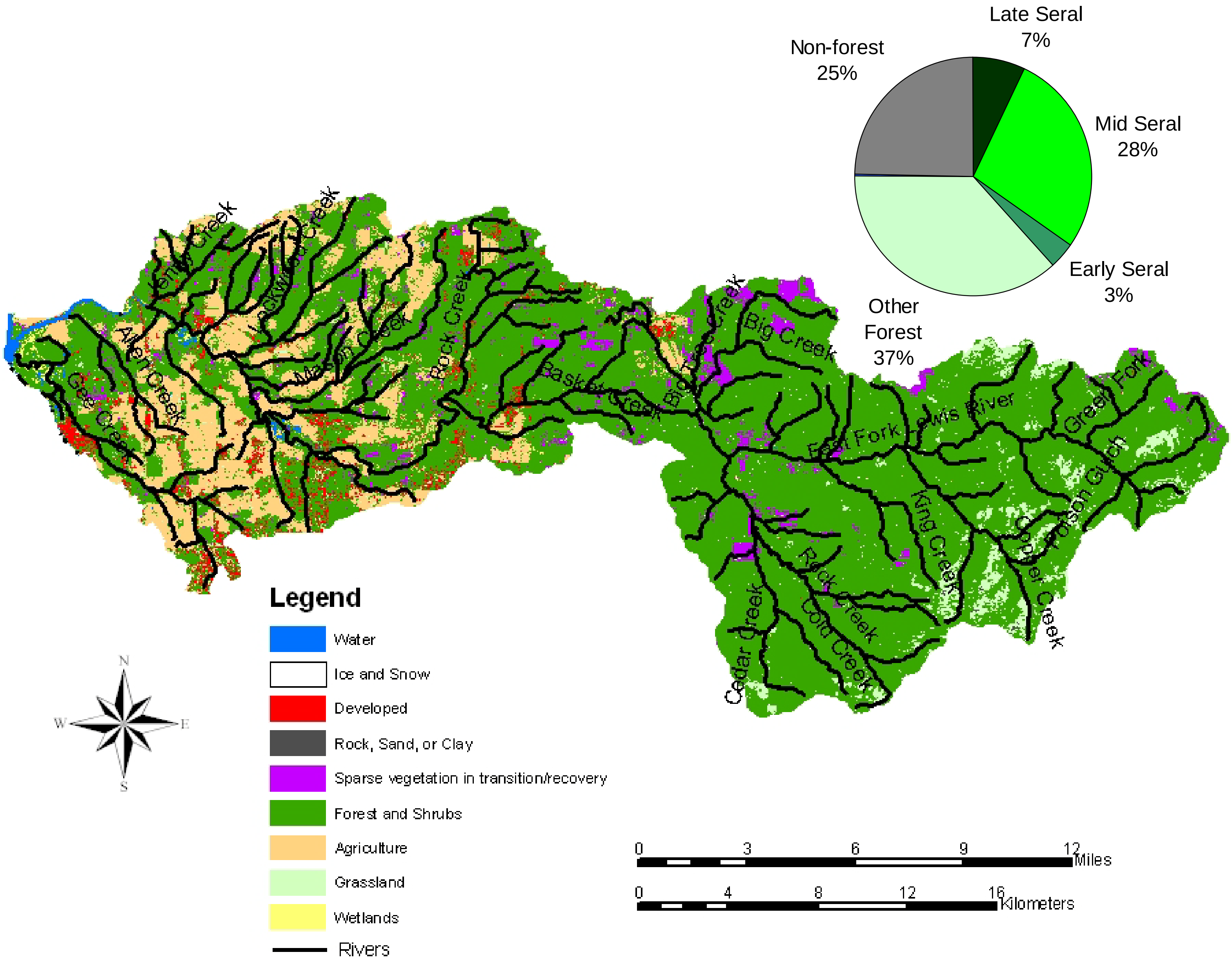


Figure L-3. Land cover within the East Fork Lewis basin. Vegetation cover (pie chart) derived from Landsat data based on methods in Lunetta et al. 1997. Mapped data was obtained from the USGS National Land Cover Dataset (NLCD).

L.3.2. Focal and Other Species of Interest

Listed salmon, steelhead, and trout species are focal species of this planning effort for the East Fork Lewis Subbasin. Other species of interest were also identified as appropriate. Species were selected because they are listed listing under the U.S. Endangered Species Act or because viability or use is significantly affected by the Federal Columbia Hydropower system. Federal hydropower system effects are not significant within the East Fork Lewis River basin although anadromous species are subject to effects in the Columbia River, estuary, and nearshore ocean. The East Fork Lewis ecosystem supports and depends on a wide variety of fish and wildlife in addition to designated species. A comprehensive ecosystem-based approach to salmon and steelhead recovery will provide significant benefits to other native species through restoration of landscape-level processes and habitat conditions. Other fish and wildlife species not directly addressed by this plan are subject to a variety of other Federal, State, and local planning or management activities.

Focal salmonid species in East Fork Lewis River watersheds include fall Chinook, chum, coho, and summer and winter steelhead. Bull trout do not occur in the subbasin. Salmon and steelhead numbers have declined to only a fraction of historical levels (Table L-1). Extinction risks are significant for all focal species – the current health or viability ranges from very low for chum, fall Chinook, summer steelhead, and coho to medium for winter steelhead. Returns of summer and winter steelhead include both natural and hatchery produced fish. The East Fork Lewis chum population is a subset of the Lewis Basin chum population which includes the North Fork and East Fork combined populations.

Other species of interest in the East Fork Lewis Subbasin include coastal cutthroat trout and Pacific lamprey. These species have been affected by many of the same habitat factors that have reduced numbers of anadromous salmonids.

Brief summaries of the population characteristics and status follow. Additional information on life history, population characteristics, and status assessments may be found in Appendix A (focal species) and B (other species).

Table L-1. Status of focal salmon and steelhead populations in the East Fork Lewis River subbasin.

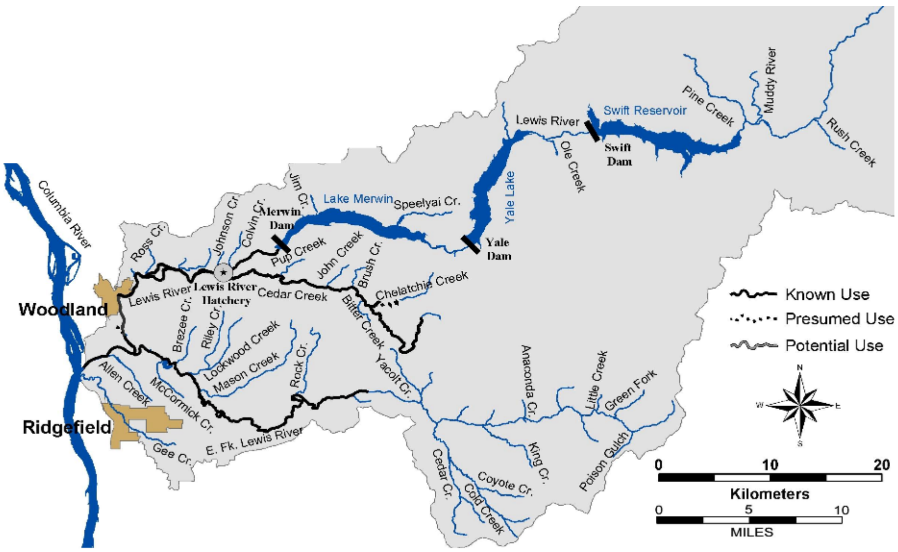
Species	Population	Recovery priority[1]	Viability		Improve-ment[4]	Abundance		
			Status[2]	Obj[3]		Historical[5]	Current[6]	Target[7]
Fall Chinook (Tule)	Lewis	Primary	VL	H+	280%	2,600	<50	1,500
Chum	Lewis	Primary	VL	H	500%	125,000	<100	1,300
Winter Steelhead	EF Lewis	Primary	M	H	25%	900	350	500
Summer Steelhead	EF Lewis	Primary	VL	H	>500%	600	<50	500
Coho	EF Lewis	Primary	VL	H	>500%	3,000	<50	2,000

[1] Primary, Contributing, and Stabilizing designations reflect the relative contribution of a population to major population group recovery goals.
[2] Baseline viability is based on Technical Recovery Team viability rating approach.
[3] Viability objective is based on the scenario contribution.
[4] Improvement is the relative increase in population production required to reach the prescribed viability goal
[5] Historical population size inferred from presumed habitat conditions using Ecosystem Diagnosis and Treatment Model and NMFS back-of-envelope calculations.
[6] Approximate current annual range in number of naturally-produced fish returning to the watershed.
[7] Abundance targets were estimated by population viability simulations based on viability goals.

Fall Chinook—Lewis Subbasin (East Fork)

ESA: Threatened 1999	SASSI: Depressed 2002

The historical East Fork Lewis River adult population is estimated from 4,000-30,000 fish. The current natural spawning number for tule fall Chinook ranges from 100-700 fish. There is no hatchery fall Chinook production. Natural spawning occurs primarily in six miles of the mainstem from Lewisville Park downstream to Daybreak Park. Spawning occurs primarily in October for the tule population, a later timed fall Chinook run spawns in November to January. Juvenile rearing occurs near and downstream of the spawning areas. Juveniles migrate from the East Fork Lewis in the spring and early summer of their first year.



Diversity

- Late spawners in the North Fork and EF Lewis are considered a lower river wild stock within the lower Columbia River ESU
- Early spawners in the EF Lewis are considered lower Columbia tules
- The EF Lewis River fall Chinook stock designated based on distinct spawning distribution and timing
- Genetic analysis of EF Lewis River fall Chinook indicated they were genetically distinct from other lower Columbia River Chinook stocks, except North Lewis River fall Chinook

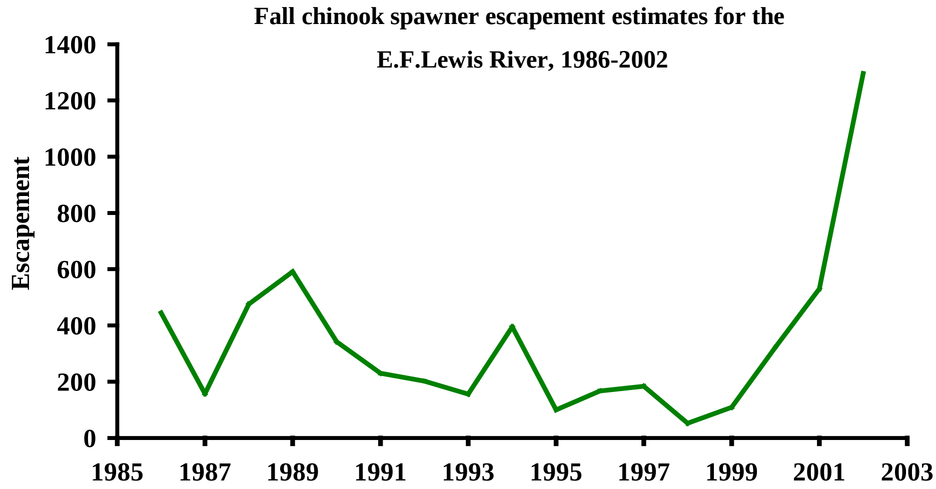
Life History

- Fall Chinook enter the Lewis River from August to November, depending on early fall rain
- Natural spawning in the EF Lewis River occurs in two distinct segments: the early segment in October and the late segment from November through January
- Age ranges from 2-year-old jacks to 6-year-old adults, with dominant adult ages of 3, 4, and 5 (averages are 20.5%, 48.5%, and 22.7%, respectively)
- Fry emerge from March to August (peak usually in 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

Distribution

- Spawning occurs primarily from Lewisville Park downstream to Daybreak Feeders (approx. 6 miles); the late spawning segment also spawns in areas upstream of Lewisville Park

- The EF Lewis late spawning fall Chinook along with North Lewis and Sandy River late spawning fall Chinook comprise the lower Columbia River wild management unit



Abundance

- Fall Chinook escapement estimates by WDFW (1951) were about 4,000 into the EF Lewis River
- EF Lewis River spawning escapement from 1986-2001 ranged from 52 to 591 (average 279)

Productivity & Persistence

- Baseline risk assessment determined a high to very high risk of extinction for fall Chinook in the Lewis subbasin
- The EF Lewis early and late components of natural produced fall Chinook have been sustained at low levels with minimal influence from hatchery fish

Hatchery

- There are no hatcheries on the EF Lewis River
- Hatchery fish have never been released into the East Fork; hatchery releases of fall Chinook in the North Lewis began as early as 1909 and continued through 1985; there may have been some straying of North Lewis hatchery fish to the EF Lewis in past years

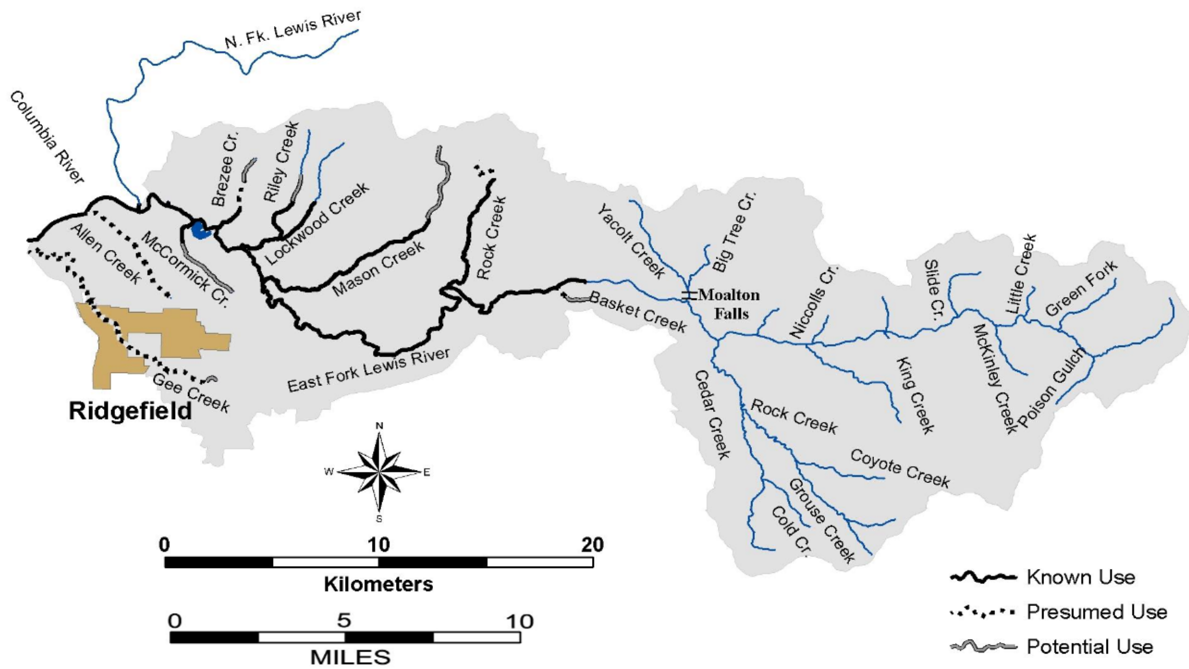
Harvest

- East Fork Lewis wild fall Chinook are harvested in ocean commercial and recreational fisheries from Oregon to Alaska, and in Columbia River commercial and sport fisheries
- East Fork Lewis late spawning fall Chinook migration patterns are likely similar to North Lewis fall Chinook and more northerly distributed than other lower Columbia Chinook populations, primarily along the coasts of British Columbia and Alaska
- East Fork Lewis early spawning fall Chinook migration patterns are likely similar to lower Columbia tule populations, primarily along the coasts of Washington and Southern British Columbia
- Columbia River commercial and sport harvest of late East Fork Lewis fall Chinook is constrained by ESA limits on Snake and Coweeman wild fall Chinook and the North Lewis spawning escapement goal
- Using North Lewis wild fall Chinook as a surrogate for late spawning East Fork Lewis Chinook suggests a harvest rate of 49% in the 1980s to early 1990s and a reduced harvest rate of 28% in the mid to late 1990s
- The EF Lewis River is closed to sport fishing for fall Chinook

Coho—Lewis Subbasin (East Fork)

ESA: Threatened 2005	**SASSI: Unknown 2002**

The historical East Fork Lewis adult population is estimated from 5,000-40,000, with the majority of returns late stock which spawn from late November to March. Some early stock coho were also historically present with spawning occurring primarily in early to mid- November. Current returns are unknown but assumed to be low. There is currently no hatchery coho released into the East Fork Lewis. Natural spawning occurs downstream of Lucia Falls (RM 21), particularly in Lockwood, Mason, and Rock creeks. Juveniles rear for a full year in the Lewis Basin before migrating as yearlings in the spring.

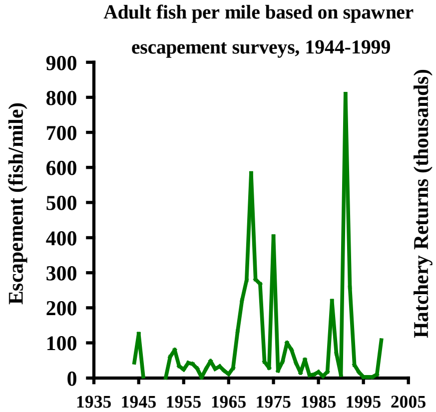


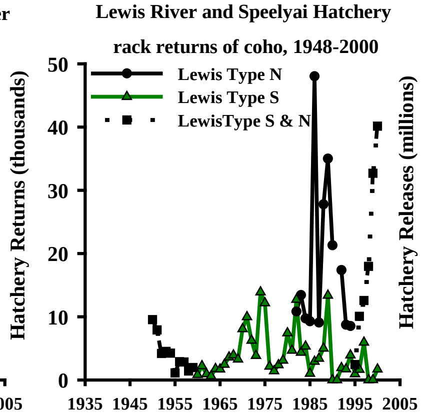
Distribution

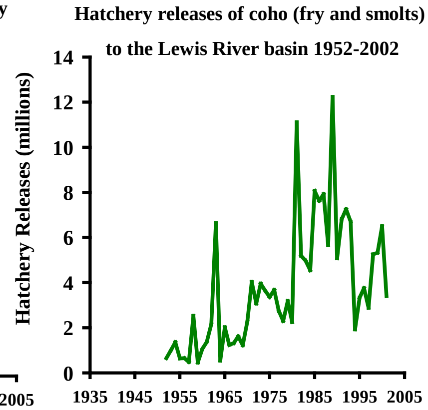
- Managers refer to early coho as Type S due to their ocean distribution generally south of the Columbia River
- Managers refer to late coho as Type N due to their ocean distribution generally north of the Columbia River
- On the East Fork, spawning occurs primarily below Lucia Falls (RM 21); Lockwood, Mason, and Rock Creeks are extensively used

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 through November)
- 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 in the spring, spend one year in fresh water, and emigrate as age-1 smolts the following spring







Diversity

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

Abundance

- Lewis River wild coho run is a fraction of its historical size
- An escapement survey in the late 1930s observed 7,919 coho in the North Fork and 1,166 coho in the East Fork
- In 1951, WDF estimated coho escapement to the basin was 15,000 fish; 10,000 in the North Fork (primarily early run) and 5,000 in the East Fork (primarily late run)

Productivity & Persistence

- Natural coho production is presumed to be generally low in most tributaries
- Baseline risk assessment determined a high to very high risk of extinction for coho in the EF Lewis subbasin
- Juvenile sampling in Lockwood Creek in 1994-95 found a low level of coho
- A smolt trap at lower Cedar Creek has shown recent year coho production to be fair to good in North and South forks of Chelatchie Creek (tributary of Cedar Creek) and in mainstem Cedar Creek
- Hatchery coho adults released above Swift Reservoir successfully spawned in upper basin tributaries

Hatchery

- The Lewis River Hatchery (completed in 1932) is located about RM 13; the Merwin Dam collection facility (completed in 1932) is located about RM 17; Speelyai Hatchery (completed in 1958) is located in Merwin Reservoir at Speelyai Bay; these hatcheries produce early and late stock coho and, spring Chinook
- Merwin Hatchery (completed in 1983) is located at RM 17 and rears steelhead, trout, and kokanee

- There are no hatcheries in the East Fork Lewis, although coho fry were periodically released from the Lewis River Hatchery in past years.

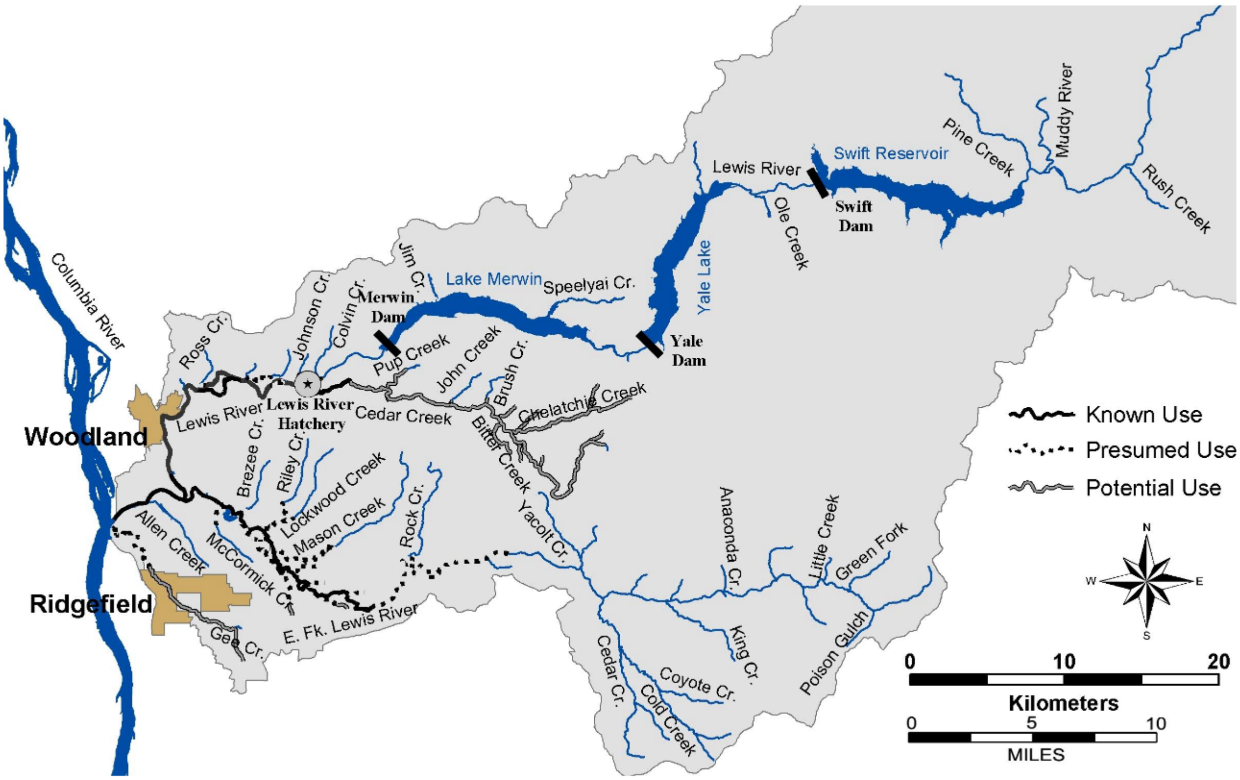
Harvest

- Until recent years, natural produced Columbia River coho were managed like hatchery fish and subjected to similar harvest rates; ocean and Columbia River combined harvest rates ranged from 70% to over 90% from 1970-83
- Ocean fisheries were reduced in the mid 1980s to protect several Puget Sound and Washington coastal wild coho populations
- Columbia River commercial coho fisheries in November were eliminated in the 1990s to reduce harvest of late Clackamas River wild coho
- Since 1999, Columbia River hatchery coho returns 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 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 hatchery coho harvest can also be substantial
- An average of 3,500 coho (1980-98) were harvested annually in the North Lewis River sport fishery
- An average of 40 coho (1982-1989) were harvested annually in the EF Lewis sport fishery
- The East Fork Lewis is now closed to fishing for coho
- CWT data analysis of the 1995-97 brood early coho released from Lewis River hatchery indicates 15% were captured in a fishery and 85% were accounted for in escapement
- CWT data analysis of the 1995-97 late coho released from Lewis River Hatchery indicates 42% were captured in a fishery and 58% were accounted for in escapement
- Fishery CWT recoveries of 1995-97 brood Lewis early coho were distributed between Washington ocean (58%), Columbia River (21%), and Oregon ocean (21%) sampling areas
- Fishery CWT recoveries of 1995-97 brood Lewis late coho were distributed between Columbia River (56%), Washington coast (31%), and Oregon ocean (21%) sampling areas

Chum—Lewis Subbasin

ESA: Threatened 1999	**SASSI: NA**

Historical adult populations produced from the Lewis Basin (including the mainstem, North, and East Lewis) are estimated from 120,000-300,000. Current natural spawning is estimated at less than 100 fish. Spawning occurs in the lower reaches of the mainstem, North Fork, East Fork, and in Cedar Creek. Natural spawning chum in the Lewis Basin are all naturally produced as no hatchery chum are released in the area. Juveniles rear in the lower reaches for a short period in the early spring and quickly migrate to the Columbia.



Distribution

- Spawning occurs in the lower reaches of the mainstem NF and EF Lewis River.
- Historically, chum salmon were common in the lower Lewis and were reported to ascent to the mainstem above the Merwin Dam site and spawn in the reservoir area
- Chum were also abundant in Cedar Creek, with at least 1,000 annual spawners (Smoker et al 1951)

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 age 3 and 4
- Fry emerge in early spring; chum emigrate as age-0 smolts, generally from March to mid-May

Abundance

- 1951 report estimated escapement of approximately 3,000 chum annually in the mainstem Lewis and East Fork and 1,000 in Cedar Creek

- 96 chum observed spawning downstream of Merwin Dam in 1955
- In 1973, spawning population of both the Lewis and Kalama subbasins estimated at only a few hundred fish
- Annually, 3-4 adult chum are captured at the Merwin Dam fish trap
- In 2002, WDFW estimated a chum spawning escapement of 28 in the North Fork Lewis and 3 in the East Fork Lewis

Productivity & Persistence

- Harvest, habitat degradation, and construction of Merwin, Yale, and Swift Dams contributed to decreased productivity
- WDFW consistently observed chum production in the North Lewis in March-May, 1977-1979 during wild Chinook seining operations
- Baseline risk assessment determined a high to very high risk of extinction for chum in the Lewis subbasin

Hatchery

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

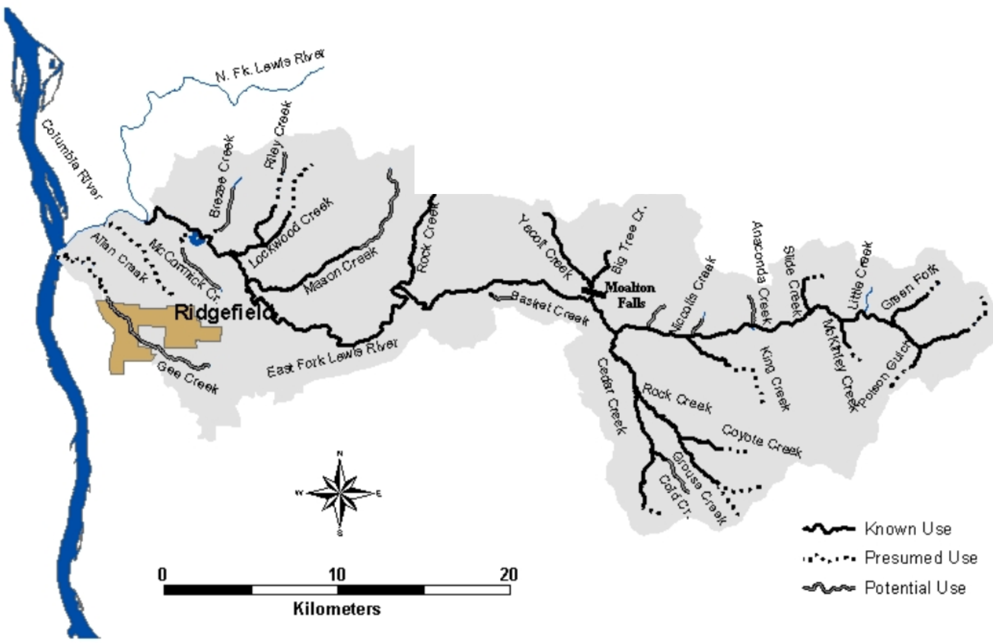
Harvest

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

Summer Steelhead—Lewis Subbasin (East Fork)

ESA: Threatened 1998	SASSI: Unknown 2002

The historical East Fork Lewis adult population is estimated from 1,000-9,000 fish. Current natural spawning returns average about 100 fish. In-breeding with Skamania Hatchery produced steelhead is thought to be low because of differences in spawn timing and distribution. Spawning occurs throughout the basin, extending to the mainstem East Fork Lewis and tributaries upstream of Moulton Falls. Juvenile rearing occurs both downstream and upstream of the spawning areas. Juveniles rear for a full year or more before migrating from the Lewis.



Distribution

- Spawning occurs in the EF Lewis River as well as Rock Creek and other tributaries; rearing habitat is available throughout most of the basin
- Upstream migration was essentially blocked at Sunset Falls until 1982 when the falls were "notched", lowering the falls from 13.5 to 8 feet; approximately 12% of the run now spawns above Sunset Falls

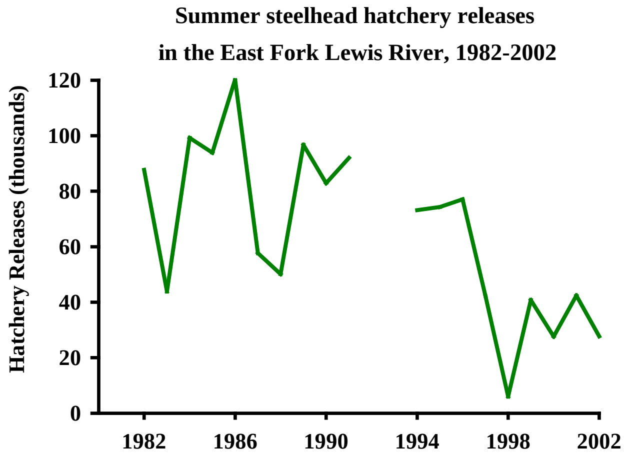
Life History

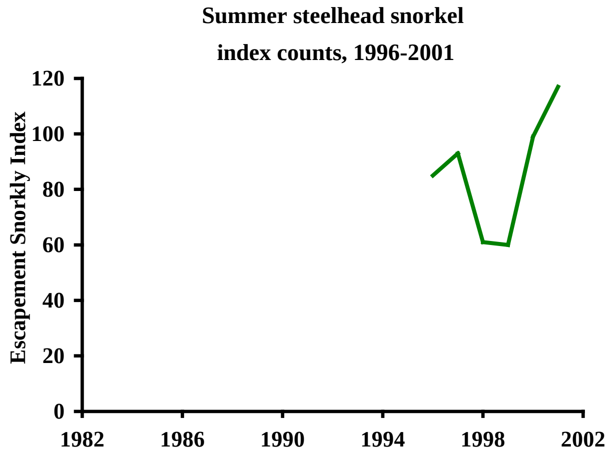
- Adult migration timing for EF Lewis River summer steelhead is from May through November
- Spawning timing on the EF Lewis River is generally from early March through early June
- Age composition data are not available for EF Lewis River summer steelhead
- Wild steelhead fry emerge from late April through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

Diversity

- Stock designated based on distinct spawning distribution and early run timing
- Progeny from Elochoman, Chambers Creek, Cowlitz, and Skamania Hatcheries have been planted in the Lewis basin; interbreeding among wild and hatchery stocks has not been measured
- After Mt. St. Helens 1980 eruption, straying Cowlitz River steelhead may have spawned with native Lewis stocks

- Genetic analysis in 1996 provided little information in determining stock distinctiveness





Abundance

- From 1925-1933, run size was estimated at 4,000 summer steelhead
- In 1936, steelhead were reported in the Lewis River during escapement surveys
- From 1963-1967, run size estimates averaged 6,500 summer steelhead
- Wild summer steelhead escapement to the EF Lewis River was estimated at 600 fish in 1984
- Average wild summer steelhead escapement to the EF Lewis River from 1991-1996 was 851
- Snorkel index escapement surveys have been conducted since 1996
- The escapement goal for the EF Lewis River is 814 wild adults

Productivity & Persistence

- Wild fish production is believed to be moderate
- Baseline risk assessment determined a high to very high risk of extinction for summer steelhead in the EF Lewis subbasin

Hatchery

- The Lewis River Hatchery (about 4 miles downstream of Merwin Dam) and Speelyai Hatchery (Speelyai Creek in Merwin Reservoir) do not produce summer steelhead
- A net pen system has been in operation on Merwin Reservoir since 1979; annual average smolt production has been 60,000 summer steelhead; release data are available from 1982-2002; current annual stocking levels in the East Fork are around 40,000 smolts
- The portion of wild summer steelhead in the run at Lucia Falls averaged 27% from 1974-1983
- Recent snorkel surveys indicate hatchery summer steelhead comprise about 70% of the spawning escapement on the EF Lewis River

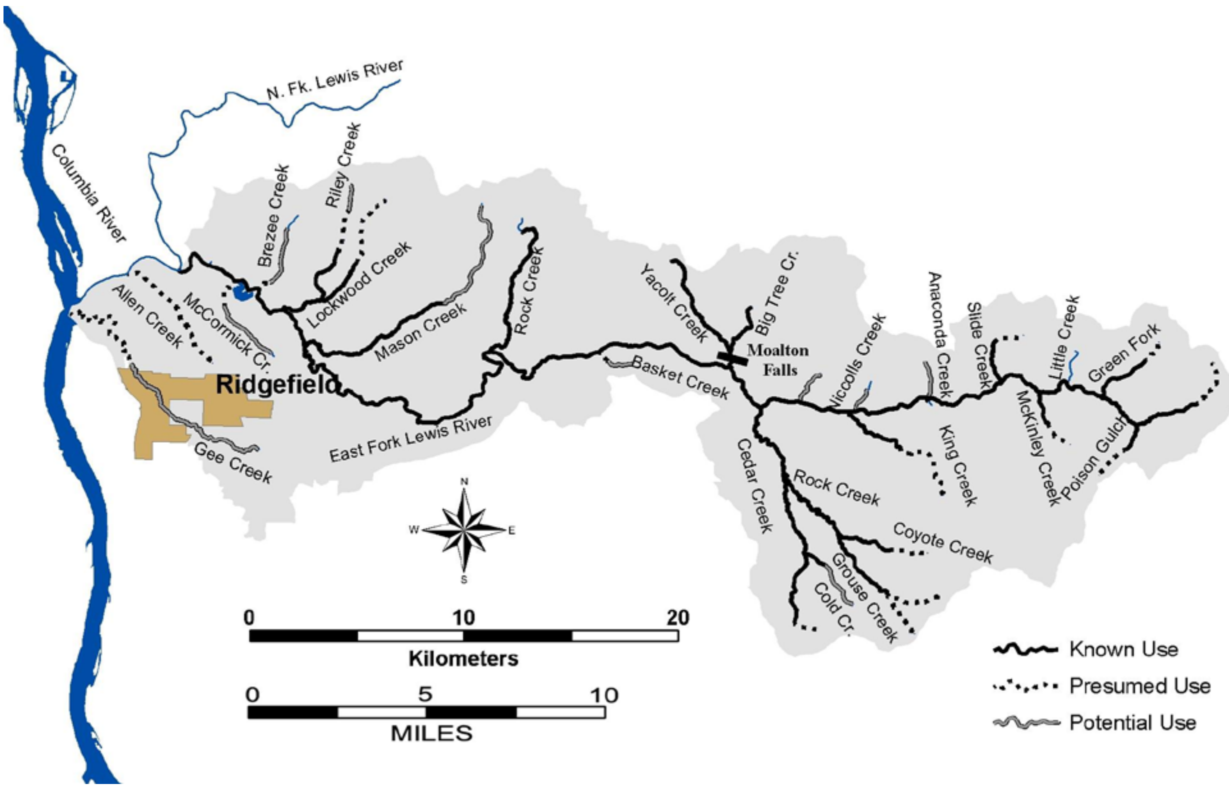
Harvest

- No directed fisheries target EF Lewis River summer steelhead; incidental mortality currently occurs during the Columbia River fall commercial fisheries and summer sport fisheries
- Summer steelhead sport harvest (wild and hatchery) in the Lewis River basin from 1980-1989 ranged from 3,001 to 8,700; historically, more fish in the sport fishery were caught in the East Fork but currently North Fork harvest exceed East Fork harvest; since 1986, regulations limit harvest to hatchery fish only
- ESA limits fishery impact on wild EF Lewis summer steelhead in the mainstem Columbia River and in the EF Lewis River

Winter Steelhead—Lewis Subbasin (East Fork)

ESA: Threatened 1998	SASSI: Depressed 2002

The historical East Fork Lewis adult population is estimated from 3,000-10,000 fish. Current natural spawning returns range from 100-300. In-breeding with Skamania Hatchery produced steelhead is possible, but likely low because of differences in spawn timing. Spawning occurs in the mainstem East Fork Lewis and tributaries. Access upstream of Sunset Falls was blocked until 1982 when the falls were "notched". Spawning time is generally from early March to early June. Juvenile rearing occurs both downstream and upstream of the spawning areas. Juveniles rear for a full year or more before migrating from the East Fork Lewis.

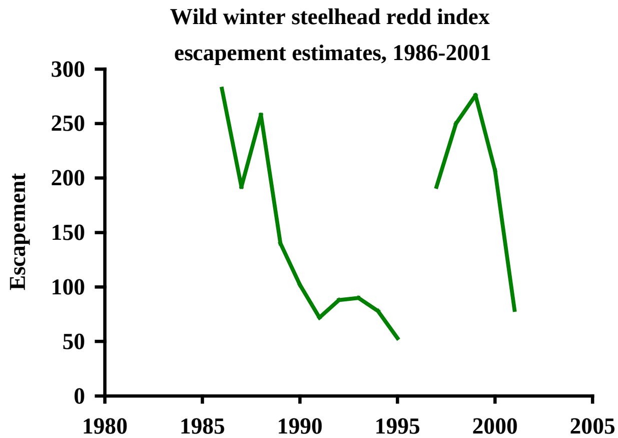


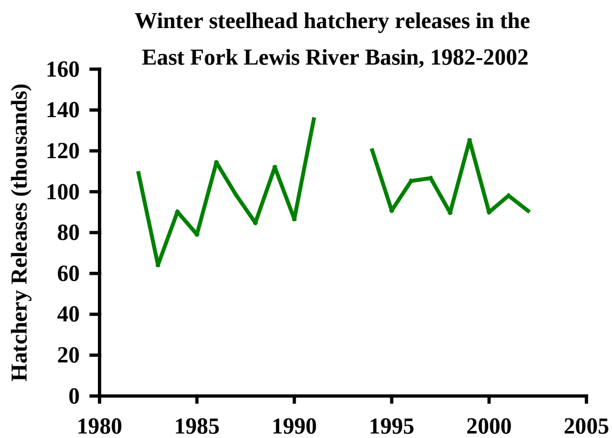
Distribution

- Spawning occurs in the EF Lewis River as well as Rock Creek and other tributaries; rearing habitat is available throughout most of the basin
- Upstream migration was essentially blocked at Sunset Falls until 1982 when the falls were "notched", lowering the falls from 13.5 to 8 feet; approximately 12% of the run now spawns above Sunset Falls

Life History

- Adult migration timing for EF Lewis winter steelhead is from December through April
- Spawning timing on the EF Lewis is generally from early March to early June
- Limited age composition data for Lewis River winter steelhead suggest that most steelhead are two-ocean fish
- 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

- EF Lewis winter steelhead stock designated based on distinct spawning distribution and late run timing
- Concern with wild stock interbreeding with hatchery brood stock from the Elochoman River, Chambers Creek, and the Cowlitz River
- After 1980 Mt. St. Helens eruption, straying Cowlitz River steelhead likely spawned with native Lewis stocks
- Allele frequency analysis of EF Lewis winter steelhead in 1996 was unable to determine the distinctiveness of the stock compared to other lower Columbia River steelhead stocks

Abundance

- In 1936, steelhead were reported in the Lewis River during escapement surveys
- Historical winter steelhead annual escapement in the Lewis River ranged from 1,000 to 11,000 fish
- Redd index escapement counts from 1986-2001 ranged from 53 to 282 (average 157); a new escapement index was instituted in 1997 and the relationship to the previous index is unknown
- Escapement goal for the EF Lewis River is 875 wild adult steelhead
- The portion of wild winter steelhead at Lucia Falls found in the creel ranged from 35% to 74% from 1974-1983
- Recent data suggests that 51% of spawning steelhead in the East Fork are of hatchery origin

Productivity & Persistence

- Baseline risk assessment determined a moderate risk of extinction for winter steelhead in the EF Lewis subbasin
- Winter steelhead natural production is unknown

Hatchery

- There are no hatcheries on the EF Lewis River
- The Ariel (Merwin) Hatchery is located below Merwin Dam the NF Lewis River; the hatchery has been releasing winter steelhead in the Lewis basin since the early 1990s, but does not release steelhead in the EF Lewis

- Annual winter steelhead hatchery smolt releases into the EF Lewis during 1982-2002 have ranged from about 60,000—140,000
- Currently program releases about 90,000 winter steelhead smolts from Skamania Hatchery into the EF Lewis. Hatchery program has changed acclimation sites to the lower East Fork to reduce hatchery/wild interactions in the upper watershed

Harvest

- No directed commercial or tribal fisheries target EF Lewis winter steelhead; incidental harvest currently occurs during the lower Columbia River spring Chinook tangle net fisheries
- Treaty Indian harvest does not occur in the Lewis River basin
- Winter steelhead sport harvest (hatchery and wild) in the Lewis River from 1980-1990 ranged from 2,245 to 6,766 (average 4,385); the portion of this harvest from the East Fork is unknown; since 1992, regulations limit harvest to hatchery fish only
- ESA limits fishery impact on wild winter steelhead in the mainstem Columbia River and in the EF Lewis River

Other Species

Pacific lamprey – Information on lamprey abundance is limited and does not exist for the East Fork Lewis population. However, based on declining trends measured at Bonneville Dam and Willamette Falls it is assumed that Pacific lamprey have declined in the East Fork Lewis basin also. Adult lamprey return from the ocean to spawn in the spring and summer. Spawning likely occurs in the small to mid-size streams of the East Fork basin. Juveniles rear in freshwater up to six years before migrating to the ocean.

L.3.3. Subbasin Habitat Conditions

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

Watershed Hydrology

The EF Lewis River watershed is primarily a low to mid-elevation, rain dominated system with extensive rain-on-snow conditions present in the upper reaches. Peak stream flows are generated by fall, winter, and spring rains with flows augmented by snowmelt in the spring and early summer (Figure L-4).

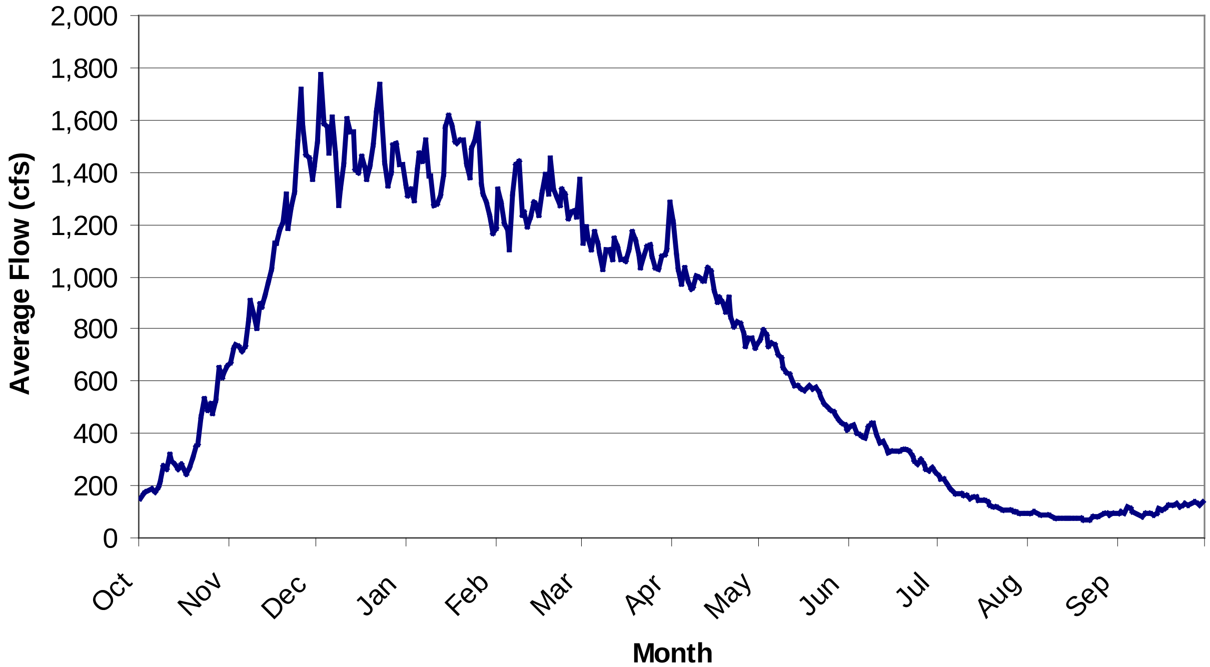


Figure L-4. Daily average stream flow for the period 1929-2002. USGS Gage #14222500; East Fork Lewis River Near Heisson, WA

The potential exists for impaired runoff conditions in certain areas due to past fires, the presence of young forest stands, high road densities, and impervious surfaces. The Integrated Watershed Assessment (IWA), which is presented in greater detail later in this chapter, indicates that 18 of the 36 subwatersheds (7th field) in the basin are "impaired" with respect to landscape conditions influencing runoff; 14 are rated as "moderately impaired"; and only 4 are considered "functional". The greatest impairments are located in the lower and middle elevation subwatersheds. These subwatersheds are primarily private agricultural, residential, or commercial forest. Runoff conditions improve in the upper watershed, which is predominantly composed of public forest land. In the uppermost, federally managed, portion of the basin, the USFS conducted a peak flow analysis that modeled the effect of vegetation removal on the 2-year peak flow. The Slide Creek, Rock Creek (upper), and Copper Creek basins show susceptibility to flow increases of greater than 10%. These basins show "moderately impaired" conditions according to the IWA. The USFS assessment also indicated that many basins have a significant increase in the length of the channel network due to roads and road ditches, which can also increase peak flows (USFS 1995).

Ecology conducted an instream flow study on the EF Lewis and 13 tributaries. The Instream Flow Incremental Methodology (IFIM) was used to model flow-habitat conditions on the mainstem while the toe-width method was used to assess flow-habitat conditions on tributaries. The IFIM results revealed that flows at certain times of the year may be below optimal for fish at various life history stages. Flows for Chinook spawning, which starts in October, were only 25% of the optimal flow in October but reached 80% of the optimal flow by November 1. Flows necessary for Chinook and steelhead juvenile rearing were only about 30% of optimum in August and September (Caldwell 1999).

Comparing spot flow measurements with flow requirements determined from the Toe-Width method revealed that spawning and rearing habitat was limited for most species in McCormick, Brezee, Lockwood, Mason, and Yacolt Creeks during the fall of 1998. The results in Rock creek suggested insufficient flows for fall spawning but optimum fall rearing conditions (Caldwell 1999).

Based on predictions of future population growth in the basin, total water use is estimated to increase from 10% (2000) to 20% (2020) of late summer flow, assuming full hydraulic continuity between ground water and stream flow. The watershed is near closure for surface water rights and for some existing surface water rights, low flow restrictions are in place in order to protect aquatic biota (LCFRB 2001). The potential for ground and/or surface water withdrawal impacts to salmonids needs further investigation.

Passage Obstructions

No artificial barriers exist on the mainstem of the East Fork Lewis. Lucia Falls at RM 21.3 is believed to block access to anadromous species except for steelhead and an occasional coho. Sunset Falls at RM 32.7 was notched in 1982, allowing for easier passage of this natural feature. Artificial passage obstructions within the watershed include culverts, road crossings, and small dams. More than 10 miles of habitat are believed to be blocked by these obstructions (see Wade 2000 for more details).

Water Quality

The mainstem from the mouth to RM 24.6 was listed on the 1998 WA state 303(d) list of impaired waterbodies due to exceedance of temperature and fecal coliform standards (WDOE 1998). Stream temperatures in the mainstem East Fork commonly exceed the 64°F (18°C) state standard, and occasionally exceed 73.4ºF (23ºC), at locations from Daybreak Park down. In the Ridgefield gravel pits (RM 8), which the stream avulsed into in 1996, temperatures may be warming as a result of large water surface areas within the former gravel pits. Temperature effects in this reach are of particular concern for salmonids (Sweet et al. 2003). USFS monitoring has showed exceedances of the 60.8ºF (16ºC) standard on the mainstem East Fork above and below Sunset Falls as well as on the Green Fork (Wade 2000).

Stream temperatures are also a concern in McCormick Creek, Lockwood Creek and lower Dean Creek. Temperatures in excess of 82.4ºF (28ºC) in lower Dean Creek have been recorded near the outlet of the J.L. Storedahl & Sons - Daybreak gravel mining pits, and conditions are believed to be generally unsuitable for salmonids during the summer (Sweet et al. 2003).

Turbidity is also a concern in portions of the basin. In lower Dean Creek, turbid water has been discharged from the gravel processing ponds owned by J. L. Storedahl and Sons (Sweet et al. 2003). Limiting Factors Analysis TAG members noticed turbidity problems in Cedar Creek, potentially from wastewater releases from Larch Mountain Corrections Facility and roads leading to the facility (Wade 2000). An unnamed tributary to the East Fork Lewis, sometimes referred to as Manley Road Creek, has turbidity problems resulting from Teboe processing/mining operations (Donna Hale, personal communication).

Turbidity measurements in lower Rock Creek exceeded state standards in 30% of the samples. Fecal coliform standards were exceeded in 55% of samples and D.O. standards were exceeded 10% of the time. These water quality problems may be due to farming operations (Hutton 1995 as cited in Wade 2000).

Low nutrient levels are assumed to exist in the East Fork Lewis basin due to the lack of sufficient salmonid carcasses as a result of low escapement numbers for most species. However, nutrient enhancement projects have planted numerous carcasses into tributary streams over the past several years (Wade 2000)

Key Habitat Availability

In the lower mainstem, pool abundance and quality are concerns between RM 6 and RM 16.2, partly as a result of the 1996 avulsion of the mainstem into the Ridgfield Pits near RM 8. This avulsion resulted in the abandonment of approximately 3,200 lineal feet of riffle habitat (used primarily for spawning) in exchange for low velocity pool habitat (used primarily for rearing). Portions of the upstream end of the avulsed reach are slowly converting to riffle habitat as the pools fill with coarse sediments (Sweet et al. 2003).

As part of the 2000 Limiting Factors Analysis, the TAG expressed concerns with the availability of suitable pool habitat on the mainstem between lower Rock Creek (RM 16.2) and Sunset Falls (RM 32.7).

USFS surveys in the upper basin, conducted as part of the 1995 watershed analysis, identified substandard pool frequency in approximately 58% of surveyed streams (USFS 1995). Pools suitable for summer steelhead holding exist on the upper mainstem below the Green Fork confluence, though many of these lack adequate cover. Good holding pools are rare on Slide, Green Fork, and the mainstem above Green Fork (USFS 1999).

Historically available side channel habitat has been reduced in the lower river due to draining of wetlands for agricultural uses and conversion to a single thread channel as a result of channel confinement projects (Sweet et al. 2003). Off-channel habitat in the upper basin is sparse and is only accessible during the highest flows (USFS 1999).

Substrate & Sediment

A large portion of sediment delivery in the lower river is from in-channel bed and bank erosion related to channel migration and avulsions. Analysis of historical aerial photos indicates that movement of the channel is a natural process in the lower mainstem alluvial reaches; however, between RM 7 and RM 10, natural rates of channel adjustment have been influenced by the presence of stream-adjacent gravel pits, which have captured the mainstem in a few locations within the past 10 years. These avulsions have altered rates of sediment generation and accumulation. The most notable avulsion occurred near RM 8 in November, 1996, when the mainstem was captured by the abandoned gravel ponds known as the Ridgefield Pits. This avulsion alone abandoned approximately 3,200 feet of riffle habitat. The previous riffle habitat was replaced by pools that are rapidly filling with sediment. In the Ridgefield Pit reach, the former gravel ponds have been filling with fine sediments that are believed to originate primarily from a high sandy bank just upstream of the avulsed reach. In some areas, riffle habitat suitable for spawning is being re-created as the pools fill. Sediment sampling downstream of the Ridgefield Pits in 2001 indicated that fine sediment volumes were less than 10% (Sweet et al. 2003).

Basin-wide sediment supply conditions were evaluated as part of the IWA watershed process modeling, which is presented later in this chapter. The results indicate that 28 out of the 36 subwatersheds in the basin are “moderately impaired” with respect to conditions that influence sediment supply. The remainder of the basin was rated as “functional” with respect to sediment supply. Most of the functional subwatersheds were concentrated in the Rock Creek basin (Upper). Sediment supply impairment is related to a number of factors, including primarily naturally unstable slopes and high road densities. The total road density in the basin is 4.13 mi/mi2 (greater then 3 mi/mi2 is considered high by most standards). The upper watershed, dominated by National Forest lands, has a relatively low overall road density of 1.79 mi/mi2. The USFS Watershed Analysis reports an estimated sediment yield due to roads of 400 tons/mi2/year, with 3 out of 23 of the subbasins in the upper watershed (portion primarily in National Forest) having high rates of surface erosion from roads (USFS 1995).

Despite the effects of roads, the Pacific Watershed Institute completed a sediment budget for the upper watershed and determined that the sediment supply is limited, primarily due to most available material having already eroded following early 20th century fires. The lack of supply of gravels may limit spawning habitat in the upper basin. Furthermore, low large woody debris (LWD) concentrations combined with the steep gradient and confinement of most upper basin channels probably results in transport of most gravels out of the upper basin (USFS 1999).

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

Woody Debris

LWD recruitment potential is of concern throughout the basin due to past forest fire impacts and harvest of riparian areas. A 1995 aerial photo analysis conducted by the USFS noted that 87% of riparian stands in the upper basin had either young, sparse hardwood stands or were burned in the early part of the century and now contained mature, dense hardwoods, with low to moderate potential for LWD recruitment (USFS 1995). In-stream LWD levels are very low also as a result of salvage logging following large fires in the early 20th century and from removal of log jams in the 1980s that were incorrectly assumed to be fish passage barriers (USFS 1999).

USFS stream surveys in the 1990s found that 92% of the surveyed streams had less than 40 pieces per mile (a poor rating), and at least 98% of the streams surveyed had concentrations of LWD less than 80 pieces per mile (USFS 1995). Limiting Factors Analysis TAG members felt that overall, LWD concentrations in the lower basin were low (Wade 2000).

Channel Stability

Bank stability is a major concern along portions of the lower 14 miles of the mainstem, particularly in areas that have received extensive alteration due to agricultural, residential, and mining development. In the broad alluvial valley between RM 7 and RM 10, dramatic channel adjustments including avulsions and lateral meander migration have occurred since 1858 (Sweet et al. 2003). Current rates of channel adjustment may be altered from their historical condition due to confinement of the river by levees and removal of riparian forests. Recent avulsions into stream-adjacent gravel pits occurred near RM 9 in 1995 and near RM 8 (Ridgefield Pits) in 1996. These adjustments abandoned a combined total of 4,900 feet of spawning habitat and have altered sediment transport dynamics in the lower river. A comprehensive evaluation of the effects of these events can be found in Sweet et al. (2003).

Reconnaissance surveys in 1999 indicated that high stream-adjacent bluffs near Daybreak Park may be contributing large amounts of fine sediment to the river, much of which is collecting in the Ridgefield Pits (Sweet et al. 2003). There are other areas of bank instability near RM 10.5 and RM 11.3. All of these conditions have dramatically altered channel stability and rates of sediment supply in the lower river. In particular, aggradation of sediments in some areas is believed to be causing erosion of lateral banks, therefore increasing width-to-depth ratios.

Bank stability problems in East Fork tributaries include streambank erosion along a segment of Mason Creek, cattle impacts on Rock Creek, and chronic mass wasting sites on upper Rock Creek and upper Lockwood Creek (Wade 2000).

Riparian Function

Riparian conditions in the lower river below RM 10 have been substantially impacted by residential, agricultural, and mining development. This area is believed to have been a gallery-type forest consisting of multiple age classes of willow, alder, ash, and cottonwood, but now consists only of widely dispersed cottonwoods, willow, and ash, with abundant reed canary grass, Himalayan blackberry, and Scotch broom in the disturbed areas. Substantial restoration efforts have involved the planting of thousands of native trees and shrubs in the past few years (Wade 2000).

An analysis of 1996 aerial photos indicated that the majority of the mainstem has lost substantial portions of riparian forest, many having been replaced by lawns. Most of the tributaries also have poor riparian conditions (Wade 2000). Riparian forests in the upper watershed have been altered by fire history, with only 4% of riparian reserves in late-successional stages and a total riparian hardwood composition of 23%. Large segments of the upper mainstem and Copper Creek have canopies that cover less than 50% of the stream channel (USFS 1995).

According to IWA watershed process modeling, which is presented in greater detail later in this chapter, 8 of the 36 subwatersheds in the basin are “impaired” with respect to riparian function. The remainder fall primarily in the “moderately impaired” category, with only 4 subwatersheds rated as “functional”. The greatest impairments are in the low elevation portions of the basin, which have received the greatest impacts to riparian areas due to agricultural and residential development. Fully functional conditions exist only in a handful of headwaters subwatersheds.

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

Floodplain Function

The lower river flows through a broad alluvial valley that has been extensively diked to protect agricultural, residential, and mining activities. Historically, nearly the entire lower river valley bottom was wetlands, with extensive channel braiding from RM 7 to RM 10. By 1937, the mainstem was mostly a single-thread channel with ephemeral floodplain sloughs where the braids once were. This simplification of the channel has reduced a substantial amount of side channel and backwater habitat that was historically used for chum spawning and could provide important overwintering habitat for juvenile coho. Limiting Factors Analysis TAG members estimated that over 50% of the off-channel habitat and wetlands in the historical lower river floodplain have been disconnected from the river (Wade 2000).

L.3.4. Stream Habitat Limitations

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

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

Population Analysis

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

Habitat-based assessments were completed in the EF Lewis basin for summer steelhead, winter steelhead, fall Chinook, chum and coho. Model results indicate an estimated 60- 81% decline in adult productivity for all species compared to historical estimates (Table L-2). Estimated historical-to-current trends in adult abundance show a decline of 43-90% for all species (Figure L-5). Fall Chinook adult abundance has declined the least, to an estimated 57% of historical levels. Adult abundance of coho, winter steelhead, and summer steelhead has declined by 82%, 49%, and 75%, respectively. Chum abundance has witnessed the most severe decline. Current estimates of chum abundance are at only 10% of historical levels. Diversity (as measured by the diversity index) has remained relatively constant for fall Chinook, chum and summer steelhead (Table L-2). However, coho and winter steelhead diversity has declined by 44% and 25%, respectively.

Smolt productivity has also declined from historical levels for each species in the EF Lewis basin (Table L-2). For fall Chinook and chum, smolt productivity has decreased by 58% and 43% respectively. For coho and winter steelhead the decrease was estimated at 70-80%. Summer steelhead smolt productivity has declined by 76%. Smolt abundance in the EF Lewis has declined most dramatically for chum and coho, with respective 79% and 83% changes from historical levels (Table L-2). Current fall Chinook and winter steelhead smolt abundance levels are modeled at approximately half of their historical numbers. Summer steelhead are estimated at a third of their historical numbers (Table L-2).

Table L-2. Population productivity, abundance, and diversity (of both smolts and adults) based on EDT analysis of current (P or patient) and historical (T or template)[1] habitat conditions.

	Adult Abundance		Adult Productivity		Diversity Index		Smolt Abundance		Smolt Productivity	
Species	**P**	**T**	**P**	**T**	**P**	**T**	**P**	**T**	**P**	**T**
Fall Chinook	1,491	2,618	3.3	8.3	0.98	1.00	186,551	331,777	371	884
Chum	4,652	45,517	2.0	10.4	0.97	1.00	2,200,608	10,474,620	641	1,122
Coho	568	5,053	2.4	19.2	0.56	0.99	12,475	68,929	54	266
Winter Steelhead	467	923	4.4	15.2	0.69	0.92	7,740	15,246	80	275
Summer Steelhead	197	563	2.1	8.6	0.84	0.97	3,647	10,403	38	158

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

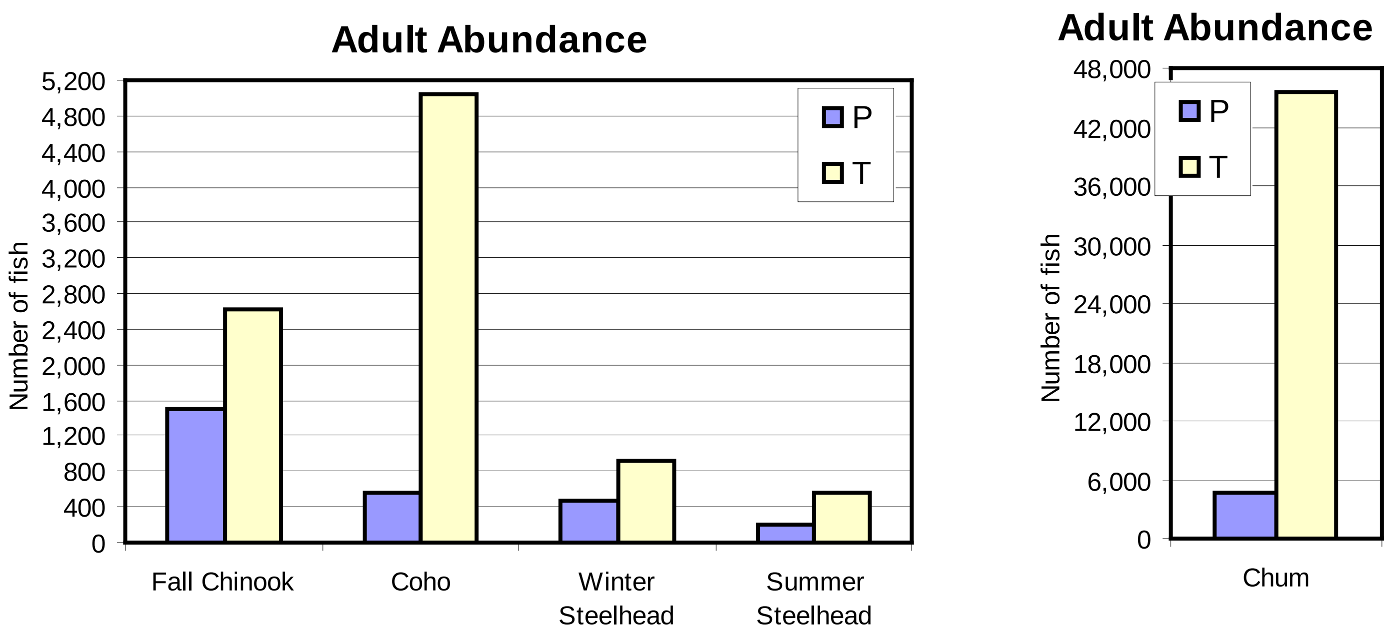


Figure L-5. Adult abundance of East Fork Lewis River fall Chinook, coho, winter steelhead and chum based on EDT analysis of current (P or patient) and historical (T or template) habitat conditions.

Stream Reach Analysis

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

Summer steelhead, which are able to ascend Sunset Falls at RM 32.7, ascend the furthest up the EF Lewis. Winter steelhead, whose distribution stops at Sunset Falls, make greater use of mainstem tributary habitats. Fall Chinook distribution ends at Lucia Falls (RM 21.3) and chum distribution ends approximately at lower Rock Creek. See Figure L-6 for a map of EDT reaches within the EF Lewis basin.

For both fall Chinook and chum, the high priority reaches are located lower in the basin. High priority reaches for fall Chinook include lower and middle mainstem reaches (EF Lewis 5-9) (Figure L-7). These reaches show an emphasis on both restoration and preservation measures. For chum, the high priority reaches are EF Lewis 4-8 (Figure L-8). All of these reaches, except for EF Lewis 4, have a combined preservation and restoration emphasis. High priority reaches for coho in the EF Lewis are similar to those for fall Chinook. Coho high priority reaches include EF Lewis 5-8 and Manley, Brezee, and Dyer Creeks (Figure L-9). For coho, all of these reaches have a restoration emphasis, suggesting that there has been degradation of key coho habitat in these areas.

The high priority reaches for winter steelhead are in the Rock Creek basin (Rock Cr 1-4) and in EF Lewis 13 (Figure L-11). These reaches represent the primary spawning and rearing areas for this population. As such, all of these reaches, except Rock Creek 1, show a preservation emphasis. High priority reaches for summer steelhead are located in the most productive spawning and rearing reaches of the upper mainstem and headwaters (EF Lewis 15-20) (Figure L-10). Steelhead would benefit from both preservation and restoration measures in these reaches.

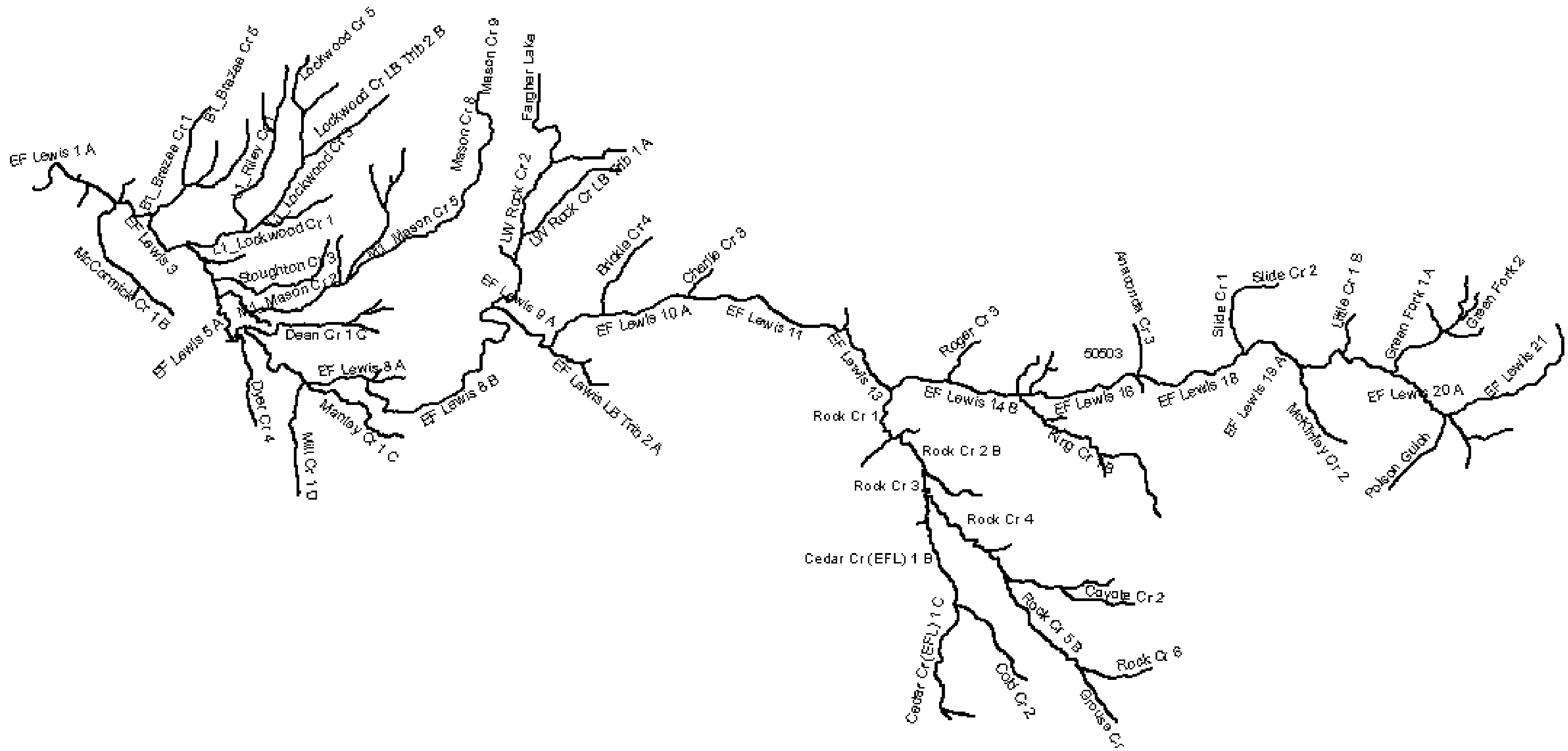


Figure L-6. East Fork Lewis River subbasin with EDT reaches identified. For readability, not all reaches are labeled.

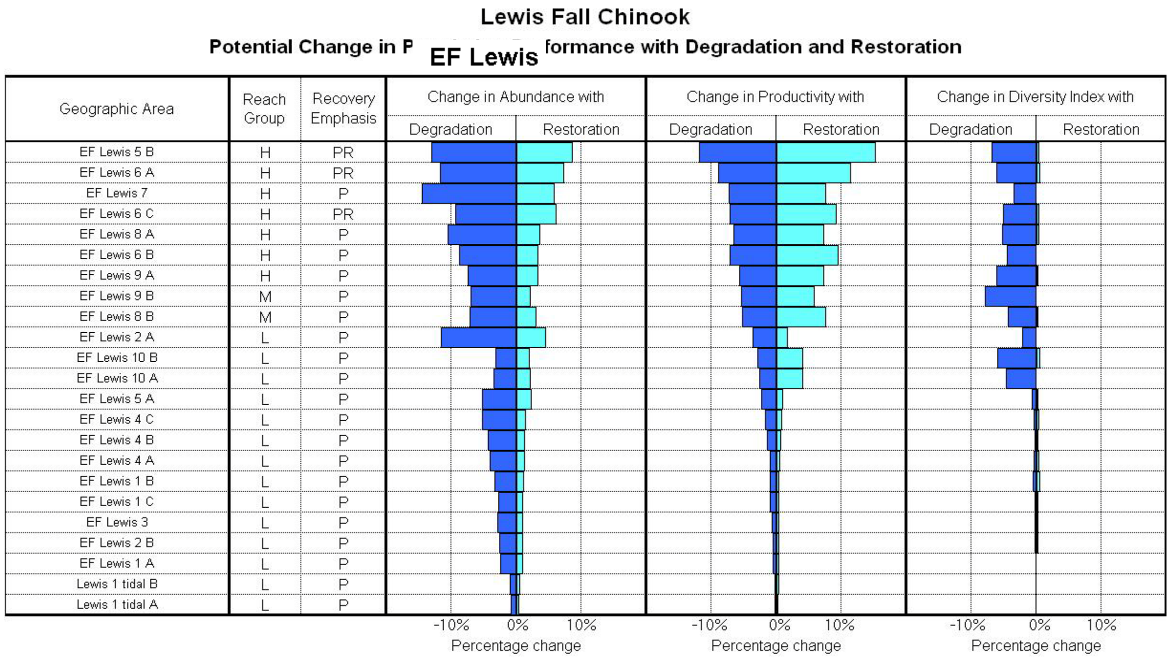


Figure L-7. **East Fork Lewis fall Chinook ladder diagram. The rungs on the ladder represent the reaches and the three ladders contain a preservation value and restoration potential based on abundance, productivity, and diversity. The units in each rung are the percent change from the current population. 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 Appendix E Chapter 6 for more information on EDT ladder diagrams.**

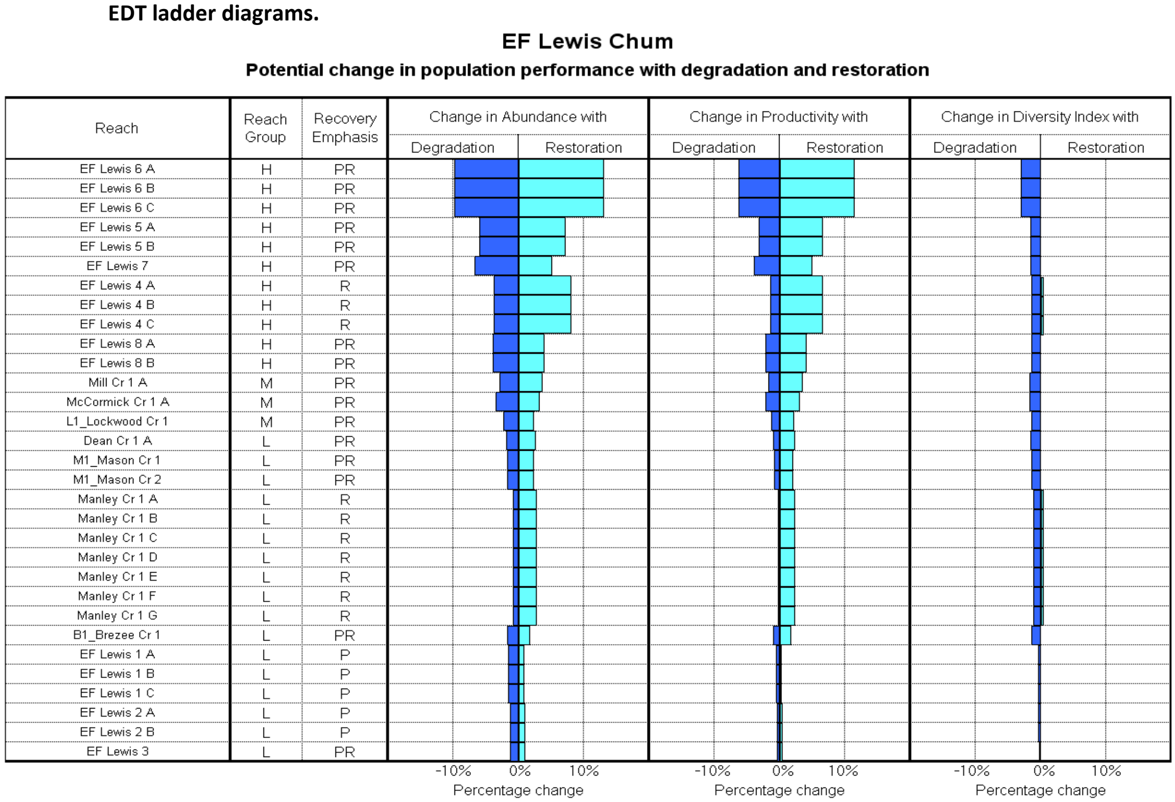


Figure L-8. **East Fork Lewis chum ladder diagram. The rungs on the ladder represent the reaches and the three ladders contain a preservation value and restoration potential based on abundance, productivity, and diversity. The units in each rung are the percent change from the current population. For each reach, a reach group designation and recovery emphasis designation is given. Percentage change values are expressed as the change per 1000 meters of stream length within the reach. See Appendix E Chapter 6 for more information on EDT ladder diagrams.**

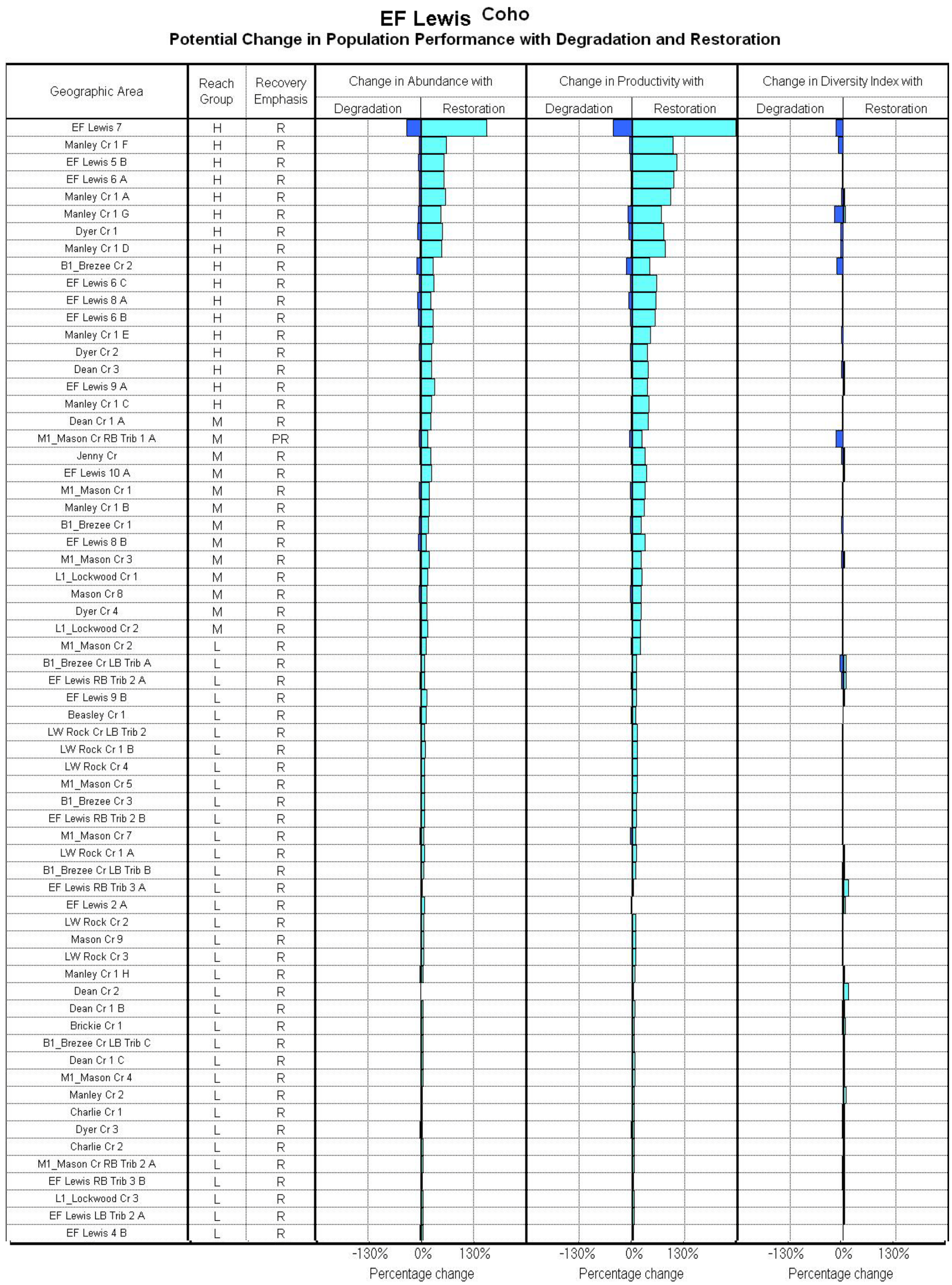


Figure L-9. East Fork Lewis coho ladder diagram. The rungs on the ladder represent the reaches and the three ladders contain a preservation value and restoration potential based on abundance, productivity, and diversity. The units in each rung are the percent change from the current population. For each reach, a reach group designation and recovery emphasis designation is given. Percentage change values are expressed as the change per 1000 meters of stream length within the reach. See Appendix E Chapter 6 for more information on EDT ladder diagrams. Some low priority reaches are not included for display purposes.

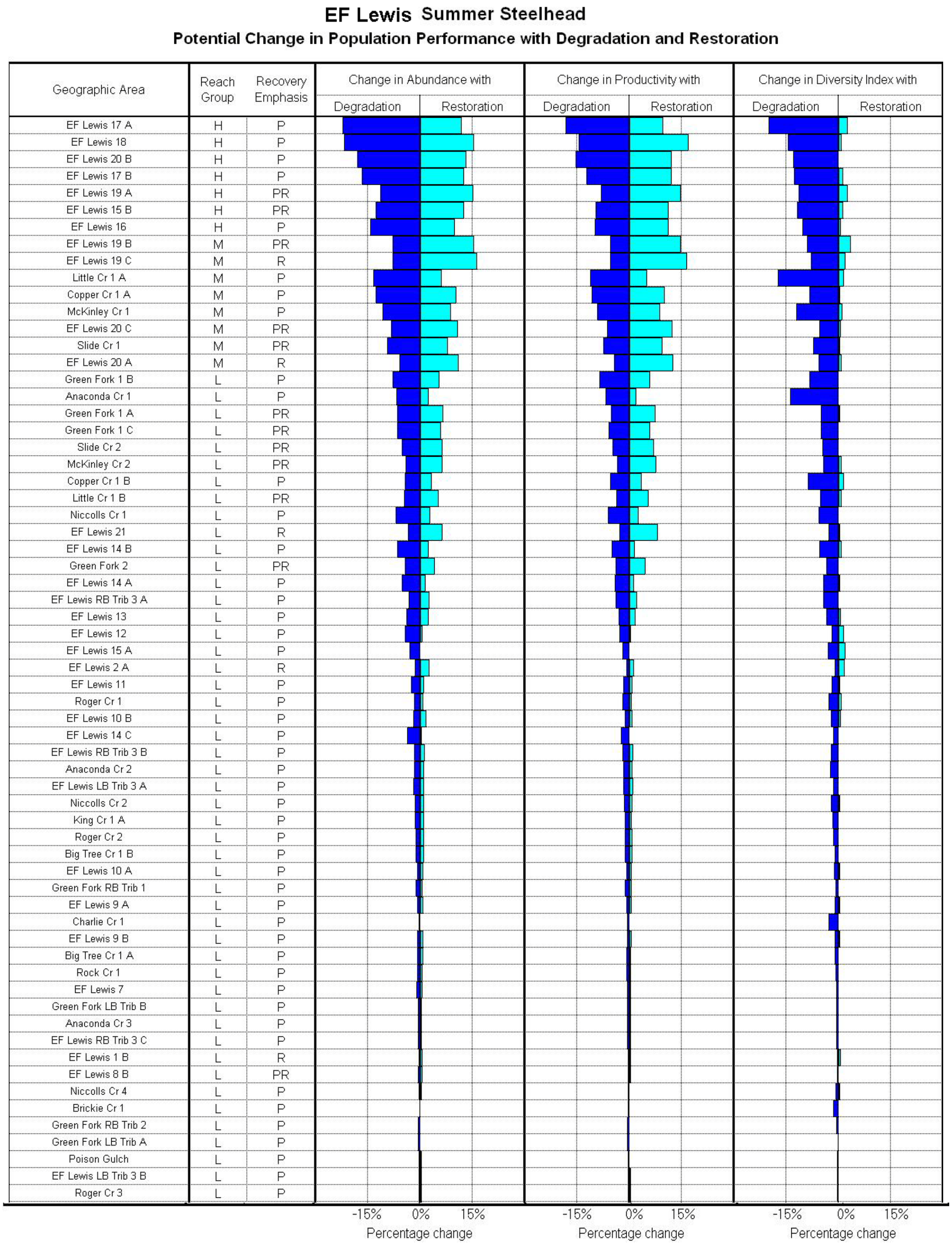


Figure L-10. East Fork Lewis summer steelhead ladder diagram. The rungs on the ladder represent the reaches and the three ladders contain a preservation value and restoration potential based on abundance, productivity, and diversity. The units in each rung are the percent change from the current population. For each reach, a reach group designation and recovery emphasis designation is given. Percentage change values are expressed as the change per 1000 meters of stream length within the reach. See Appendix E Chapter 6 for more information on EDT ladder diagrams. Some low priority reaches are not included for display purposes.

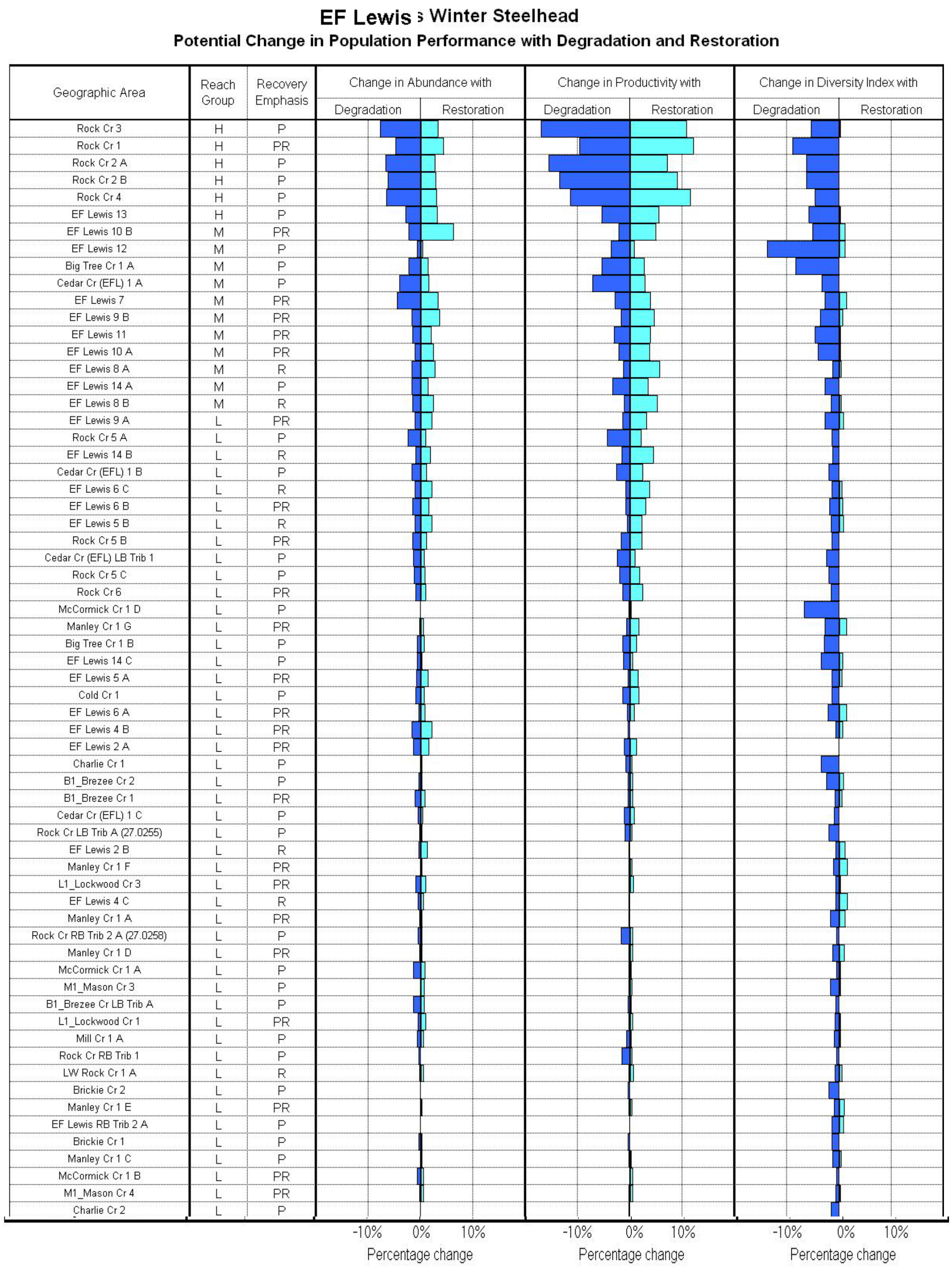


Figure L-11. East Fork Lewis River subbasin winter steelhead ladder diagram. The rungs on the ladder represent the reaches and the three ladders contain a preservation value and restoration potential based on abundance, productivity, and diversity. The units in each rung are the percent change from the current population. For each reach, a reach group designation and recovery emphasis designation is given. Percentage change values are expressed as the change per 1000 meters of stream length within the reach. See Appendix E Chapter 6 for more information on EDT ladder diagrams. Some low priority reaches are not included for display purposes.

Habitat Factor Analysis

The Habitat Factor Analysis of EDT identifies the most important habitat factors affecting fish in each reach. Whereas the EDT reach analysis identifies reaches where changes are likely to significantly affect the fish, the Habitat Factor Analysis identifies specific stream reach conditions that may be modified to produce an effect. Like all EDT analyses, the habitat factor analysis compares current/patient and historical/template habitat conditions. For each reach, EDT generates what is referred to as a "consumer reports diagram", which identifies the degree to which individual habitat factors are acting to suppress population performance. The effect of each habitat factor is identified for each life stage that occurs in the reach and the relative importance of each life stage is indicated. For additional information and examples of this analysis, see Appendix E. Inclusion of the consumer report diagram for each reach is beyond the scope of this document. A summary of the most critical life stages and the habitat factors affecting them are displayed for each species in Table L-3.

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

Important fall Chinook reaches are located in the lower mainstem. The greatest impacts here are sediment, key habitat, and temperature (Figure L-12). There is a large influx of sediment from channel sources due to rapid channel migration rates and avulsions into streamside gravel pits. These conditions have served to decrease overall channel stability and have increased bank erosion. Low LWD levels, channelization, and degraded riparian forests have contributed to a lack of habitat diversity. Key habitat has been lost due to channelization and channel avulsions. Temperature is impacted by sparse canopy cover. Flow and sediment impacts are related to upper basin forest and road conditions, with some effects still lingering from large fires and floods in the 1920s and 30s.

The high priority areas for chum are similar to those for fall Chinook. These reaches suffer from similar sediment problems and loss of key habitat (Figure L-16). However, an additional impact to chum in these areas comes from lack of habitat diversity. These reaches have experienced heavy channelization (diking) and riparian zone degradation. LWD levels are low in these streams. Residential development and agriculture have altered sediment and flow regimes. Furthermore, the high density of people in the area increases the risk of harassment impacts from anglers and recreationalists. Key restoration areas for coho in the EF Lewis are generally located in middle and lower mainstem sections. In these areas, habitat impacts to coho come from sediment, loss of both key habitat and habitat diversity, and poor channel stability (Figure L-13). The causes of impacts are similar to those discussed for fall Chinook and chum. The loss of off-channel rearing habitat through levees, channel simplification, and development has had a large impact on coho.

High priority reaches for summer steelhead are located in upper mainstem reaches that are affected mostly by channel instability, sediment, high temperature, and loss of key habitat (Figure L-14). Habitat diversity is also low, due to degraded riparian zones and low LWD levels. Flow and sediment impacts are related to upper basin forest and road conditions, with some effects still lingering from large fires and floods in the 1920s and 30s. The 1995 USFS watershed analysis (USFS 1995) rated nearly all of the headwater reaches occupied by summer steelhead (except for the Green Fork) as having poor (<40 pieces per mile) LWD abundance. The bulk of these reaches also have riparian canopy openings of greater than 50%. Sediment impacts in the channel below Sunset Falls (EF Lewis 17) and in Green Fork Creek stem largely from past fires and floods (USFS 1995). The 1995 watershed analysis rated 14 of 23 upper basin subwatersheds as being impaired with regards to peak flows, primarily because of high road densities and young forest stands.

As described in the reach analysis section, the high priority reaches for winter steelhead are in the middle mainstem (EF Lewis 13) and in the Rock Creek basin (Rock 1-4). Fine sediment and loss of key habitat have had a negative impact on the population (Figure L-15). Sediment impacts are mostly from upriver sources. Habitat diversity impacts stem from degraded riparian zones and low LWD levels.

Table L-3. Summary of the primary limiting factors affecting life stages of focal salmonid species. Results are summarized from EDT Analysis.

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

EF Lewis Fall Chinook
Protection and Restoration Strategic Priority Summary

Geographic area priority	Attribute class priority for restoration																
Geographic area	Channel stability	Chemicals	Competition (w/ hatch)	Competition (other sp)	Flow	Food	Habitat diversity	Harassment/poaching	Obstructions	Oxygen	Pathogens	Predation	Sediment load	Temperature	Withdrawals	Key habitat quantity
EF Lewis 5 B	•				•	•	•						⬤	⬤		⬤
EF Lewis 6 A	•				•	•	•						⬤	⬤		⬤
EF Lewis 7	•					•							⬤	⬤		⬤
EF Lewis 6 C	•				•	•	•					•	⬤	⬤		⬤
EF Lewis 8 A	•				•		•	•					⬤	⬤		⬤
EF Lewis 6 B	•				•	•	•						⬤	⬤		
EF Lewis 9 A	•				•		⬤						⬤	⬤		⬤
EF Lewis 9 B	•				•		⬤						⬤	⬤		⬤
EF Lewis 8 B	•				•	•	•	•					⬤	⬤		⬤
EF Lewis 2 A	•				•	•	⬤					•	•	•		•
EF Lewis 10 B	⬤				•	•	⬤						⬤	⬤		⬤
EF Lewis 10 A	•				•	•	⬤						⬤	⬤		⬤
EF Lewis 5 A	•				•	•	•					•		•		⬤
EF Lewis 4 C	•				•	•	•					•		•		•
EF Lewis 4 B	•				•	•	•					•		•		•
EF Lewis 4 A	•				•	•	•					•		•		•
EF Lewis 1 B	•				•	•	•					•	•	•		•
EF Lewis 1 C	•				•	•	•					•	•	•		•
EF Lewis 3	•				•	•	•					•		•		•
EF Lewis 2 B	•				•	•	•					•	•	•		•
EF Lewis 1 A	•				•	•	•					•	•	•		•
Lewis 1 tidal B	•				•		⬤					•	•			•
Lewis 1 tidal A	•				•		⬤					•	•			•

1/ "Channel stability" applies to freshwater areas only.

Key to strategic priority (corresponding Benefit Category letter also shown)

A [⬤] High
B [●] Medium
C [•] Low
D & E [ ] Indirect or General

Figure L-12. East Fork Lewis subbasin fall Chinook habitat factor analysis diagram. Diagram displays the relative impact of habitat factors in specific reaches. The reaches are ordered according to their restoration and preservation rank, which factors in their potential benefit to overall population abundance, productivity, and diversity. The reach with the greatest potential benefit is listed at the top. The dots represent the relative impact of habitat attributes on reach-level performance. See Appendix E Chapter 6 for more information on habitat factor analysis diagrams. Some low priority reaches may not be included for display purposes.

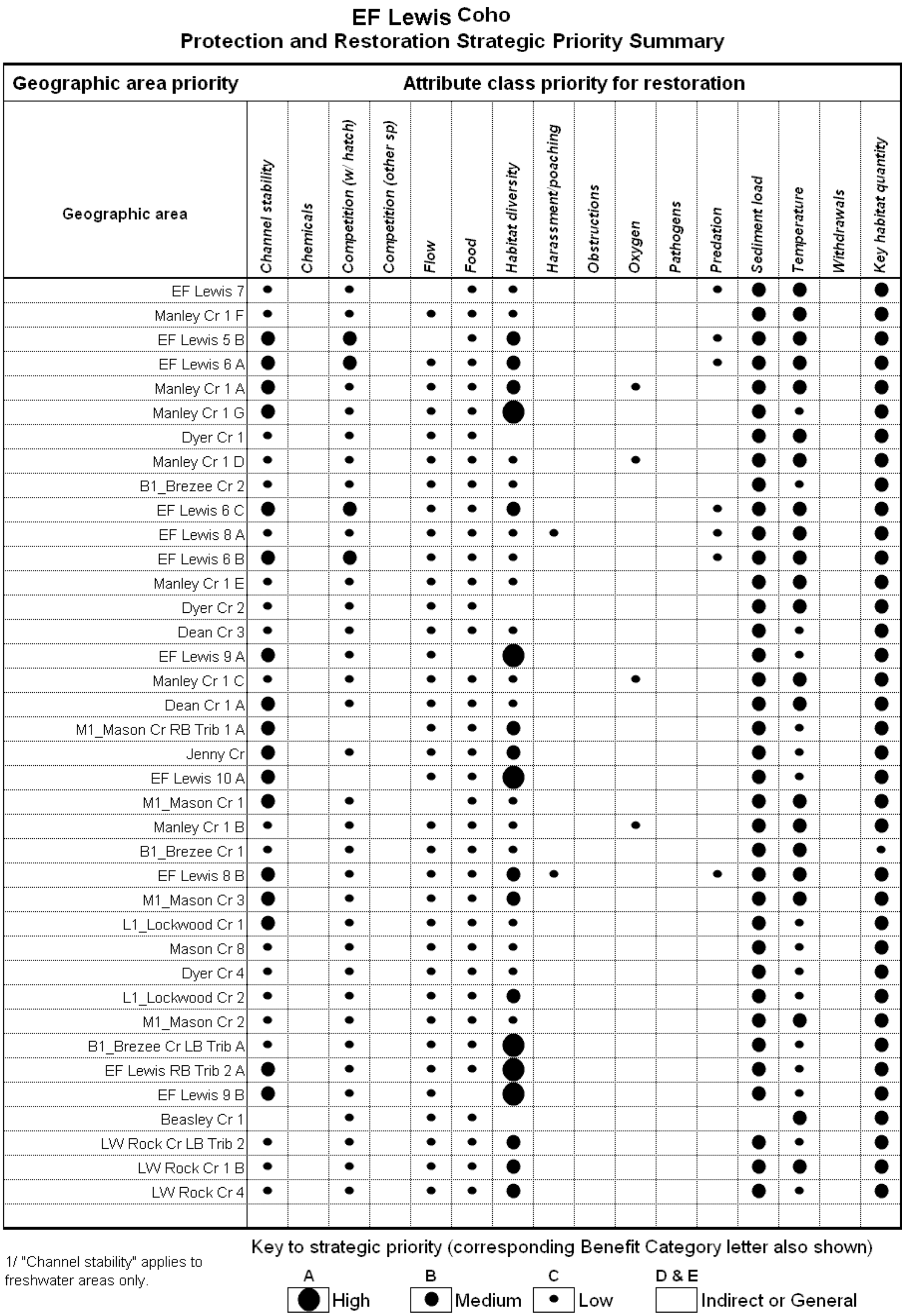


Figure L-13. East Fork Lewis coho habitat factor analysis diagram. Diagram displays the relative impact of habitat factors in specific reaches. The reaches are ordered according to their restoration and preservation rank, which factors in their potential benefit to overall population abundance, productivity, and diversity. The reach with the greatest potential benefit is listed at the top. The dots represent the relative impact of habitat attributes on reach-level performance. See Appendix E Chapter 6 for more information on habitat factor analysis diagrams. Some low priority reaches may not be included for display purposes.

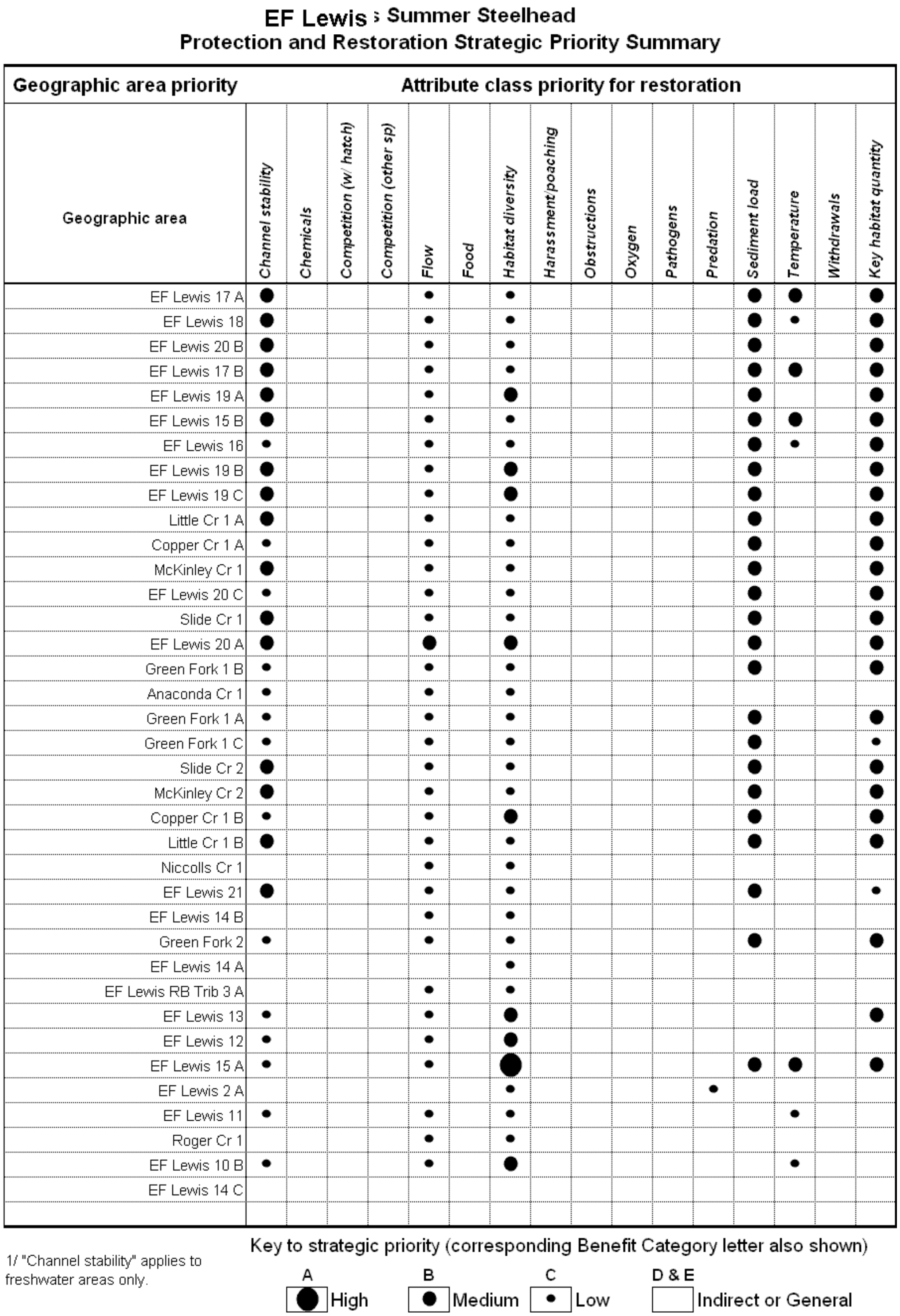


Figure L-14. East Fork Lewis summer steelhead habitat factor analysis diagram. Diagram displays the relative impact of habitat factors in specific reaches. The reaches are ordered according to their restoration and preservation rank, which factors in their potential benefit to overall population abundance, productivity, and diversity. The reach with the greatest potential benefit is listed at the top. The dots represent the relative impact of habitat attributes on reach-level performance. See Appendix E Chapter 6 for more information on habitat factor analysis diagrams. Some low priority reaches may not be included for display purposes.

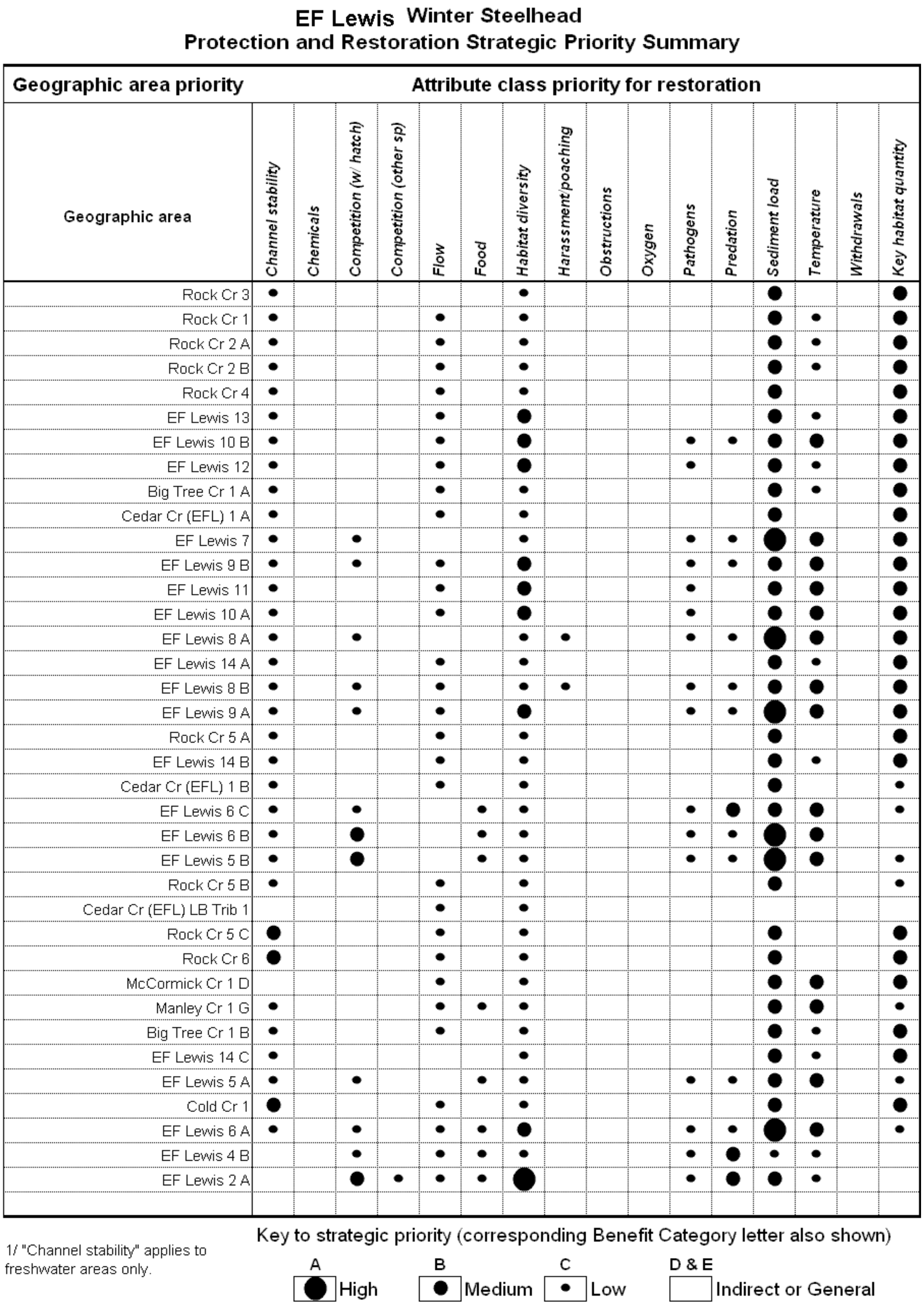


Figure L-15. East Fork Lewis River subbasin winter steelhead habitat factor analysis diagram. Diagram displays the relative impact of habitat factors in specific reaches. The reaches are ordered according to their restoration and preservation rank, which factors in their potential benefit to overall population abundance, productivity, and diversity. The reach with the greatest potential benefit is listed at the top. The dots represent the relative impact of habitat attributes on reach-level performance. See Appendix E Chapter 6 for more information on habitat factor analysis diagrams. Some low priority reaches may not be included for display purposes.

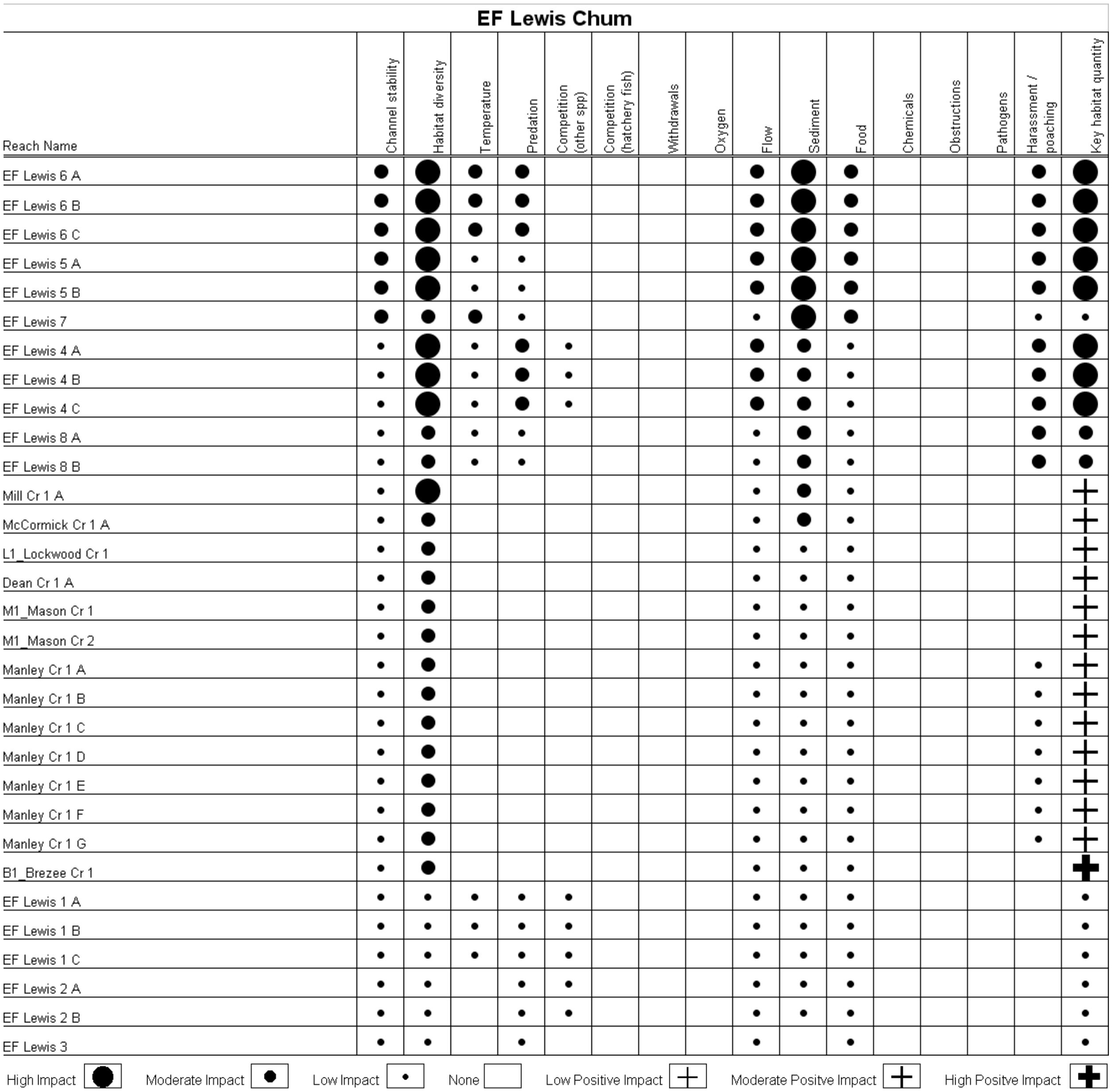


Figure L-16. East Fork Lewis subbasin chum habitat factor analysis diagram. This chum habitat factor analysis diagram differs from the others in that the dot size represents not only the relative within-reach impact of the habitat attributes, but also the relative contribution of each reach's impact on total population performance. The dots therefore decrease in size towards the bottom of the chart.

L.3.5. Watershed Process Limitations

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

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

The East Fork Lewis River is composed of 34 subwatersheds within the East Fork proper, and two independent tributaries, Gee Creek and Allen Canyon Creek. Gee Creek discharges into the Columbia at the Lewis River confluence, whereas Allen Canyon Creek enters the lower Lewis between the East Fork/North Fork split and the Columbia. IWA results for the East Fork Lewis River watershed are shown in Table L-4. A reference map showing the location of each subwatershed in the basin is presented in Figure L-17. Maps of the distribution of local and watershed level IWA results are displayed in Figure L-18.

Hydrology

Current Conditions— There is a dramatic difference in hydrologic conditions between the upper and lower watershed. In the lower watershed, local hydrologic conditions are uniformly impaired, with the exception of the independent tributaries (Gee and Allen Canyon Creeks) as well as the mainstem subwatershed furthest downstream (50602).

Subwatersheds above Lucia Falls are for the most part rated moderately impaired at the local level, with the exception of three subwatersheds with more substantial impairment (50202 Anaconda Creek, 50507 Roger Creek, and 50505 Yacolt Creek), and four non-contiguous subwatersheds in the upper basin with functional conditions, including the headwaters of the mainstem (50101), Coyote Creek (50403, a tributary to upper Rock Creek), lower Copper Creek (50301), and Cedar Creek (50402, a tributary to Rock Creek).

Analysis of hydrologic conditions at the watershed scale produces a small number of changes in IWA ratings. For example, two upper mainstem subwatersheds (50201, 50203) earn a functional rating due to the influence of upstream functional conditions.

Predicted Future Trends— In the lower portion of the basin, low levels of public ownership, low levels of mature forest cover, high road densities, and intense development pressure are likely to lead to downward trends in hydrologic conditions. More than 75% of areas zoned for development remain vacant, meaning this area may develop extensively over the next 20 years. As a result, impervious surfaces, road density, and stream crossing density will likely increase.

These trends will apply in low-elevation tributaries, which generally have low forest cover and increasing development. The tributaries to the East Fork—including Brezee, Lockwood, Mason and Mill Creeks, in addition to non-key subwatersheds—likely will become increasingly ‘flashy’, featuring higher, short-duration flows during the rainy season, while also suffering lower base flows during late summer months due to loss of riparian cover, increased watershed imperviousness, higher rates of surface water withdrawal, and depletion of groundwater resources due to withdrawal and reduced infiltration.

Mainstem subwatersheds in the lower East Fork may suffer similar consequences due to development pressure, but hydrologic effects will be substantially governed by conditions further upstream in the upper watershed. Hydrologic continuity has been substantially degraded by the loss of wetlands, gravel mining, and construction of levees. The East Fork avulsion through abandoned gravel pits in the lower river impacted spawning and rearing habitat.

Upper watershed hydrologic conditions are likely to maintain current conditions or gradually improve due to the high percentage of public ownership and low levels of anticipated development. Predicted improvements are based on improved forest management practices on both federal (GPNF) and state (WDNR) lands. Road and road-crossing removal as well as riparian restoration are likely to provide substantial hydrologic benefits.

Sediment Supply

Current Conditions— Local sediment conditions fall primarily into the moderately impaired category, with no cases of impaired sediment condition and with nearly all functional subwatersheds occurring in the upper basin. Local sediment conditions are moderately impaired throughout the lower watershed, including the mainstem and tributaries Brezee Creek (50611), Lockwood Creek (50602) and Mason Creek (50613).

The change between natural and current erodability is similar for both the upper and lower portions of the basin, and therefore subwatersheds in these areas are rated similarly. However, on an absolute scale, erodability indices are much greater in the lower basin. This is an important distinction: while the IWA method rates sediment conditions as similarly degraded throughout the watershed due to the relative difference between natural and current conditions, the absolute levels remain very low throughout the upper watershed while the lower watershed is in the moderate to high category. Impaired conditions in the lower watershed are not surprising given the extremely low percentage of public ownership, mature forest cover of only 9%, very high road densities ranging from 4.8-7.7 mi/sq mi, and erodable soils.

Whereas rain-on-snow conditions are prevalent in most of the upper watershed, they are generally absent downstream of Lucia Falls. However, due to the stability of soils and much higher level of mature forest cover (57%), rain-on-snow events have less adverse impacts on upper subwatersheds. Road densities in the upper watershed range from 1.9-5.6 mi/sq mi, while stream crossing densities are moderately high.

Watershed level analysis results in few changes to local sediment condition ratings as all but one functional subwatershed are located in terminal areas (i.e., without effects from upstream subwatersheds).

Predicted Future Trends— As with hydrologic trends, the lower watershed is not likely to experience substantial improvements in sediment conditions in the next 20 years due to development pressures. Furthermore, natural erodability is moderately high (due to geologic conditions) and road densities are unlikely to decrease.

Even with moderate impairment, geology in the upper watershed naturally limits the extent of deleterious, episodic sediment erosion. Sediment processes are likely to improve based on a trend towards improved forest and road management on public lands. Natural regeneration of previously harvested and burned areas will also yield improved sediment supply conditions.

Table L-4. IWA results for the East Fork Lewis River Watershed

Subwatershed[a]	Local Process Conditions[b]			Watershed Level Process Conditions[c]		Upstream Subwatersheds[d]
	Hydrology	Sediment	Riparian	Hydrology	Sediment	
50601	M	M	I	M	M	50101, 50203, 50201, 50202, 50302, 50301, 50508, 50509, 50503, 50502, 50507, 50405, 50404, 50403, 50402, 50401, 50506, 50504, 50505, 50502, 50501, 50616, 50605, 50604, 50615, 50614, 50613, 50604, 50603, 50612, 50611, 50608, 50602, 50609, 50607, 50606, 50610
50610	M	M	M	M	M	none
50606	M	M	M	M	M	50101, 50203, 50201, 50202, 50302, 50301, 50508, 50509, 50503, 50502, 50507, 50405, 50404, 50403, 50402, 50401, 50506, 50504, 50505, 50502, 50501, 50616, 50605, 50604, 50615, 50614, 50613, 50604, 50603, 50612, 50611, 50608, 50602, 50609, 50607
50607	M	M	M	M	M	none
50609	I	M	I	I	M	none
50602	M	M	M	I	M	50101, 50203, 50201, 50202, 50302, 50301, 50508, 50509, 50503, 50502, 50507, 50405, 50404, 50403, 50402, 50401, 50506, 50504, 50505, 50502, 50501, 50616, 50605, 50604, 50615, 50614, 50613, 50604, 50603, 50612, 50611, 50608, 50609, 50607
50608	I	M	I	I	M	none
50611	M	M	M	M	M	none
50612	I	F	M	I	M	50611
50603	I	M	I	I	M	50101, 50203, 50201, 50202, 50302, 50301, 50508, 50509, 50503, 50502, 50507, 50405, 50404, 50403, 50402, 50401, 50506, 50504, 50505, 50502, 50501, 50616, 50605, 50604, 50615, 50614, 50613, 50604, 50612, 50611
50613	I	M	M	I	M	none
50614	I	M	I	I	M	none
50615	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	
50604	I	M	M	I	M	50101, 50203, 50201, 50202, 50302, 50301, 50508, 50509, 50503, 50502, 50507, 50405, 50404, 50403, 50402, 50401, 50506, 50504, 50505, 50502, 50501, 50616, 50605, 50615
50605	I	M	I	I	M	none
50616	I	M	M	M	M	50101, 50203, 50201, 50202, 50302, 50301, 50508, 50509, 50503, 50502, 50507, 50405, 50404, 50403, 50402, 50401, 50506, 50504, 50505, 50502, 50501
50501	I	M	M	M	M	50101, 50203, 50201, 50202, 50302, 50301, 50508, 50509, 50503, 50502, 50507, 50405, 50404, 50403, 50402, 50401, 50506, 50504, 50505, 50502
50505	I	M	I	I	M	None
50504	I	M	I	I	M	50506
50506	I	M	M	I	M	none
50401	M	F	M	F	F	50405, 50404, 50403, 50402
50402	F	F	M	M	F	50404
50403	I	F	M	I	F	none
50404	M	M	F	M	M	
50405	M	F	M	M	F	
50507	I	M	M	I	M	
50502	M	F	M	M	M	50101, 50203, 50201, 50202, 50302, 50301, 50508, 50509, 50503, 50502, 50507, 50405, 50404, 50403, 50402, 50401, 50506, 50504, 50505
	M	F	M	M	M	50101, 50203, 50201, 50202, 50302, 50301, 50508, 50509, 50503, 50502, 50507, 50405, 50404, 50403, 50402, 50401, 50506, 50504, 50505
50503	M	M	M	F	M	50101, 50203, 50201, 50202, 50302, 50301, 50508, 50509
50509	M	M	M	M	M	none
50508	I	M	M	I	M	none
50301	F	M	M	M	M	50302
50302	I	F	M	I	F	none

Subwatershed[a]	Local Process Conditions[b]			Watershed Level Process Conditions[c]		Upstream Subwatersheds[d]
	Hydrology	Sediment	Riparian	Hydrology	Sediment	
50202	F	F	F	F	F	none
50201	M	M	M	F	M	50203, 50101
50203	M	M	F	F	M	50101
50101	F	M	F	F	M	none

Notes:

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

F: Functional
M:Moderately impaired
I:Impaired

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

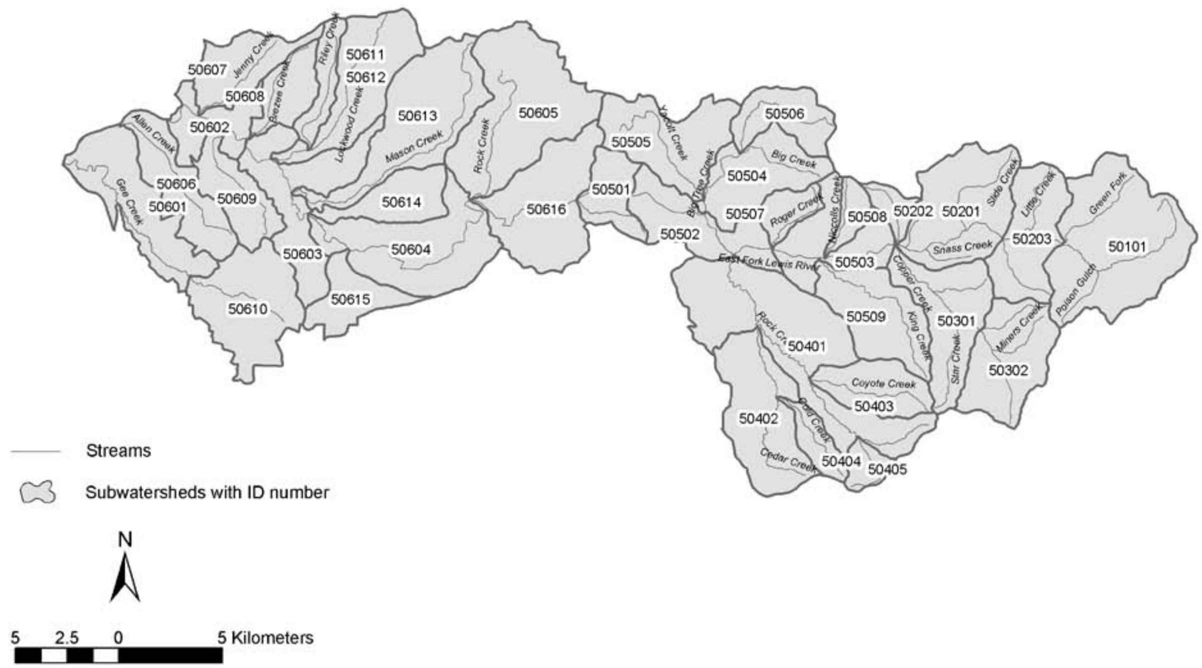


Figure L-17. Map of the East Fork Lewis River basin showing the location of the IWA subwatersheds.

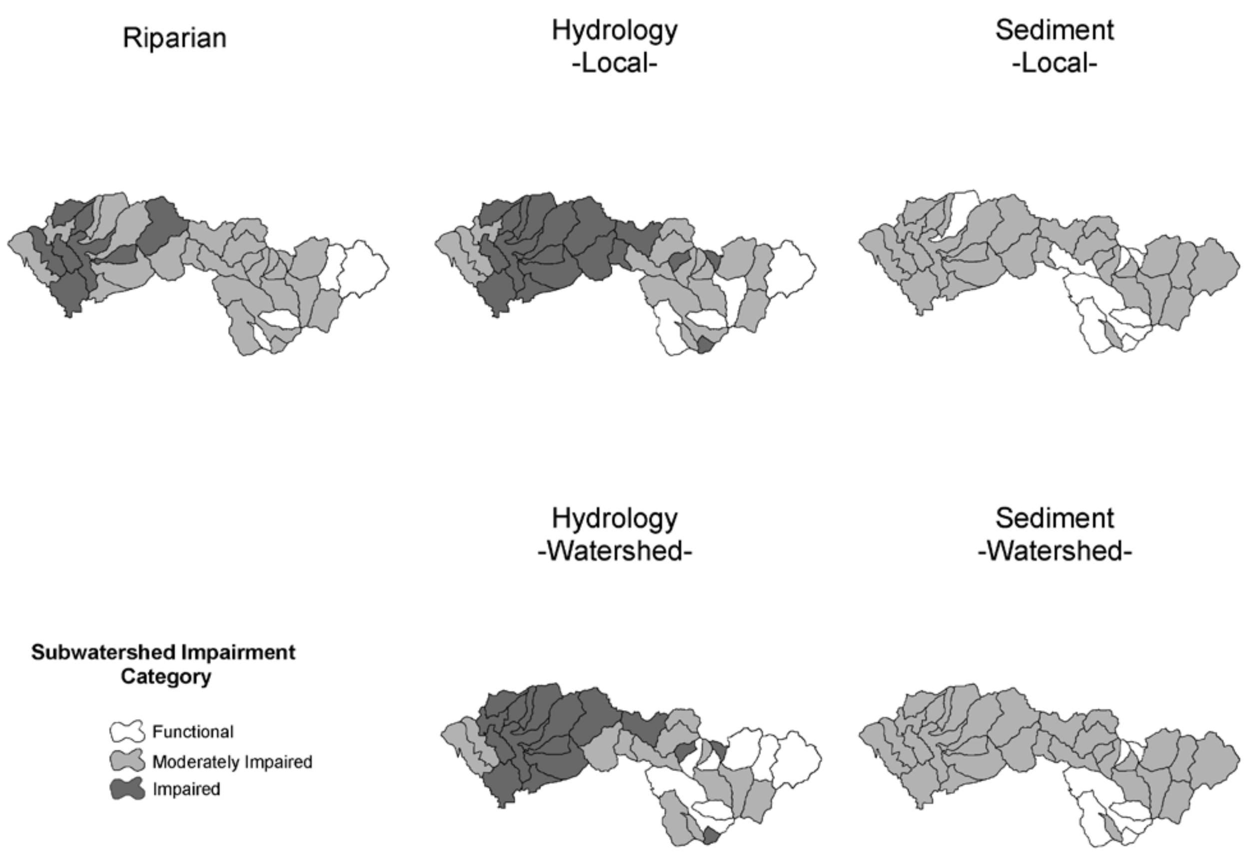


Figure L-18. IWA subwatershed impairment ratings by category for the East Fork Lewis River basin

Riparian Condition

Current Conditions— Riparian conditions are evenly divided in the lower watershed between impaired and moderately impaired categories. Riparian conditions in the upper watershed are for the most part moderately impaired, with localized areas of functional conditions in headwater areas. Riparian impairment in the upper basin is primarily the result of timber harvest and historical stand replacing fires. In the lower watershed, riparian impairment can be attributed to timber harvest, residential development, roadways, and agricultural uses.

Predicted Future Trends— Upper watershed riparian conditions are represented by a patchwork of functional and moderately impaired subwatersheds. Currently, functional riparian areas are found in only four subwatersheds in the entire basin, all located in the upper reaches of the watershed on publicly owned lands. Forest management by WDNR and the USFS are expected to result in improved riparian conditions.

Moderately impaired to impaired riparian condition ratings are most prevalent along the lower mainstem and tributaries. Historical riparian forests within the mainstem floodplain have been almost entirely removed, limiting LWD recruitment while also reducing channel roughness and stability, which results in higher rates of bank erosion during high flows. Absent restorative measures, episodic levee avulsion and bank erosion events may accelerate in the future. In the lower mainstem and tributary subwatersheds, currently degraded conditions are generally expected to persist due to existing road densities, channelization, and current land uses. However, riparian conditions on the large tract of County-owned lands downstream from Daybreak are expected to improve as a result of dedicated replanting efforts.

L.3.6. Other Factors and Limitations

Hatcheries

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

There are no hatcheries operating in the East Fork Lewis Basin. Skamania Hatchery winter and summer steelhead are released into the East Fork Lewis to provide harvest opportunity (Table L-5). Skamania Hatchery steelhead are a composite stock and are genetically different from the naturally-produced steelhead in the East Fork Lewis River. The main threats from hatchery steelhead are potential domestication of the naturally-produced steelhead as a result of adult interactions or ecological interactions between natural juvenile salmon and hatchery released juvenile steelhead.

Table L-5. East Fork Lewis Hatchery Production.

Hatchery	Release Location	Winter Steelhead	Summer Steelhead
Skamanaia	East Fork Lewis	90,000	30,000

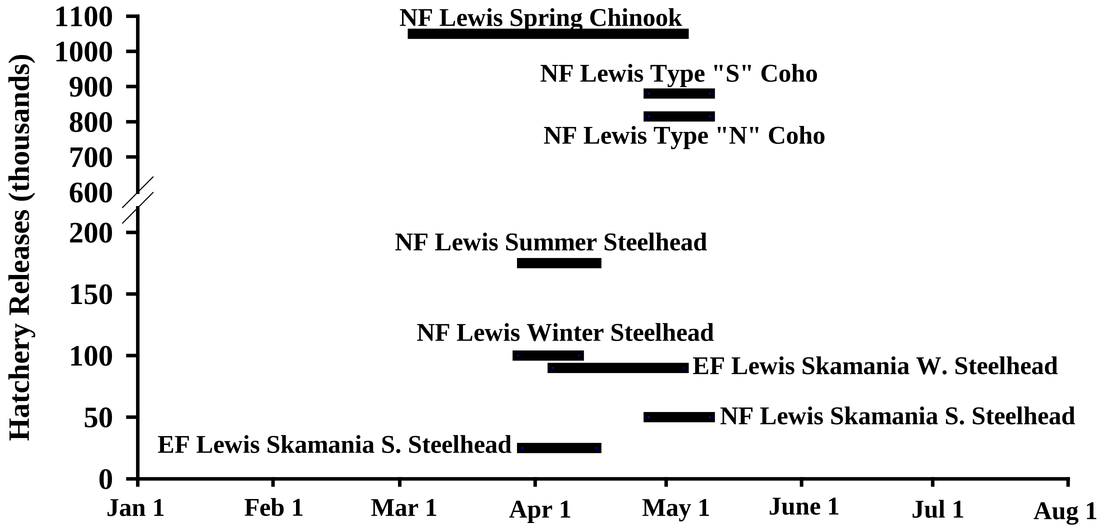


Figure L-19. Magnitude and timing of hatchery releases in the Lewis River basins by species, based on 2003 brood production goals.

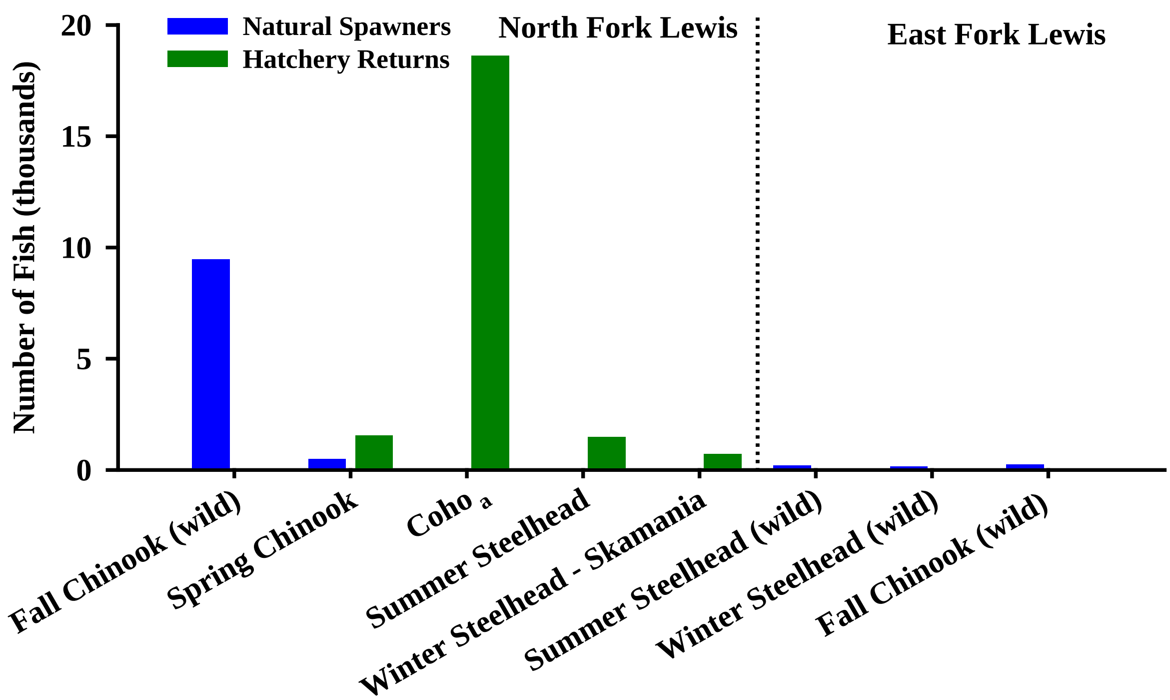


Figure L-20. Recent average hatchery returns and estimates of natural spawning escapement in the Lewis River basin by species. The years used to calculate averages varied by species, based on available data. The data used to calculate average hatchery returns and natural escapement for a particular species and basin were derived from the same years in all cases. All data were from 1992 to the present. Calculation of each average utilized a minimum of 5 years of data.

Hatchery Effects: Genetics—Broodstock for the former fall Chinook hatchery program on the NF Lewis likely came from native Lewis River fall Chinook and the degree of influence from outside stocks is unknown. Fall Chinook hatchery releases ended in 1986; Lewis River fall Chinook are the only lower Columbia stock to maintain a healthy wild population with negligible hatchery influence. Genetic analysis in 1990 indicated that NF and EF Lewis River fall Chinook were genetically similar and both were distinct from all other lower Columbia River fall Chinook stocks. There is no hatchery fall Chinook production in the EF Lewis

Coho broodstock collection comes from adults returning to the Lewis River Salmon Hatchery and the Merwin Hatchery trap facility. WDFW and Fish First have started a small research and enhancement program for wild late coho. This 15,000-smolt and 75,000-fry release program used wild adults collected at the grist mill trap on Cedar Creek. There is no coho hatchery program on the EF Lewis, although there has been coho fry planted into tributary streams historically.

Broodstock for the NF Lewis winter steelhead hatchery program originated from a mixture of Beaver Creek and Skamania hatchery winter steelhead stocks; Chambers Creek and Cowlitz hatchery stocks also have been released in the basin. Current broodstock collection comes from adults returning to the Lewis River and Merwin hatchery traps. Allele frequency analysis of NF and EF Lewis River winter steelhead was unable to determine the distinctiveness of either stock compared to other lower Columbia River winter steelhead stocks. In recent years, wild late winter steelhead have been collected at Merwin Trap and returned to the Lewis River below Merwin Dam. These wild fish may be used in the future as a brood source for reintroduction of winter steelhead to natural habitats upstream of Swift Dam. The hatchery winter steelhead released in the EF Lewis are Skamania Hatchery stock.

Broodstock for the NF Lewis summer steelhead hatchery program originated from Skamania and Klickitat River crosses; Beaver Creek, Chambers Creek, and Cowlitz River summer steelhead stocks have also been released in the basin. Current broodstock collection comes from adults returning to the Lewis River and Merwin hatchery traps. The hatchery steelhead released into the EF Lewis are Skamania Hatchery stock.

Water Quality/Disease— Water for the Lewis River Salmon Hatchery comes directly from the Lewis River; this site serves as the primary final rearing site for hatchery spring Chinook in the basin. Because the facility is located downstream of multiple hydroelectric generation facilities, influent dissolved gas levels have been a problem. The hatchery is equipped with four degassing towers that are efficient in treating incoming water. Effluent is monitored under the hatchery's NPDES permit. Fish health is monitored continuously by hatchery staff; a fish pathologist visits monthly. The area fish health specialist inspects fish prior to release.

Water for the Speelyai Hatchery comes directly from Speelyai Creek; the facility serves as the primary location for adult broodstock holding and spawning, incubation, and early rearing for the spring Chinook hatchery program. Water quality, clarity, and temperature are good; flow to the rearing ponds is about 9,200 gpm. Effluent is monitored under the hatchery's NPDES permit. Adults being held for broodstock collection are inoculated twice with erythromycin. Daily 1-hour standard formalin drip treatments combat fungus problems in the adult holding pond. During the incubation process, eggs are water-hardened in iodophor for viral pathogens; formalin is used to control fungus outbreaks. Disease control procedures are conducted according to the Fish Health Policy. Water for the Merwin Hatchery comes directly from Lake Merwin; water clarity is generally good and water temperatures range from 42-61°F. All water to the hatchery is ozonated and runs through a stripper, entrained gasses are removed, and the water is well-oxygenated. Lake Merwin water is used for adult holding, incubation, and rearing; flow to the rearing ponds is approximately 5,000 gpm. Effluent from the facility is monitored according to the hatchery's NPDES permit. Adults being held for broodstock collection are treated with formalin, hydrogen peroxide, or a combination to control fungus growth. During the incubation process, eggs are water hardened in iodophor for viral pathogens; formalin is used to control fungus outbreaks. Fish health is monitored continuously by hatchery staff; a fish pathologist visits monthly. Disease control procedures during incubation and rearing are conducted according to the Fish Health Policy. The area fish health specialist inspects fish prior to release.

Passage— Adult collection facilities at Lewis River consist of a volunteer ladder with a "V" weir that prevents the escape of captured fish. Because adults are volunteers to the ladder, trap avoidance is possible. Traps are opened at various times of the year to collect fish during the entire length of each run. The Lewis River Hatchery trap is 200'x7'x5' with a flow of 3,500 gpm. Fish that escape the Lewis hatchery trap can encounter Merwin Dam trap, four miles upstream of the Lewis Hatchery. There is no adult passage at Merwin Dam although reintroduction of salmon and steelhead to the upper watershed is planned during the next hydro-license period. No other hatchery facility in the basin has an adult collection system, except a trap at the grist mill on Cedar Creek.

Supplementation— The only purpose of each hatchery program of the Lewis Complex has been to provide harvest opportunity to mitigate for the loss of adult fish resulting from hydroelectric development in the Lewis River basin. However, the new hydro-license is expected to include an integrated hatchery program for harvest and also supplementation to reintroduce natural coho, winter steelhead, and spring Chinook to the upper Lewis watershed. The hatcheries will develop appropriate broodstocks for supplementation and provide facilities which will enable both harvest and natural reintroduction goals to be achieved.

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

WDFW completed a Benefit-Risk Assessment Procedure (BRAP) in 2004 to provide a framework for considerations of hatchery reforms consistent with the Recovery Plan. The BRAP evaluates hatchery programs in the ecological context of the watershed, with integrated assessment and decisions for hatcheries, harvest, and habitat. The risk assessment procedure consists of five basic steps, grouped into two blocks. A policy framework assesses population status of wild populations, develops risk tolerance profiles for all stock conditions, and assign risk tolerance profiles to all stocks. A risk assessment characterizes risk assessments for each hatchery program and identifies appropriate management actions to reduce risk.

Table L-6 identifies hazards levels associated with risks involved with hatchery programs in the East Fork Lewis River Basin. Table L-7 identifies preliminary strategies proposed to address risks identified in the BRAP for the same populations. The BRAP risk assessments and strategies to reduce risk have been key in providing the biological context to develop the hatchery recovery measures for lower Columbia River sub-basins.

Table L-6. Preliminary BRAP for hatchery programs affecting populations in the East Fork Lewis River.

	Hatchery Program		Risk Assessment of Hazards															
			Address Genetic Risks					Address Ecological Risks				Address Demographic Risks		Address Facility Risks			
East Fork Lewis Population	Name	Release (millions)	Mating Procedure	Integrated Program	Segregated Program	Research/ Monitoring	Broodstock Source	Number Released	Release Procedure	Disease Containment	Research/ Monitoring	Culture Procedure	Research/ Monitoring	Reliability	Improve Passage	Improve Screening	Pollution Abatement
Fall Chinook	EF Lewis S. Steelhead 1+	0.025						●	●		●						
	EF Lewis W. Steelhead 1+	0.080						●	●		●						
	Merwin W. Steelhead	0.100						●	●		●						
	Lewis Coho Type S	0.880						●	●		●						
	Lewis Coho Type N	0.815						●	●		●						
	Lewis Sp. Chinook 1+	0.900						●	●		●						
	Fish First Sp. Chinook 1+	0.150						●	●		●						
	NF Lewis S. Steelhead 1+	0.050						●	●		●				—	—	
	Merwin S. Steelhead 1+	0.175						●	●		●						
	Speelyai Net Pens S. Steelhead 1+	0.060						●	●		●						
	Klineline (Salmon Ck) W. Steelhead 1+	0.020						●	●		●						
Late Fall Chinook	EF Lewis S. Steelhead 1+	0.025						●	●		●						
	EF Lewis W. Steelhead 1+	0.080						●	●		●						
	Merwin W. Steelhead	0.100						●	●		●						
	Lewis Coho Type S	0.880						●	●		●						
	Lewis Coho Type N	0.815						●	●		●						
	Lewis Sp. Chinook 1+	0.900						●	●		●						
	Fish First Sp. Chinook 1+	0.150						●	●		●						
	NF Lewis S. Steelhead 1+	0.050						●	●		●						
	Merwin S. Steelhead 1+	0.175						●	●		●						
	Speelyai Net Pens S. Steelhead 1+	0.060						●	●		●						
	Klineline (Salmon Ck) W. Steelhead 1+	0.020						●	●		●						
Spring Chinook	EF Lewis S. Steelhead 1+	0.025						●	●		●						
	EF Lewis W. Steelhead 1+	0.080						●	●		●						
	Merwin W. Steelhead	0.100						●	●		●						
	Lewis Coho Type S	0.880						●	●		●						
	Lewis Coho Type N	0.815						●	●		●						
	Lewis Sp. Chinook 1+	0.900		●	●	●		●	●		●		●				
	Fish First Sp. Chinook 1+	0.150		●	●	●		●	●		●		●				
	NF Lewis S. Steelhead 1+	0.050						●	●		●						
	Merwin S. Steelhead 1+	0.175						●	●		●						
	Speelyai Net Pens S. Steelhead 1+	0.060						●	●		●						
	Klineline (Salmon Ck) W. Steelhead 1+	0.020						●	●		●						

Table L-7. Preliminary strategies proposed to address risks identified in the BRAP for East Fork Lewis River Basin.

Symbol	Description
○	Risk of hazard consistent with current risk tolerance profile.
?	Magnitude of risk associated with hazard unknown.
●	Risk of hazard exceeds current risk tolerance profile.
(grey shading)	Hazard not relevant to population

East Fork Lewis Population	Hatchery Program Name	Release (millions)	Genetic: Effective Population Size	Genetic: Domestication	Genetic: Diversity	Ecological: Predation	Ecological: Competition	Ecological: Disease	Demographic: Survival Rate	Demographic: Reproductive Success	Catastrophic Loss	Facility: Passage	Facility: Screening	Facility: Water Quality
Fall Chinook	EF Lewis S. Steelhead	0.025				?	?	○				○	○	○
	EF Lewis W. Steelhead	0.080				?	?	○				○	○	○
	Merwin W. Steelhead	0.100				?	?	○				○	○	○
	Lewis Coho Type S	0.880				?	?	○				○	○	○
	Lewis Coho Type N	0.815				?	?	○				○	○	○
	Lewis Coho Type N Eggs	0.860				?	?	○				○	○	○
	Lewis Sp. Chinook 1+	0.900				?	?	○				○	○	○
	Fish First Sp. Chinook 1+	0.150				?	?	○				○	○	○
	NF Lewis River S. Steelhead	0.050				?	?	○				○	○	○
	Merwin S. Steelhead	0.175				?	?	○				○	○	○
	Speelyai Net Pens S. Steelhead	0.060				?	?	○				○	○	○
Late Fall Chinook	EF Lewis S. Steelhead	0.025				?	?	○				○	○	○
	EF Lewis W. Steelhead	0.080				?	?	○				○	○	○
	Merwin W. Steelhead	0.100				?	?	○				○	○	○
	Lewis Coho Type S	0.880				?	?	○				○	○	○
	Lewis Coho Type N	0.815				?	?	○				○	○	○
	Lewis Coho Type N Eggs	0.860				?	?	○				○	○	○
	Lewis Sp. Chinook 1+	0.900				?	?	○				○	○	○
	Fish First Sp. Chinook 1+	0.150				?	?	○				○	○	○
	NF Lewis River S. Steelhead	0.050				?	?	○				○	○	○
	Merwin S. Steelhead	0.175				?	?	○				○	○	○
	Speelyai Net Pens S. Steelhead	0.060				?	?	○				○	○	○
Spring Chinook	EF Lewis S. Steelhead	0.025				?	?	○				○	○	○
	EF Lewis W. Steelhead	0.080				?	?	○				○	○	○
	Merwin W. Steelhead	0.100				?	?	○				○	○	○
	Lewis Coho Type S	0.880				?	?	○				○	○	○
	Lewis Coho Type N	0.815				?	?	○				○	○	○
	Lewis Coho Type N Eggs	0.860				?	?	○				○	○	○
	Lewis Sp. Chinook 1+	0.900	○	○	○	?	?	○	○	?	○	○	○	○
	Fish First Sp. Chinook 1+	0.150	○	○	○	?	?	○	○	?	○	○	○	○
	NF Lewis River S. Steelhead	0.050				?	?	○				○	○	○
	Merwin S. Steelhead	0.175				?	?	○				○	○	○
	Speelyai Net Pens S. Steelhead	0.060				?	?	○				○	○	○
Chum	EF Lewis S. Steelhead	0.025				?	○	○				○	○	○
	EF Lewis W. Steelhead	0.080				?	○	○				○	○	○
	Merwin W. Steelhead	0.100				?	○	○				○	○	○
	Lewis Coho Type S	0.880				?	○	○				○	○	○
	Lewis Coho Type N	0.815				?	○	○				○	○	○
	Lewis Coho Type N Eggs	0.860				?	○	○				○	○	○
	Lewis Sp. Chinook 1+	0.900				?	○	○				○	○	○
	Fish First Sp. Chinook 1+	0.150				?	○	○				○	○	○
	NF Lewis River S. Steelhead	0.050				?	○	○				○	○	○
	Merwin S. Steelhead	0.175				?	○	○				○	○	○
	Speelyai Net Pens S. Steelhead	0.060				?	○	○				○	○	○
Summer Steelhead	EF Lewis S. Steelhead	0.025	○	○	?	?	?	○				○	○	○
	EF Lewis W. Steelhead	0.080				?	?	○				○	○	○
	Merwin W. Steelhead	0.100				?	?	○				○	○	○
	Lewis Coho Type S	0.880				?	?	○				○	○	○
	Lewis Coho Type N	0.815				?	?	○				○	○	○
	Lewis Sp. Chinook 1+	0.900				?	?	○				○	○	○
	Fish First Sp. Chinook 1+	0.150				?	?	○				○	○	○
	NF Lewis River S. Steelhead	0.050				?	?	○				○	○	○
	Merwin S. Steelhead	0.175	○	○	?	?	?	○				○	○	○
	Speelyai Net Pens S. Steelhead	0.060	○	○	?	?	?	○				○	○	○
	Klineline(Salmon Ck) W. Steelhea	0.020				?	?	○				○	○	○
Winter Steelhead	EF Lewis S. Steelhead	0.025				?	?	○						
	EF Lewis W. Steelhead	0.080	○	○	?	?	?	○				○	○	○
	Merwin W. Steelhead	0.100	○	○	?	?	?	○				○	○	○
	Lewis Coho Type S	0.880				?	?	○				○	○	○
	Lewis Coho Type N	0.815				?	?	○				○	○	○

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

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

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

For Primary populations:

- pHOS should be less than 5% of the naturally spawning population, unless the hatchery population is integrated with the natural population.
- For integrated populations, pNOB should exceed pHOS by at least a factor of two, corresponding to a PNI (proportionate natural influence) value of 0.67 or greater and pHOS should be less than 0.30.

For Contributing populations:

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

For Stabilizing populations:

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

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

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

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

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

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

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

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

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

EF Lewis River – Fall Chinook

The HSRG observed that although this is designated a Primary population, it is not meeting its standards because of strays from out-of-basin hatchery programs. The HSRG recommends monitoring the contribution of hatchery strays to spawning escapement.

EF Lewis River – Coho

Since the EF Lewis River coho currently meet the standards for a Primary population designation, the HSRG does not have specific recommendations for this population.

EF Lewis River – Summer Steelhead

The HSRG noted that due to the ecological and genetic risks from the segregated summer steelhead program on the ESA listed steelhead, the program should be modified in one of 3 ways:

1. Reduce the size of the hatchery program by about 50%
2. Manage to remove additional hatchery adults (harvest or trap)
3. Replace with an integrated summer run program of up to 40,000 smolts

Additional recommendations include:

- Manage acclimation and releases to reduce residualism to the extent possible
- Consider this stream as a candidate for a “Wild Steelhead Management Zone” which would require eliminating all hatchery releases in the EF Lewis

EF Lewis River – Winter Steelhead

The HSRG noted that due to the ecological and genetic risks from the segregated winter steelhead program on the ESA listed steelhead, the program should be modified in one of 3 ways:

1. Reduce the size of the current hatchery program to 20,000 smolts
2. Reduce the size of the current segregated winter steelhead hatchery program to 45,000 smolts and manage to remove 50% of the unharvested hatchery adults
3. Replace with an integrated winter run program of approximately 40,000 smolts and manage to remove 50% of the unharvested hatchery adults

Additional recommendations include:

- Manage acclimation and release to reduce residualism and recapture unharvested adults to the extent possible.
- Consider this stream as a candidate for a “Wild Steelhead Management Zone” which would require eliminating all hatchery releases in the EF Lewis

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

Harvest

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

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

At the time of interim plan completion, fishing impact rates on lower Columbia River naturally-spawning salmon populations ranges from 2.5% for chum salmon to 45% for tule fall Chinook (Table L-8). These rates include estimates of direct harvest mortality as well as estimates of incidental mortality in catch and release fisheries. Fishery impact rates for hatchery produced coho, and steelhead are higher than for naturally-spawning fish of the same species because of selective fishing regulations. These rates generally reflect recent year (2001-2003) fishery regulations and quotas controlled by weak stock impact limits and annual abundance of healthy targeted fish. Actual harvest rates will vary for each year dependent on annual stock status of multiple west coast salmon populations, however, these rates generally reflect expected impacts of harvest on lower Columbia naturally-spawning and hatchery salmon and steelhead under current harvest management plans.

Table L-8. Approximate annual exploitation rates (% harvested) for naturally-spawning lower Columbia salmon and steelhead under current management controls (represents 2001-2003 fishing period).

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

Columbia River fall Chinook are subject to freshwater and ocean fisheries from Alaska to their rivers of origin in fisheries targeting abundant Chinook stocks originating from Alaska, Canada, Washington, Oregon, and California. Columbia tule fall Chinook harvest is constrained by a Recovery Exploitation Rate (RER) developed by NMFS for management of Coweeman naturally-spawning fall Chinook. Some in-basin sport fisheries (like the East Fork Lewis) are closed to the retention of Chinook to protect naturally spawning populations. Harvest of lower Columbia bright fall Chinook is managed to achieve an escapement goal of 5,700 natural spawners in the North Fork Lewis.

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

Harvest of East Fork Lewis coho occurs in the ocean commercial and recreational fisheries off the Washington and Oregon coasts and Columbia River. Wild coho impacts are limited by fishery management to retain marked hatchery fish and release unmarked wild fish. The East Fork Lewis sport fishery is closed to salmon.

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

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

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

Mainstem and Estuary Habitat

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

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

Hydropower Construction and Operation

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

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

Ecological Interactions

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

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

Ocean Conditions

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

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

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

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

L.3.7. Summary of Human Impacts on Salmon and Steelhead

Stream habitat, estuary/mainstem habitat, harvest, hatchery and ecological interactions have all contributed to reductions in productivity, numbers, and population viability. Pie charts in Figure L-21 describe the relative magnitude of potentially-manageable human impacts in each category of limiting factor for East Fork Lewis Basin salmon and steelhead. Impact values were developed for a base period corresponding to species listing dates. This depiction is useful for identifying which factors are most significant for each species and where improvements might be expected to provide substantial benefits. Larger pie slices indicate greater significance and scope for improvement in an impact for a given species. These numbers also serve as a working hypothesis for factors limiting salmonid numbers and viability.

This assessment indicates that current salmonid status is the result of large impacts distributed among several factors. No single factor accounts for a majority of effects on all species. Thus, substantial improvements in salmonid numbers and viability will require significant improvements in several factors. Loss of subbasin habitat quality and quantity for spawning and rearing accounts for the largest relative impact across all species except for fall Chinook where harvest dominates. Loss of estuary habitat has affected all species. Fishery impacts in the ocean, Columbia River, and subbasin have been reduced to a relatively small share of the impacts except for fall Chinook and coho. No hatcheries are operated in the basin, however, releases of hatchery summer and winter steelhead in the basin have some affect on wild steelhead populations. Hatchery impacts to fall Chinook are from out-of-basin straying. No dams are operated in the subbasin and hydrosystem impacts are limited to habitat effects in the Columbia River mainstem and estuary. Subbasin fish populations are subject to predation impacts on juveniles and adults by fish, pinniped, and bird predators in the Columbia River and estuary.

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

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

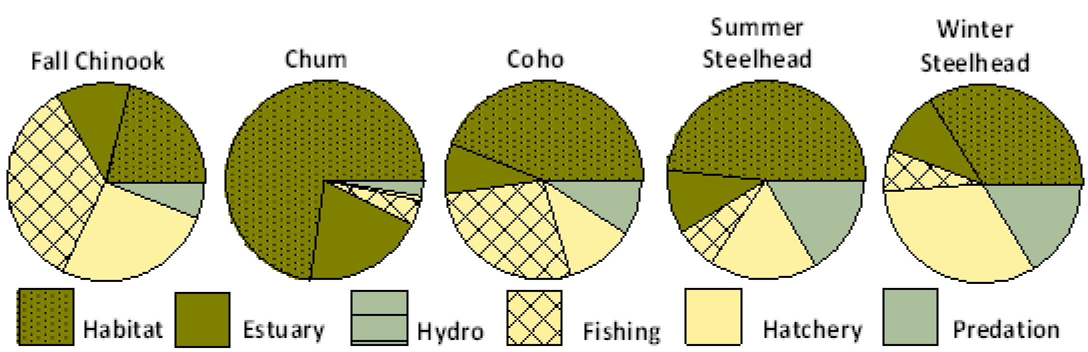


Figure L-21. Relative contribution of potentially manageable impacts on East Fork Lewis River salmonid populations.

L.4. Key Programs and Projects

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

L.4.1. Federal Programs

NMFS

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

U.S. Army Corps of Engineers

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

Environmental Protection Agency

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

United States Forest Service

The Unites States Forest Service (USFS) manages federal forest lands within the Gifford Pinchot National Forest (GPNF). The GPNF operates under the Gifford Pinchot Forest Plan (GPFP). Management prescriptions within the GPFP have been guided by the 1994 Northwest Forest Plan, which calls for management of forests according to a suite of management designations including Reserves (e.g. late successional forests, riparian forests), Adaptively-Managed Areas, and Matrix Lands. Most timber harvest occurs in Matrix Lands. The GPNF implements a wide range of ecosystem restoration activities.

Natural Resources Conservation Service

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

Northwest Power and Conservation Council

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

L.4.2. State Programs

Washington Department of Natural Resources

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

Washington Department of Fish & Wildlife

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

Washington Department of Ecology

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

Washington Department of Transportation

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

Management & Roadside Development Program; Environmental Mitigation Program; the Stormwater Retrofit Program; and the Chronic Environmental Deficiency Program.

Washington Recreation and Conservation Office

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

Lower Columbia Fish Recovery Board

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

L.4.3. Local Government Programs

Clark County

Clark County plans under the State's Growth Management Act and Shoreline Management Act, and manages stormwater under its NPDES permit issued by the Department of Ecology. Natural resources are managed under several programs within the Departments of Environmental Services, Public Works, and Vancouver-Clark Parks.

City of Ridgefield

The city of Ridgefield adopts by reference SEPA provisions. The critical areas are identified on the city's comprehensive plan map, and described in the sensitive lands chapter of the zoning code.

City of Battle Ground

The city of Battle Ground's comprehensive planning occurs under the state Growth Management Act. Battle Ground manages natural resource impacts through a Critical Areas Ordinance and a Stormwater Ordinance.

Clark Conservation District

Clark Conservation District provides technical assistance, cost-share assistance, and project monitoring in Clark County. Clark CD assists agricultural landowners in the development of farm plans and in the participation in the Conservation Reserve Enhancement Program. Farm plans optimize use, protect sensitive areas, and conserve resources.

L.4.4. Non-governmental Programs

Columbia Land Trust

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

Lower Columbia Fish Enhancement Group

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

L.4.5. Tribal Programs

Cowlitz Indian Tribe

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

L.4.6. NPCC Fish & Wildlife Program Projects

There are no NPCC Fish & Wildlife Program Projects in the East Fork Lewis Basin.

L.4.7. Washington Salmon Recovery Funding Board Projects

Type	Project Name	Subbasin
Restoration	EF Lewis River Assessment	EF Lewis
Restoration	East Fork Lewis Riparian Restoration	EF Lewis
Restoration	Lewis River Preserve Restoration	EF Lewis
Study	EF Lewis River Riparian Restoration Monitoring	EF Lewis
Study	EF Lewis River Watershed Assessment	EF Lewis
Restoration	Lower East Fork Lewis River Floodplain Restoration	EF Lewis
Design	Upper Daybreak Stream Habitat Enhancement	EF Lewis
Design	Lewisville Park Stream Habitat Enhancement	EF Lewis
Restoration	Lockwood Creek Riparian Planting	EF Lewis
Preservation	EF Lewis Reach 17	EF Lewis
Preservation	EF Lewis Reach 6 Dean Creek	EF Lewis
Restoration	Lockwood Restoration Phase III	EF Lewis
Restoration	Lower Dean Creek Restoration	EF Lewis
Preservation	EF Lewis – Christopher	EF Lewis
Design	West Daybreak	EF Lewis

L.5. Management Plan

L.5.1. Vision

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

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

The East Fork Lewis Subbasin will play a key role in the regional recovery of salmon and steelhead. Natural populations of fall Chinook, chum, coho, and summer and winter steelhead, will be restored to high levels of viability by significant reductions in human impacts throughout the lifecycle. Salmonid recovery efforts will provide broad ecosystem benefits to a variety of subbasin fish and wildlife species. Recovery will be accomplished through a combination of improvements in subbasin, Columbia River mainstem, and estuary habitat conditions as well as careful management of hatcheries, fisheries, and ecological interactions among species.

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

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

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

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

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

L.5.2. Biological Objectives

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

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

Recovery goals call for restoring all four anadromous salmonid populations to a high or very high viability level. This level will provide for a 95% to 99% probability of population survival over 100 years. Cutthroat will benefit from improvements in stream habitat conditions for anadromous species. Lamprey are also expected to benefit from habitat improvements in the estuary, Columbia River mainstem, and East Fork Lewis Subbasin although specific spawning and rearing habitat requirements are not well known. Bull trout do not occur in the subbasin.

Table L-9. Current viability status of East Fork Lewis populations and the biological objective status that is necessary to meet the recovery criteria for the Cascade strata and the lower Columbia ESU.

Species	Population	Recovery priority[1]	Viability Status[2]	Viability Obj[3]	Improve-ment[4]	Abundance Historical[5]	Abundance Current[6]	Abundance Target[7]
Fall Chinook (Tule)	Lewis	Primary	VL	H+	280%	2,600	<50	1,500
Chum	Lewis	Primary	VL	H	500%	125,000	<100	1,300
Winter Steelhead	EF Lewis	Primary	M	H	25%	900	350	500
Summer Steelhead	EF Lewis	Primary	VL	H	>500%	600	<50	500
Coho	EF Lewis	Primary	VL	H	>500%	3,000	<50	2,000

[1] Primary, contributing, and stabilizing designations reflect the relative contribution of a population to major population group recovery goals.
[2] Baseline viability is based on Technical Recovery Team viability rating approach.
[3] Viability objective is based on the scenario contribution.
[4] Improvement is the relative increase in population production required to reach the prescribed viability goal
[5] Historical population size inferred from presumed habitat conditions using Ecosystem Diagnosis and Treatment Model and NMFS back-of-envelope calculations.
[6] Approximate current annual range in number of naturally-produced fish returning to the watershed.
[7] Abundance targets were estimated by population viability simulations based on viability goals.

L.5.3. Integrated Strategy

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

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

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

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

The following table (Table L-10) identifies population and factor-specific improvements consistent with the biological objectives for this subbasin. Per factor increments are less than the population net because factor affects are compounded at different life stages and density dependence is largely limited to freshwater tributary habitat. For example, productivity of East Fork Lewis River fall Chinook must increase by 90% to reach population viability goals. This requires impact reductions equivalent to a 23% improvement in productivity or survival for each of six factor categories. Thus, tributary habitat impacts on fall Chinook must decrease from a 40% to a 31% impact in order to achieve the required 23% increase in tributary habitat potential from the current 60% of historical potential to 69% of historical potential.

Table L-10. Productivity improvements consistent with biological objectives for the East Fork Lewis River.

Species	Net increase	Per factor	Baseline impacts					
			Hab.	Estuary	Dams	Pred.	Fishery	Hatch.
Fall Chinook	280%	42%	0.40	0.23	0.00	0.11	0.65	0.50
Chum	500%	50%	0.90	0.25	0.00	0.03	0.05	0.01
Coho	>500%	50%	0.80	0.15	0.00	0.16	0.50	0.21
Summer Steelhead	>500%	50%	0.70	0.15	0.00	0.24	0.10	0.26
Winter Steelhead	25%	9%	0.50	0.15	0.00	0.24	0.10	0.08

L.5.4. Tributary Habitat

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

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

Priority areas, limiting factors and threats were used to develop a prioritized suite of habitat measures. Measures are based solely on biological and physical conditions. For each measure, the key programs that address the measure are identified and the sufficiency of existing programs to satisfy the measure is discussed. The measures, in conjunction with the program sufficiency considerations, were then used to identify specific actions necessary to fill gaps in measure implementation. Actions differ from measures in that they address program deficiencies as well as biophysical habitat conditions. The process for developing measures and actions is illustrated in Figure L-22 and each component is presented in detail in the sections that follow.

Priority Areas, Limiting Factors and Threats

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

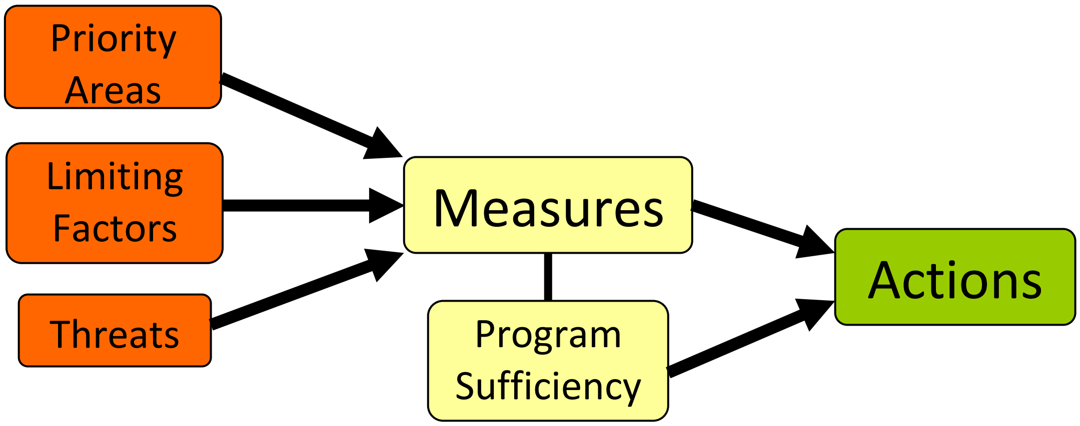


Figure L-22. Flow chart illustrating the development of subbasin measures and actions.

Summary: Decades of human activity in the East Fork Lewis River Basin have significantly altered watershed processes and reduced both the quality and quantity of habitat needed to sustain viable populations of salmon and steelhead. Moreover, with the exception of fall Chinook, stream habitat conditions within the East Fork Lewis Basin have a high impact on the health and viability of salmon and steelhead relative to other limiting factors. The following bullets provide a brief overview of each of the priority areas in the basin. These descriptions are a summary of the reach-scale priorities that are presented in the next section. These descriptions summarize the species most affected, the primary limiting factors, the contributing land-use threats, and the general type of measures that will be necessary for recovery. A tabular summary of the key limiting factors and land-use threats can be found in Table L-11.

- **Lower mainstem** *(reaches EF Lewis 4-10, Dyer Creek 1-3, and Manley 1 A-G)* – The lower mainstem EF Lewis contains important spawning and rearing habitats for fall Chinook, chum, and coho. This mixed use area is heavily impacted by agriculture, rural residential development, and gravel mining. The recovery emphasis is for restoration and preservation measures. Effective restoration measures will involve riparian restoration, reductions in streambank erosion, re-connection of floodplains, and restoration of mining related impairments and future avulsion risks. Land-use planning/growth management is critical to make sure that expanding development and land-use conversions do not continue to impair habitat conditions or habitat-forming processes.
- **Middle mainstem & Rock Creek** *(reaches EF Lewis 15-20; Rock Creek 1-4)* – The middle mainstem EF Lewis and Rock Creek are most important for winter steelhead, although summer steelhead also utilize these reaches to some degree. There are agricultural and rural residential uses along these reaches but forestry impacts dominate. The recovery emphasis is for restoration and preservation. Effective restoration measures will include riparian restoration and restoration of watershed processes related to forest practices (i.e., forest road and timber harvest impacts). Emphasis should be placed on preserving functional sediment supply conditions in the Rock Creek basin.
- **Upper mainstem** *(reaches EF Lewis 15-20)* – Summer steelhead use the greatest proportion of upper EF Lewis reaches. Winter steelhead may utilize some of these reaches but they rarely make significant use of reaches above Sunset Falls (upstream end of reach EF Lewis 17). Nearly the entire upper basin is within the Gifford Pinchot National Forest and forestry impacts dominate. Past wildfires have had a lasting impact on channels. The recovery emphasis is for preservation and restoration. Effective restoration measures will include riparian restoration and watershed process restoration related to forest practices.

Table L-11. Salmonid habitat limiting factors and threats in priority areas. Priority areas include the lower mainstem (LM), middle mainstem + Rock Creek (MR), and upper mainstem (UM) portions of the EF Lewis basin. Linkages between each threat and limiting factor are not displayed – each threat directly and indirectly affects a variety of habitat factors.

Limiting Factors	LM	MR	UM	Threats	LM	MR	UM
Habitat connectivity				***Agriculture/grazing***			
Blockages to off-channel habitats	✓			Clearing of vegetation	✓		
Habitat diversity				Riparian grazing	✓		
Lack of stable instream woody debris	✓	✓	✓	Floodplain filling	✓		
Altered habitat unit composition	✓	✓	✓	***Rural/suburban development***			
Loss of off-channel and/or side-channel habitats	✓			Clearing of vegetation	✓		
Channel stability				Floodplain filling	✓		
Bed and bank erosion	✓			Increased impervious surfaces	✓		
Channel down-cutting (incision)	✓			Increased drainage network	✓		
Riparian function				Roads – riparian / floodplain impacts	✓		
Reduced stream canopy cover	✓	✓		Leaking septic systems	✓		
Reduced bank/soil stability	✓	✓	✓	***Forest practices***			
Exotic and/or noxious species	✓			Timber harvests –sediment supply impacts		✓	✓
Reduced wood recruitment	✓	✓	✓	Timber harvests – impacts to runoff		✓	✓
Floodplain function				Riparian harvests (historical)		✓	✓
Altered nutrient exchange processes	✓			Forest roads – impacts to sediment supply		✓	✓
Reduced flood flow dampening	✓			Forest roads – impacts to runoff		✓	✓
Restricted channel migration	✓			Forest roads – riparian/floodplain impacts			✓
Disrupted hyporheic processes	✓			Catastrophic wildfire (historical)			✓
Stream flow				Splash-dam logging (historical)		✓	✓
Altered magnitude, duration, or rate of change	✓	✓	✓	***Channel manipulations***			
Water quality				Bank hardening	✓		
Altered stream temperature regime	✓			Channel straightening	✓		
Excessive turbidity	✓			Artificial confinement	✓		
Bacteria	✓			Clearing and snagging (historical)			✓
Substrate and sediment				***Mining***			
Lack of adequate spawning substrate			✓	Clearing of vegetation	✓		
Excessive fine sediment	✓	✓	✓	Channel and/or floodplain substrate removal	✓		
Embedded substrates	✓	✓	✓	Floodplain filling	✓		
				Increased water surface area	✓		
				Disrupted hyporheic flow			
				Increased sedimentation			

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

Spatial priorities were also identified at the subwatershed scale. Subwatershed-scale priorities were directly determined by reach-scale priorities, such that a Group A subwatershed contains one or more Tier 1 reaches. Scaling up from reaches to the subwatershed level was done in recognition that actions to protect and restore critical reaches might need to occur in adjacent and/or upstream upland areas. For example, high sediment loads in a Tier 1 reach may originate in an upstream contributing subwatershed where sediment supply conditions are impaired because of current land use practices. Subwatershed-scale priorities can be used in conjunction with the IWA to identify watershed process restoration and preservation opportunities. The specific rules for designating reach tiers and subwatershed groups are presented in Table L-12. Reach tier designations for this basin are included in Table L-13. Reach tiers and subwatershed groups are displayed on a map in Figure L-23.

Table L-12. Rules for designating reach tier and subwatershed group priorities. See Biological Objectives section for information on population designations.

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

Table L-13. Reach Tiers in the East Fork Lewis River Basin

Tier 1	EF Lewis 7	EF Lewis 4 C	EF Lewis 13	EF Lewis 18
	EF Lewis 8 A	EF Lewis 5 A	Jenny Cr	EF Lewis 19 A
	EF Lewis 5 B	Dean Cr 1 A	M1_Mason Cr RB Trib 1 A	EF Lewis 20 B
	EF Lewis 6 A	Dyer Cr 1	McCormick Cr 1 D	McCormick Cr 1 G (pond)
	EF Lewis 6 B	Manley Cr 1 A	Mill Cr 1 C	McCormick Cr 1 H (pond)
	EF Lewis 6 C	Manley Cr 1 D	Rock Cr 1	Rock Cr 2 A
	EF Lewis 8 B	Manley Cr 1 E	EF Lewis 15 B	Rock Cr 2 B
	EF Lewis 9 A	Manley Cr 1 F	EF Lewis 16	Rock Cr 3
	EF Lewis 4 A	Manley Cr 1 G	EF Lewis 17 A	Rock Cr 4
	EF Lewis 4 B	B1_Brezee Cr 2	EF Lewis 17 B	
Tier 2	EF Lewis 10 A	Manley Cr 1 C	Swanson Cr	EF Lewis 20 C
	EF Lewis 9 B	McCormick Cr 1 A	Cedar Cr (EFL) 1 A	Little Cr 1 A
	EF Lewis 10 B	Big Tree Cr 1 A	Copper Cr 1 A	Mason Cr 8
	Mill Cr 1 A	EF Lewis 11	Dean Cr 3	McCormick Cr 1 I
	Dyer Cr 2	EF Lewis 12	Dyer Cr 4	McKinley Cr 1
	L1_Lockwood Cr 1	EF Lewis 14 A	EF Lewis 19 B	Slide Cr 1
	M1_Mason Cr 1	M1_Mason Cr 3	EF Lewis 19 C	
	Manley Cr 1 B	McCormick Cr 1 C	EF Lewis 20 A	
Tier 4	EF Lewis 1 A	LW Rock Cr RB Trib A	Cedar Cr (EFL) 1 B	Mason Cr Culv 2
	EF Lewis 1 B	LW Rock Cr RB Trib B	Cedar Cr (EFL) 1 C	Mason Cr Culv 3
	EF Lewis 1 C	LW Rock Cr RB Trib Culv	Cedar Cr (EFL) LB Trib 1	Mason Cr Culv 4
	EF Lewis 2 A	M1_Mason Cr 4	Cold Cr 1	Mason Cr Culv 5
	EF Lewis 2 B	M1_Mason Cr 5	Copper Cr 1 B	Mason Cr RB Trib 2 Culv 1
	EF Lewis 3	M1_Mason Cr RB Trib 2 A	Coyote Cr 1 (27.0265)	Mason Cr RB Trib 2 Culv 2
	B1_Brezee Cr 1	Manley Cr Culv 1	Dean Cr 2	Mason Cr RB Trib 2 RB Trib 1 A
	Brickie Cr 1	Manley Cr Culv 2	Dean Cr Culv 2	Mason Cr RB Trib 2 RB Trib 1 B
	Brickie Cr 2	Manley Cr Culv 3	EF Lewis 15 A	Mason Cr RB Trib 2 RB Trib 1 Culv 1
	Brickie Cr Dam	Manley Cr Culv 4	EF Lewis 21	McCormick Cr 1 E (pond)
	Charlie Cr 1	Manley Cr Culv 5	EF Lewis LB Trib 2 B	McCormick Cr 1 F
	Charlie Cr 2	Manley Cr Culv 6	EF Lewis LB Trib 3 A	McCormick Cr Culv 3
	Charlie Cr Culv	Manley Cr Culv 7	EF Lewis LB Trib 3 B	McCormick Cr Culv 4
	EF Lewis LB Trib 2 A	Mason Cr Culv 1	EF Lewis RB Trib 2 RB Trib	McCormick Cr Culv 5
	EF Lewis RB Trib 2 A	Mason Cr RB Trib 1 B	EF Lewis RB Trib 3 A	McCormick Cr LB Trib
	LW Rock Cr 1 A	Mason Cr RB Trib 1 Culv	EF Lewis RB Trib 3 B	McKinley Cr 2
	M1_Mason Cr 2	McCormick Cr 1 B	EF Lewis RB Trib 3 C	Niccolls Cr 1
	Manley Cr 1 H	McCormick Cr Culv 1	EF Lewis RB Trib 3 Culv 1	Niccolls Cr 2
	B1_Brezee Cr 3	McCormick Cr Culv 2	EF Lewis RB Trib 3 Culv 2	Niccolls Cr 3
	B1_Brezee Cr 4	Mill Cr 1 B	Green Fork 1 A	Niccolls Cr 4
	B1_Brezee Cr 5	Mill Cr 1 D	Green Fork 1 B	Niccolls Cr Culv 1
	B1_Brezee Cr LB Trib A	Mill Cr Culv 1	Green Fork 1 C	Niccolls Cr Culv 2
	B1_Brezee Cr LB Trib B	Mill Cr Culv 2	Green Fork 2	Poison Gulch
	Beasley Cr 1	Mill Cr Fishway	Green Fork LB Trib A	Riley Cr 3
	Beasley Cr 2	Moulton Falls	Green Fork LB Trib B	Riley Cr 4
	Beasley Cr Culv 1	Roger Cr 1	Green Fork LB Trib Culv	Riley Cr 5
	Big Tree Cr 1 B	Roger Cr 2	Green Fork RB Trib 1	Riley Cr Culv 1
	Brezee Cr Culv	Roger Cr 3	Green Fork RB Trib 2	Riley Cr Culv 2
	Brezee Cr Dam 1	Roger Cr Culv 1	Grouse Cr	Riley Cr Culv 3
	Brezee Cr Dam 2	Roger Cr Culv 2	Horseshoe Falls	Riley Cr RB Trib A
	Brezee Cr LB Trib Culv 1	Stoughton Cr 1	King Cr 1 A	Riley Cr RB Trib B
	Charlie Cr 3	Anaconda Cr 1	King Cr 1 B	Riley Cr RB Trib Culv
	Charlie Cr Dam	Anaconda Cr 2	King Cr 2	Rock Cr 5 A
	Dean Cr 1 B	Anaconda Cr 3	L1_Riley Cr 2	Rock Cr 5 B
	Dean Cr 1 C	Anaconda Cr Culv 1	Little Cr 1 B	Rock Cr 5 C
	Dean Cr Culv 1	Anaconda Cr Culv 2	Lockwood Cr LB Trib 1 B	Rock Cr 6
	Dyer Cr 3	B1_Brezee Cr LB Trib C	Lockwood Cr LB Trib 1 Culv	Rock Cr LB Trib A (27.0255)
	EF Lewis 14 B	B1_Brezee Cr LB Trib D	LW Rock Cr 2	Rock Cr LB Trib B
	EF Lewis 14 C	B1_Brezee Cr LB Trib E	LW Rock Cr 3	Rock Cr RB Trib 1

	EF Lewis LB Trib 1	B1_Brezee Cr LB Trib RB Trib A	LW Rock Cr 4	Rock Cr RB Trib 2 A (27.0258)
	EF Lewis RB Trib 1	B1_Brezee Cr LB Trib RB Trib B	LW Rock Cr Culv 1	Rock Cr RB Trib 2 B
	EF Lewis RB Trib 2 B	Beasley Cr 3	LW Rock Cr LB Trib 1 A	Rock Cr RB Trib 3
	L1_Lockwood Cr 2	Beasley Cr Culv 2	LW Rock Cr LB Trib 2	Slide Cr 2
	L1_Lockwood Cr 3	Brezee Cr LB Trib Culv 2	M1_Mason Cr 6	Stoughton Cr 2
	L1_Lockwood Cr 4	Brezee Cr LB Trib Culv 3	M1_Mason Cr 7	Stoughton Cr 3
	L1_Lockwood Cr LB Trib 1 A	Brezee Cr LB Trib RB Trib Culv	M1_Mason Cr RB Trib 2 B	Stoughton Cr Culv 1
	L1_Lockwood Cr LB Trib 2 A	Brickie Cr 3	M1_Mason Cr RB Trib 2 C	Stoughton Cr Dam
	L1_Riley Cr 1	Brickie Cr 4	Manley Cr 2	Sunset Falls
	Lucia Falls	Brickie Cr Culv	Manley Cr Culv 8	M1_Mason Cr RB Trib 2 D
	LW Rock Cr 1 B	Brickie Cr Falls	Mason Cr 9	

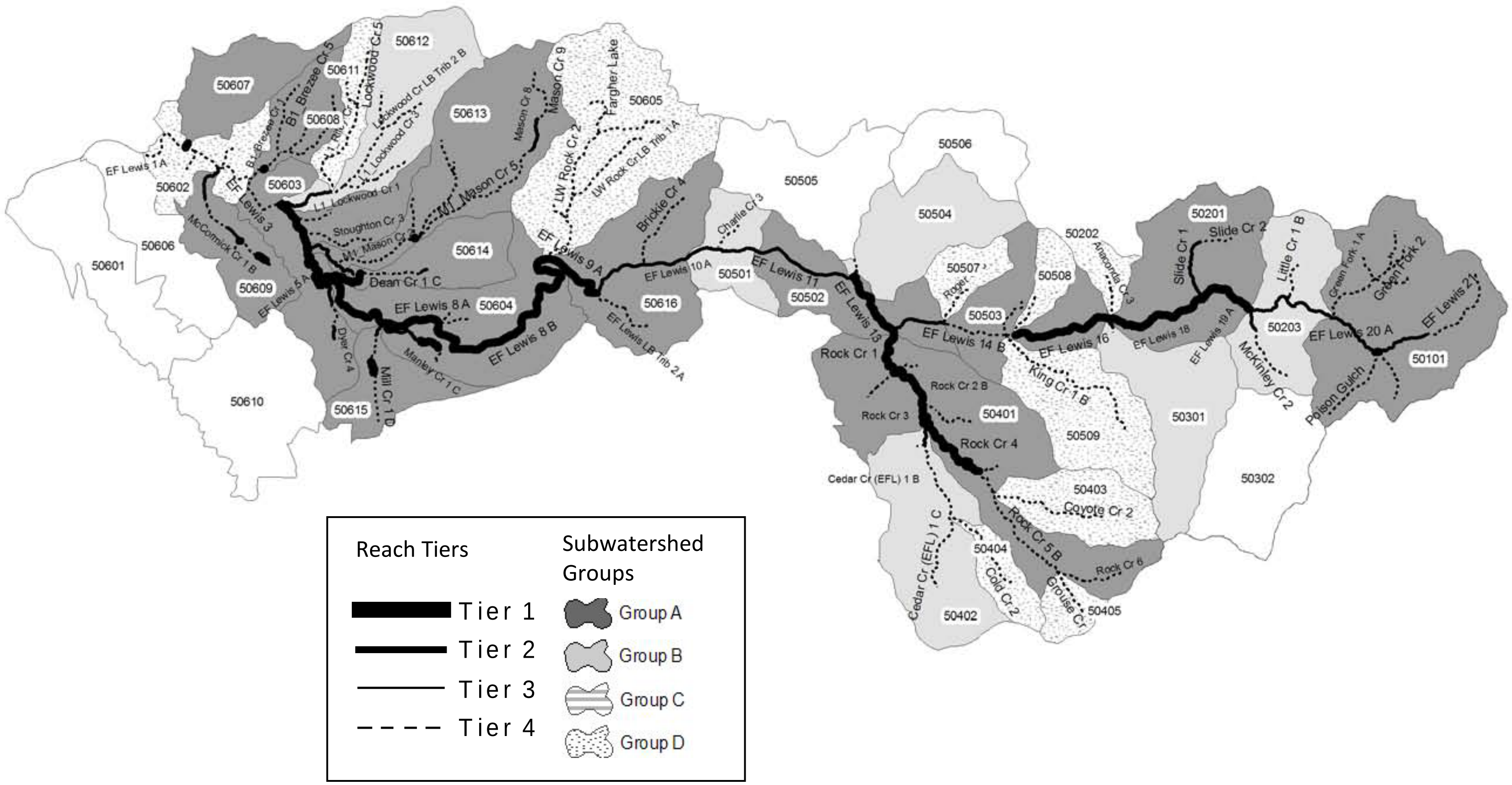


Figure L-23. Reach tiers and subwatershed groups in the East Fork Lewis River Basin. Tier 1 reaches and Group A subwatersheds represent the areas where recovery actions would yield the greatest benefits with respect to species recovery objectives. The subwatershed groups are based on Reach Tiers. Priorities at the reach scale are useful for identifying stream corridor recovery measures. Priorities at the subwatershed scale are useful for identifying watershed process recovery measures. Watershed process recovery measures for stream reaches will need to occur within the surrounding (local) subwatershed as well as in upstream contributing subwatersheds.

Habitat Measures

Measures are means to achieve the regional strategies that are applicable to the East Fork Lewis Basin and are necessary to accomplish the biological objectives for focal fish species. Measures are based on the technical assessments for this subbasin (Section 3.0) as well as on the synthesis of priority areas, limiting factors, and threats presented earlier in this section. The measures applicable to the East Fork Lewis Basin are presented in priority order in Table L-14. Each measure has a set of submeasures that define the measure in greater detail and add specificity to the particular circumstances occurring within the subbasin. The table for each measure and associated submeasures indicates the limiting factors that are addressed, the contributing threats that are addressed, the species that would be most affected, and a short discussion. Priority locations are given for some measures. Priority locations typically refer to either stream reaches or subwatersheds, depending on the measure. Addressing measures in the highest priority areas first will provide the greatest opportunity for effectively accomplishing the biological objectives.

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

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

Habitat Actions

The prioritized measures and associated gaps are used to develop specific Actions for the subbasin. These are presented in Table L-15. Actions are different than the measures in a number of ways: 1) actions have a greater degree of specificity than measures, 2) actions consider existing programs and are therefore not based strictly on biophysical conditions, 3) actions refer to the agency or entity that would be responsible for carrying out the action, and 4) actions are related to an expected outcome with respect to the biological objectives. Actions are not presented in priority order but instead represent the suite of activities that are all necessary for recovery of listed species. The priority for implementation of these actions will consider the priority of the measures they relate to, the "size" of the gap they are intended to fill, and feasibility considerations.

Table L-14. Prioritized measures for the East Fork Lewis River Basin.

#1 – Protect stream corridor structure and function

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Protect floodplain function and channel migration processes B. Protect riparian function C. Protect access to habitats D. Protect instream flows through management of water withdrawals E. Protect channel structure and stability F. Protect water quality G. Protect the natural stream flow regime	Potentially addresses many limiting factors	Potentially addresses many limiting factors	All Species	There currently are productive habitats for steelhead in the upper basin, especially in the portion of the basin upstream of Sunset Falls within National Forest. Significant degradation of stream corridor habitat has occurred over the years in the private, mixed-use lands in the lower and middle basin. This area has historically been utilized for timber harvest, agriculture, mining, and rural residential uses and is experiencing increasing development pressure. Preventing further degradation of stream channel structure, riparian function, and floodplain function will be an important component of recovery.

Priority Locations

1st- Tier 1 or 2 reaches with functional riparian conditions according to the IWA
2nd- Tier 1 or 2 reaches in mixed-use lands at risk of further degradation
3rd- All remaining reaches

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
NMFS	ESA Section 7 and Section 10	✓	
US Army Corps of Engineers (USACE)	Dredge & fill permitting (Clean Water Act sect. 404); Navigable waterways protection (Rivers & Harbors Act Sect, 10)	✓	
USFS	Northwest Forest Plan	✓	
WA Department of Natural Resources (WDNR)	State Lands HCP, Forest Practices Rules, Riparian Easement Program	✓	
WA Department of Fish and Wildlife (WDFW)	Hydraulics Projects Approval	✓	
Clark County	Comprehensive Planning		✓
City of Battle Ground	Comprehensive Planning		✓
City of Ridgefield	Comprehensive Planning		✓
Clark Conservation District (NRCS)	Agricultural land habitat protection programs		✓
Noxious Weed Control Boards (State and County level)	Noxious Weed Enforcement, Education, Control		✓
Non-Governmental Organizations (NGOs) (e.g. Columbia Land Trust) and public agencies	Land acquisition and easements		✓

Program Sufficiency and Gaps

Alterations to stream corridor structure that may impact aquatic habitats are regulated through the WDFW Hydraulics Project Approval (HPA) permitting program. Other regulatory protections are provided through USACE permitting, ESA consultations, HCPs, DNR Aquatic Lands Authorization, and local government regulations. Riparian areas within federal timber lands are protected through the Northwest Forest Plan. Riparian areas within private timberlands are protected through the Forest Practices Rules (FPR) administered by WDNR. The FPRs came out of an extensive review process and are believed to adequately protect riparian areas with respect to stream shading, bank stability, and LWD recruitment. The program is new, however, and careful monitoring of the effect of the regulations is necessary, particularly with respect to effects on watershed hydrology and sediment delivery. Land-use conversion and development are increasing throughout the basin and local comprehensive planning must provide adequate and consistent protections across jurisdictions. Conversion of land-use from forest or agriculture to residential use has the potential to increase impairment of aquatic habitat, particularly when residential development is paired with flood control measures. Local jurisdictions can guide potentially harmful land-use conversions through zoning and tax incentives. It is imperative that ordinances prevent new development in floodplains by utilizing Best Management Practices developed at the state level. In cases where existing programs are unable to provide sufficient resource protections, conservation easements and land acquisition may be necessary.

#2 – Protect hillslope processes

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Manage forest practices to minimize impacts to sediment supply processes, runoff regime, and water quality B. Manage agricultural practices to minimize impacts to sediment supply processes, runoff regime, and water quality C. Manage growth and development to minimize impacts to sediment supply, runoff regime, and water quality	• Excessive fine sediment • Excessive turbidity • Embedded substrates • Stream flow – altered magnitude, duration, or rate of change of flows • Water quality impairment	• Timber harvest – impacts to sediment supply, water quality, and runoff processes • Forest roads – impacts to sediment supply, water quality, and runoff processes • Agricultural practices – impacts to sediment supply, water quality, and runoff processes • Development – impacts to sediment supply, water quality, and runoff processes	All species	There currently are functioning runoff and sediment supply processes in portions of the headwaters and the Rock Creek basin. Most of the remainder of the basin is moderately impaired with respect to sediment supply. Mixed-use lands are mostly impaired with respect to runoff due to lack of forest cover and impervious surfaces. Preventing additional degradation will be important for habitat recovery.

Priority Locations

1st- Functional subwatersheds contributing to Tier 1 or 2 reaches (functional for sediment *or* flow according to the IWA – local rating)
2nd- All other functional subwatersheds plus Moderately Impaired subwatersheds contributing to Tier 1 or 2 reaches
3rd- All other Moderately Impaired subwatersheds plus Impaired subwatersheds contributing to Tier 1 or 2 reaches

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDNR	Forest Practices Rules, State Lands HCP	✓	
USFS	Northwest Forest Plan	✓	
Clark County	Comprehensive Planning		✓
City of Battleground	Comprehensive Planning		✓
City of Ridgefield	Comprehensive Planning		✓
Clark Conservation District / NRCS	Agricultural land habitat protection programs		✓

Program Sufficiency and Gaps

Hillslope processes on federal forest lands in the upper basin are protected through the Northwest Forest Plan. Hillslope processes on private forest lands are protected through Forest Practices Rules administered by the WDNR. These rules, developed as part of the Forests & Fish Agreement, are believed to be adequate for protecting watershed sediment supply, runoff processes, and water quality on private forest lands. Small private landowners may be unable to meet some of the requirements on a timeline commensurate with large industrial landowners. Financial assistance to small owners would enable greater and quicker compliance. On non-forest lands (agriculture and developed), local government comprehensive planning is the primary nexus for protection of hillslope processes. Local govenments can control impacts through zoning that protects existing uses, through stormwater management ordinances, and through tax incentives to keep agricultural and forest lands from becoming developed. These protections are especially important in the EF Lewis basin due to expanding growth. There are limited regulatory protections of hillslope processes that relate to agricultural practices; such deficiencies need to be addressed through local or state authorities. Clark County's Agricultural Module of its Habiat Conservation Ordinance regulates sediment discharges from agricultural operations. Also, the Clark Conservation District's farm plan program assists producers in preventing discharge of nutrients, chemicals, and sediment. Protecting hillslope processes on agricultural lands would also benefit from the expansion of technical assistance and landowner incentive programs (NRCS, Conservation Districts).

#3 - Restore floodplain function and channel migration processes in the mainstem and major tributaries

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Set back, breach, or remove artificial confinement structures	• Bed and bank erosion • Altered habitat unit composition • Restricted channel migration • Disrupted hyporheic processes • Reduced flood flow dampening • Altered nutrient exchange processes • Channel incision • Loss of off-channel and/or side-channel habitat • Blockages to off-channel habitats	• Floodplain filling • Channel straightening • Artificial confinement	All species	Much of the lower mainstem has been subject to artificial channel confinement associated with mining, residential development, and agriculture. Restoring floodplain function and channel migration processes will lead to improvements in riparian and channel habitats. Selective breaching, setting back, or removing confining structures would help to restore floodplain and CMZ function as well as facilitate the creation of off-channel and side channel habitats. There are challenges with implementation due to private lands, existing infrastructure already in place, potential flood risk to property, and large expense.

Priority Locations

1st- Tier 1 reaches with hydro-modifications
2nd- Tier 2 reaches with hydro-modifications
3rd- Other reaches with hydro-modifications

Key Programs

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

Program Sufficiency and Gaps

There currently are no programs that set forth strategies for restoring floodplain function and channel migration processes in the EF Lewis Basin. Without programmatic changes, projects are likely to occur only seldom as opportunities arise and only if financing is made available. The level of floodplain and CMZ impairment in the Lower EF Lewis and the importance of these processes to listed fish species put an increased emphasis on restoration. Means of increasing restoration activity include building partnerships with landowners, increasing landowner participation in conservation programs, allowing restoration projects to serve as mitigation for other activities, and increasing funding for NGOs and government entities to conduct projects. Floodplain restoration projects are often expensive, large-scale efforts that require partnerships among many agencies, NGOs, and landowners. Building partnerships is a necessary first step toward floodplain and CMZ restoration. Clark County's ownership of over 2000 acres along the lower east Fork provides the opportunity for restoration of floodplain function where downstream impacts can be controlled.

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

Submeasures	Factors Addressed	Threats Addressed	Target species	Discussion
A. Upgrade or remove problem forest roads B. Reforest heavily cut areas not recovering naturally C. Employ agricultural Best Management Practices with respect to contaminant use, erosion, and runoff D. Reduce watershed imperviousness E. Reduce effective stormwater runoff from developed areas	• Excessive fine sediment • Excessive turbidity • Embedded substrates • Stream flow – altered magnitude, duration, or rate of change of flows • Water quality impairment	• Timber harvest – impacts to sediment supply, water quality, and runoff processes • Forest roads – impacts to sediment supply, water quality, and runoff processes • Agricultural practices – impacts to sediment supply, water quality, and runoff processes • Development – impacts to water quality and runoff processes	All species	Hillslope runoff and sediment delivery processes have been degraded due to past intensive timber harvest, road building, agriculture, and development. These processes must be addressed for reach-level habitat recovery to be successful.

Priority Locations

1st- Moderately impaired or impaired subwatersheds contributing to Tier 1 reaches (mod. impaired or impaired for sediment *or* flow according to IWA – local rating)
2nd- Moderately impaired or impaired subwatersheds contributing to Tier 2 reaches
3rd- Moderately impaired or impaired subwatersheds contributing to other reaches

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDNR	State Lands HCP, Forest Practices Rules	✓	
WDFW	Habitat Program		✓
USFS	Northwest Forest Plan, Habitat Projects	✓	
Clark Conservation District / NRCS	Agricultural land habitat restoration programs		✓
NGOs, tribes, Conservation Districts, agencies, landowners	Habitat Projects		✓
Clark County	Comprehensive Planning		✓
City of Battle Ground	Comprehensive Planning		✓
City of Ridgefield	Comprehensive Planning		✓

Program Sufficiency and Gaps

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

#5 - Restore riparian conditions throughout the basin

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Restore the natural riparian plant community B. Exclude livestock from riparian areas C. Eradicate invasive plant species from riparian areas	• Reduced stream canopy cover • Altered stream temperature regime • Reduced bank/soil stability • Reduced wood recruitment • Lack of stable instream woody debris • Exotic and/or invasive species • Bacteria	• Timber harvest – riparian harvests • Riparian grazing • Clearing of vegetation due to agriculture and residential development	All species	Riparian areas have been degraded by a host of land-uses including timber harvest, road building, mining, agriculture, and development. Although most riparian areas are now protected, natural recovery is limited in many areas by existing land use. The increasing abundance of exotic and invasive species is also a concern. Riparian restoration projects are relatively inexpensive and are often supported by landowners. There is a high potential benefit due to the many limiting factors that are addressed.

Priority Locations

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

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDNR	State Lands HCP, Forest Practices Rules	✓	
USFS	Northwest Forest Plan, Habitat Projects	✓	
WDFW	Habitat Program		✓
Clark Conservation District / NRCS	Agricultural land habitat restoration programs		✓
Clark County	Comprehensive Plan		✓
NGOs, tribes, Conservation Districts, agencies, landowners	Habitat Projects		✓
Noxious Weed Control Boards (State and County level)	Noxious Weed Education, Control, and Enforcement		✓

Program Sufficiency and Gaps

There are no regulatory mechanisms for actively restoring riparian conditions; however, existing programs will afford protections that will allow for the *passive* restoration of riparian forests. These protections are believed to be adequate for riparian areas on forest lands that are subject to Forest Practices Rules or the State forest lands HCP. Other lands receive variable levels of protection and passive restoration through the Clark County Comprehensive Plan. Many degraded riparian zones in urban, agricultural, rural residential, or transportation corridor uses will not passively restore with existing regulatory protections and will require active measures. Riparian restoration in these areas may entail livestock exclusion, tree planting, road relocation, invasive species eradication, and adjusting current land-use in the riparian zone. Means of increasing restoration activity include building partnerships with landowners, increasing landowner participation in conservation programs, allowing restoration projects to serve as mitigation for other activities, and increasing funding for NGOs, government entities, and landowners to conduct restoration projects. . Clark County's ownership of over 2000 acres along the lower east Fork provides the opportunity for restoration of riparian conditions.

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

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Exclude livestock from riparian areas B. Increase riparian shading C. Decrease channel width-to-depth ratios D. Reduce delivery of chemical contaminants to streams E. Address leaking septic systems	• Bacteria • Altered stream temperature regime • Chemical contaminants	• Timber harvest – riparian harvests • Riparian grazing • Leaking septic systems • Clearing of vegetation due to rural development and agriculture • Chemical contaminants from agricultural and developed lands	• All species	There are known temperature impairments throughout the basin. There are also known fecal coliform bacteria impairments, although bacteria is more of a human health concern than a fish health concern. Degraded riparian areas and cattle access to streams are contributing factors to both temperature and bacteria. Excluding livestock from riparian areas is particularly important along some of the heavily grazed tributaries. Leaking septic systems may be contributing to bacteria levels in areas with concentrated rural residential development. The degree of impact of agricultural pollutants is unknown and needs further assessment.

Priority Locations

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

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
Washington Department of Ecology	Water Quality Program		✓
WDNR	State Lands HCP, Forest Practices Rules	✓	
USFS	Northwest Forest Plan, Habitat Projects	✓	
WDFW	Habitat Program		✓
Clark Conservation District / NRCS	Agricultural land habitat restoration programs, Centennial Clean Water Program		✓
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
NGOs, tribes, Conservation Districts, agencies, landowners	Habitat Projects		✓
Clark County Health Department	Septic System Program		✓

Program Sufficiency and Gaps

Ecology's Water Quality Program manages the State 303(d) list of impaired water bodies. There are several listings for temperature and fecal coliform bacteria in the EF Lewis Basin and several additional areas listed as a concern (WDOE 2004). Water Quality Clean-up Plans (TMDLs) are required by Ecology and it is anticipated that the TMDLs will adequately set forth strategies to address the temperature and bacteria impairments. It will be important that the strategies specified in the TMDLs are implementable and adequately funded. The 303(d) listings are believed to address the primary water quality concerns; however, other impairments may exist that the current monitoring effort is unable to detect. Additional monitoring is needed to fully understand the degree of water quality impairment in the basin, especially regarding agricultural pollutants.

#7 – Provide for adequate instream flows during critical periods

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Protect instream flows through water rights closures and enforcement B. Restore instream flows through acquisition of existing water rights C. Restore instream flows through implementation of water conservation measures	• Stream flow – Maintain or improve flows during low-flow Summer months	• Water withdrawals	All species	Expanding growth has increased pressures for ground and surface water withdrawals. It is crucial that withdrawals are managed carefully to minimize impacts on aquatic resources. Instream flow management strategies for the EF Lewis Basin have been identified as part of Watershed Planning for WRIA 27 (LCFRB 2004). Strategies include water rights closures, setting of minimum flows, and drought management policies. This measure applies to instream flows associated with water withdrawals and diversions, generally a concern only during low flow periods. Hillslope processes also affect low flows but these issues are addressed in separate measures.

Priority Locations

Entire Basin

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
Washington Department of Ecology	Water Resources Program		✓
City of Battleground	Water Supply Program		✓
City of Ridgefield	Water Supply Program		✓
Clark Public Utilities	Water Supply Program		✓

Program Sufficiency and Gaps

The Water Resources Program of Ecology, in cooperation with the WDFW and other entities, manages water rights and instream flow protections. A collaborative process for setting and managing instream flows was launched in 1998 with the Watershed Planning Act (HB 2514), which called for the establishment of local watershed planning groups who's objective was to recommend instream flow guidelines to Ecology through a collaborative process. It is anticipated that the WRIA 27/28 watershed management plan will be adopted by the Planning Unit in December, 2004. Instream flow management in the EF Lewis Basin will be conducted using the recommendations of the WRIA 27/28 Planning Unit, which is coordinated by the LCFRB. Draft products of the WRIA 27/28 watershed planning effort can be found on the LCFRB website: www.lcfrb.gen.wa.us. The recommendations of the planning unit have been developed in close coordination with recovery planning and the instream flow prescriptions developed by this group are anticipated to adequately protect instream flows necessary to support healthy fish populations. The measures specified above are consistent with the planning group's recommended strategies. Development of a regional water source in the Vancouver Lake Lowlands to provide water to the City of Battleground and other communities is a central element of the management plan. Ecology should implement the recommendations of the WRIA 27/28 Planning Unit with respect to instream flow rule development.

#8 – Restore access to habitat blocked by artificial barriers

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Restore access to isolated habitats blocked by culverts, dams, or other barriers	• Blockages to channel habitats • Blockages to off-channel habitats	Dams, culverts, in-stream structures	coho, winter steelhead, summer steelhead	As many as 30 miles of potentially accessible habitat are blocked by culverts or other barriers. The blocked habitat is believed to be marginal in the majority of cases and no individual barriers in themselves account for a significant portion of blocked miles (there are 23 barriers total). Passage restoration projects should focus only on cases where it can be demonstrated that there is good potential benefit and reasonable project costs.

Priority Locations

1st- Culverts on McCormick, Brezee Creek & tribs, Mason Creek, Gee Creek (not in EF basin proper)
2nd- Other small tributaries with blockages

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
WDNR	Forest Practices Rules, Family Forest Fish Passage, State Forest Lands HCP	✓	
WDFW	Habitat Program		✓
USFS	Northwest Forest Plan, Habitat Projects	✓	
Washington Department of Transportation / WDFW	Fish Passage Program		✓
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
NGOs, tribes, Conservation Districts, agencies, landowners	Habitat Projects		✓
Clark County	Roads Program		✓

Program Sufficiency and Gaps

The Forest Practices Rules require forest landowners to restore fish passage at artificial barriers by 2016. Small forest landowners are given the option to enroll in the Family Forest Fish Program in order to receive financial assistance to fix blockages. The Washington State Department of Transportation, in a cooperative program with WDFW, manages a program to inventory and correct blockages associated with state highways. The Salmon Recovery Funding Board, through the Lower Columbia Fish Recovery Board, funds barrier removal projects. Past efforts have corrected major blockages and have identified others in need of repair. Additional funding is needed to correct remaining blockages. Further monitoring and assessment is needed to ensure that all potential blockages have been identified and prioritized.

#9 - Restore channel structure and stability

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Place stable woody debris in streams to enhance cover, pool formation, bank stability, and sediment sorting B. Structurally modify channel morphology to create suitable habitat C. Restore natural rates of erosion and mass wasting within river corridors	• Lack of stable instream woody debris • Altered habitat unit composition • Reduced bank/soil stability • Excessive fine sediment • Excessive turbidity • Embedded substrates	• None (symptom-focused restoration strategy)	All species	Channel structure and stability have been compromised by altered sediment and flow regimes, degraded riparian conditions, stream-adjacent gravel mining/processing, and confinement. Large wood installation projects could benefit habitat conditions in many areas although watershed processes contributing to wood deficiencies should be considered and addressed prior to placing wood in streams. Other structural enhancements to stream channels may be warranted in some places, particularly in reaches that have been simplified through channel straightening and confinement or that has experienced avulsions into streamside gravel processing ponds.

Priority Locations

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

Key Programs

Agency	Program Name	Sufficient	Needs Expansion
NGOs, tribes, Conservation Districts, agencies, landowners	Habitat Projects		✓
WDFW	Habitat Program		✓
USFS	Habitat Projects		✓
USACE	Water Resources Development Act (Sect. 1135 & Sect. 206)		✓
Lower Columbia Fish Enhancement Group	Habitat Projects		✓
Clark Conservation District / NRCS	Agricultural land habitat restoration programs		✓

Program Sufficiency and Gaps

There are no regulatory mechanisms for actively restoring channel stability and structure. Passive restoration is expected to slowly occur as a result of protections afforded to riparian areas and hillslope processes. Past projects have largely been opportunistic and have been completed due to the efforts of local NGOs, landowners, and government agencies; such projects are likely to continue in a piecemeal fashion as opportunities arise and if financing is made available. The lack of LWD in stream channels, and the importance of wood for habitat of listed species, places an emphasis on LWD supplementation projects. Addressing channel stability and structure associated with the stream-adjacent gravel ponds along the lower river is also a high priority. Means of increasing restoration activity include building partnerships with landowners, increasing landowner participation in conservation programs, allowing restoration projects to serve as mitigation for other activities, and increasing funding for NGOs, government entities, and landowners to conduct restoration projects.

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

Submeasures	Factors Addressed	Threats Addressed	Target Species	Discussion
A. Restore historical off-channel and side-channel habitats where they have been eliminated B. Create new channel or off-channel habitats (i.e. spawning channels)	• Loss of off-channel and/or side-channel habitat	• Floodplain filling • Channel straightening • Artificial confinement	chum coho	There has been significant loss of off-channel and side-channel habitats, especially along the lower mainstem that has been extensively channelized. This has severely limited chum spawning habitat and coho overwintering habitat. Targeted restoration or creation of habitats would increase available habitat where full floodplain and CMZ restoration is not possible.

Priority Locations

1st- Lower Mainstem EF Lewis

2nd- Other reaches that may have potential for off-channel and side-channel habitat restoration or creation

Key Programs

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

Program Sufficiency and Gaps

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

Table L-15. Habitat actions for the East Fork Lewis Basin.

Action	Status	Responsible Entity	Measures Addressed	Spatial Coverage of Target Area[1]	Expected Biophysical Response[2]	Certainty of Outcome[3]
EF Lew 1. Expand standards in local government comprehensive plans to provide high levels of protection of ecologically important areas (i.e. stream channels, riparian zones, floodplains, CMZs, wetlands, unstable geology)	Expansion of existing program or activity	Clark County Battleground	1 & 2	High: Applies to all private lands under county jurisdiction	High: Protection of water quality, riparian function, stream channel structure (e.g. LWD), floodplain function, CMZs, wetland function, runoff processes, and sediment supply processes	High
EF Lew 2. Manage future growth and development patterns to ensure the protection of watershed processes. This includes limiting the conversion of agriculture and timber lands to developed uses through zoning regulations and tax incentives (in consideration of urban growth boundaries)	Expansion of existing program or activity	Clark County Battleground	1 & 2	High: Applies to all private lands under county jurisdiction	High: Protection of water quality, riparian function, stream channel structure (e.g. LWD), floodplain function, CMZs, wetland function, runoff processes, and sediment supply processes	High
EF Lew 3. Conduct floodplain restoration where feasible along the mainstem and in major tributaries that have experienced channel confinement. Address past and potential avulsions into gravel processing ponds. Build partnerships with landowners and agencies and provide financial incentives	New program or activity	NRCS, CCD, NGOs, WDFW, LCFRB, USACE, LCFEG, Tribes	3, 5, 6, 8 & 9	High: Lower mainstem EF Lewis and lower portion of major tributaries	Medium: Restoration of floodplain function, habitat diversity, and habitat availability.	High
EF Lew 4. Continue to manage federal forest lands according to the Northwest Forest Plan	Activity is currently in place	USFS	1, 2, 4, 5, 6 & 8	Medium: National Forest lands in the upper basin	High: Increase in instream LWD; reduced stream temperature extremes; greater streambank stability; reduction in road-related fine sediment delivery; decreased peak flow volumes; restoration and preservation of fish access to habitats	High
EF Lew 5. Prevent floodplain impacts through land use controls and Best Management Practices	Expansion of existing program or activity	Clark County, Battleground Ecology	1	Medium: Applies to privately owned flood prone lands under local jurisdiction	High: Protection of floodplain function, CMZ processes, and off-channel/side-channel habitat. Prevention of reduced habitat diversity and key habitat availability	High

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

Action	Status	Responsible Entity	Measures Addressed	Spatial Coverage of Target Area[1]	Expected Biophysical Response[2]	Certainty of Outcome[3]
EF Lew 6. Monitor, evaluate, and enforce the Stordahl Habitat Conservation Plan	Activity is currently in place	NMFS, USFWS	9	Medium: Applies to privately owned lands downstream of Daybreak Park	High: Protection of water quality, riparian function, stream channel structure (e.g. LWD), erosion, mass wasting, bank stability and sediment supply processes	High
EF Lew 7. Increase funding available to purchase easements or property in sensitive areas in order to protect watershed function where existing programs are inadequate	Expansion of existing program or activity	LCFRB, NGOs, WDFW, USFWS, BPA (NPCC)	1 & 2	Medium: Residential, agricultural, or forest lands at risk of further degradation	High: Protection of riparian function, floodplain function, water quality, wetland function, and runoff and sediment supply processes	High
EF Lew 8. Review and adjust operations to ensure compliance with the Endangered Species Act; examples include roads, parks, and weed management	Expansion of existing program or activity	Clark County, Battleground	1, 4, 5, & 6	Low: Applies to lands under public jurisdiction	Medium: Protection of water quality, greater streambank stability, reduction in road-related fine sediment delivery, restoration and preservation of fish access to habitats	High
EF Lew 9. Increase technical assistance to landowners and increase landowner participation in conservation programs that protect and restore habitat and habitat-forming processes. Includes increasing incentives (financial or otherwise) and increasing program marketing and outreach	Expansion of existing program or activity	NRCS, CCD, WDNR, WDFW, LCFEG, Clark County, Battleground	All measures	High: Private lands. Applies to lands in agriculture, rural residential, and forestland uses throughout the basin	High: Increased landowner stewardship of habitat. Potential improvement in all factors	Medium
EF Lew 10. Fully implement and enforce the Forest Practices Rules (FPRs) on private timber lands in order to afford protections to riparian areas, sediment processes, runoff processes, water quality, and access to habitats	Activity is currently in place	WDNR	1, 2, 4, 5, 6 & 8	Medium: Private commercial timber lands	High: Increase in instream LWD; reduced stream temperature extremes; greater streambank stability; reduction in road-related fine sediment delivery; decreased peak flow volumes; restoration and preservation of fish access to habitats	Medium
EF Lew 11. Implement the prescriptions of the WRIA 27/28 Watershed Planning Unit regarding instream flows. Develop a regional water source in the Vancouver Lake Lowlands within 10 years and assess the feasibility of a regional source in the North Fork Lewis tidal reach	Activity is currently in place	Ecology, WDFW, WRIA 27/28 Planning Unit, CPU, Battleground, Ridgefield	7	High: Entire basin	High: Adequate instream flows to support life stages of salmonids and other aquatic biota.	High

Action	Status	Responsible Entity	Measures Addressed	Spatial Coverage of Target Area[1]	Expected Biophysical Response[2]	Certainty of Outcome[3]
EF Lew 12. Increase the level of implementation of voluntary habitat enhancement projects in high priority reaches and subwatersheds. This includes building partnerships, providing incentives to landowners, and increasing funding	Expansion of existing program or activity	LCFRB, BPA (NPCC), NGOs, WDFW, NRCS, CCD, LCFEG	3, 4, 5, 6, 7, 8, & 10	High: Priority stream reaches and subwatersheds throughout the basin	Medium: Improved conditions related to water quality, LWD quantities, bank stability, key habitat availability, habitat diversity, riparian function, floodplain function, sediment availability, & channel migration processes	Medium
EF Lew 13. Increase technical support and funding to small forest landowners faced with implementation of Forest and Fish requirements for fixing roads and barriers to ensure full and timely compliance with regulations	Expansion of existing program or activity	WDNR	1, 2, 4, 5, 6 & 8	Medium: Small private timberland owners	High: Reduction in road-related fine sediment delivery; decreased peak flow volumes; restoration and preservation of fish access to habitats	Medium
EF Lew 14. Protect and restore native plant communities from the effects of invasive species	Expansion of existing program or activity	Weed Control Boards (local and state); NRCS, CCD	1 & 5	High: Greatest risk is in agriculture and residential use areas	Medium: restoration and protection of native plant communities necessary to support watershed and riparian function	Low
EF Lew 15. Assess the impact of fish passage barriers throughout the basin and restore access to potentially productive habitats	Expansion of existing program or activity	WDFW, WDNR, Clark County WSDOT, LCFEG, Clark CD	8	Medium: As many as 30 miles of stream are potentially blocked by artificial barriers	Medium: Increased spawning and rearing capacity due to access to blocked habitat. Habitat is marginal in most cases	Medium
EF Lew 16. Conduct forest practices on state lands in accordance with the Habitat Conservation Plan in order to afford protections to riparian areas, sediment processes, runoff processes, water quality, and access to habitats	Activity is currently in place	WDNR	1, 2, 4, 5, 6 & 8	Medium: State timber lands in the EF Lewis Basin (approximately 16% of the basin area)	Medium: Increase in instream LWD; reduced stream temperature extremes; greater streambank stability; reduction in road-related fine sediment delivery; decreased peak flow volumes; restoration and preservation of fish access to habitats. Response is medium because of location and quantity of state lands	Medium
EF Lew 17. Address water quality issues through the development and implementation of water quality clean up plans (TMDLs)	Expansion of existing program or activity	Ecology	6	Medium: Temperature impaired and 303(d) listed streams	Medium: Protection and restoration of water quality	Low
EF Lew 18. Create and/or restore lost side-channel/off-channel habitat for chum spawning and coho overwintering	New program or activity	LCFRB, BPA (NPCC), NGOs, WDFW, NRCS, Clark CD	10	Low: Lower mainstem EF Lewis	High: Increased habitat availability for spawning and rearing	Low

L.5.5. Hatcheries

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

Subbasin Hatchery Strategy

The desired future state of fish production within the East Fork Lewis River Basin includes natural salmon and steelhead populations that are improving on a trajectory to recovery and hatchery programs that either enhance the natural fish recovery trajectory or are operated to not impede progress towards recovery. Hatchery recovery measures in each subbasin are tailored to the specific ecological and biological circumstances for each species in the subbasin. This may involve substantial changes in hatchery programs from their historical focus on production for fishery for lost fishery benefits. The recovery strategy includes a mixture of conservation programs and mitigation programs. Mitigation programs involve areas or practices selected for consistency with natural population conservation and recovery objectives. A summary of the types of natural production enhancement strategies and fishery enhancement strategies to be implemented in the East Fork Lewis River Basin are displayed by species in Table L-16. More detailed descriptions and discussion of the regional hatchery strategy can be found in Volume I.

Table L-16. Summary of potential natural production and fishery enhancement strategies for the East Fork Lewis River.

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

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

Conservation-based hatchery programs include strategies and measures which are specifically intended to enhance or protect production of a particular wild fish population within the basin. A unique conservation strategy is developed for each species and watershed depending on the status of the natural population, the biological relationship between the hatchery and natural populations, ecological attributes of the watershed, and logistical opportunities to jointly manage the populations. Four types of hatchery conservation strategies may be employed:

Natural Refuge Watersheds: In this strategy, certain sub-basins are designated as wild-fish-only areas for a particular species. The refuge areas include watersheds where populations have persisted with minimum hatchery influence and areas that may have a history of hatchery production but would not be subjected to future hatchery influence as part of the recovery strategy. More refuge areas may be added over time as wild populations recover. These refugia provide an opportunity to monitor population trends independent of the confounding influence of hatchery fish natural population on fitness and our ability to measure natural population productivity and will be key indicators of natural population status within the ESU. The East Fork Lewis River Basin would be a refuge area for natural fall Chinook

Hatchery Supplementation: This strategy utilizes hatchery production as a tool to assist in rebuilding depressed natural populations. Supplementation would occur in selected areas that are producing natural fish at levels significantly below current capacity or capacity is expected to increase as a result of immediate benefits of habitat or passage improvements. This is intended to be a temporary measure to jump start critically low populations and to bolster natural fish numbers above critical levels in selected areas until habitat is restored to levels where a population can be self sustaining. This strategy would include chum and coho salmon in the East Fork Lewis Basin.

Hatchery/Natural Isolation: This strategy is focused on physically separating hatchery adult fish from naturally-produced adult fish to avoid or minimize spawning interactions to allow natural adaptive processes to restore native population diversity and productivity. The strategy may be implemented in the entire watershed or more often in a section of the watershed upstream of a barrier or trap where the hatchery fish can be removed. This strategy is currently aimed at hatchery steelhead in watersheds with trapping capabilities. The strategy may also become part of fall Chinook as well as coho strategies in certain watersheds in the future as unique wild runs develop. This strategy would not be included in near-term measures for the East Fork Lewis Basin but could be considered in the future for coho. This definition refers only to programs where fish are physically sorted using a barrier or trap. Some fishery mitigation programs, particularly for steelhead, are managed to isolate hatchery and wild stocks based on run timing and release locations.

Hatchery/Natural Merged Conservation Strategy: This strategy addresses the case where natural and hatchery fish have been homogenized over time such that they are principally all one stock that includes the native genetic material for the basin. Many spring Chinook, fall Chinook, and coho populations in the lower Columbia currently fall into this category. In many cases, the composite stock productivity is no longer sufficient to support a self-sustaining natural population especially in the face of habitat degradation. The hatchery program will be critical to maintaining any population until habitat can be improved and a strictly natural population can be re-established. This merged strategy is intended to transition these mixed populations to a self-supporting natural population that is not subsidized by hatchery production or subject to deleterious hatchery impacts. Elements include separate management of hatchery and natural subpopulations, regulation of hatchery fish in natural areas, incorporation of natural fish into hatchery broodstock, and annual abundance-driven distribution. Corresponding programs are expected to evolve over time dependent on changes in the populations and in the habitat productivity. This strategy is primarily aimed at Chinook salmon in areas where harvest production occurs. There is not a Chinook harvest program in the East Fork Lewis Basin.

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

Hatchery Measures and Actions

Hatchery strategies and measures are focused on evaluating and reducing biological risks consistent with the conservation strategies identified for each natural population. Artificial production programs within the East Fork Lewis Basin have been evaluated in detail through the WDFW Benefit-Risk Assessment Procedure (BRAP) relative to risks to natural populations. The BRAP results were utilized to inform the development of these program actions specific to the East Fork Lewis River Basin (Table L-17). The Sub-Basin plan hatchery recovery actions were developed in coordination with WDFW and at the same time as the Hatchery and Genetic Management Plans (HGMP) were developed by WDFW for each hatchery program. As a result, the hatchery actions represented in this document will provide direction for specific actions which will be detailed in the HGMPs submitted by WDFW for public review and for NMFS approval. It is expected that the HGMPs and these recovery actions will be complimentary and provide a coordinated strategy for the East Fork Lewis Basin hatchery programs. Further explanation of specific strategies and measures for hatcheries can be found in Volume I.

Table L-17. Potential hatchery implementation actions in the East Fork Lewis River Basin.

Activity	Action	Hatchery Program Addressed	Natural Populations Addressed	Limiting Factors Addressed	Threats Addressed	Expected Outcome
• Continue to mass mark Skamania Hatchery steelhead releases to provide the means to identify hatchery fish for selective fisheries and to distinguish between hatchery and wild fish returning to the EF Lewis River.	*Adipose fin-clip mark hatchery released steelhead.	Skamania Hatchery winter and summer steelhead released into the EF Lewis River	EF Lewis winter and summer steelhead.	Domestication, Diversity, Abundance	• In-breeding • Harvest	• Continue selective fishery opportunity for hatchery produced summer steelhead in the East Fork Lewis. • Enable visual identification of hatchery and wild returns to provide the means to account for and manage the natural and wild escapement consistent with biological objectives
• Maintain EF Lewis as a refugia for natural fall Chinook without genetic influence from hatchery produced fall Chinook,	*Preclude release of hatchery produced Chinook into the East For Lewis.	All fall Chinook programs	EF Lewis fall Chinook	Domestication, Diversity	• In-breeding	• EF Lewis fall Chinook population rebuilds while maintaining genetic legacy attributes. • EF Lewis fall Chinook possesses genetic attributes which enable the population to reach productivity potential.
• Hatchery produced steelhead will be scheduled for release during the time when the maximum numbers of fish are smolted and prepared to emigrate rapidly. • Juvenile rearing strategies will be implemented to provide a fish growth schedule which coincides with an optimum release time for hatchery production survival and to minimize time spent in the EF Lewis Basin.	*Juvenile release strategies to minimize impacts to natural populations	Skamania Hatchery winter and summer steelhead released into the EF Lewis.	EF Lewis steelhead, coho, fall Chinook, and chum	Predation, Competition	• Hatchery smolt residence time in the EF Lewis.	• Minimal residence time of hatchery released juvenile resulting in reduced ecological interactions between hatchery and wild juveniles. • Minimized predation by summer steelhead smolts upon natural produced winter and summer steelhead, coho, fall Chinook, and chum. • Improved survival of wild juveniles, resulting in increased productivity and abundance of winter and summer steelhead, coho, fall Chinook, and chum

Activity	Action	Hatchery Program Addressed	Natural Populations Addressed	Limiting Factors Addressed	Threats Addressed	Expected Outcome
• Develop a chum brood stock utilizing natural returns to the North Lewis and East Fork Lewis. Establish a brood stock program at Lewis River hatchery complex to supplement East Fork Lewsis chum populations. • Utilize coho production from a lower Columbia facility, as determined by WDFW, to supplement the natural coho population in the East Fork Lewis. Program would be aimed towards early and late stock coho supplementation	** Hatchery programs utilized for chum and coho supplementation	Lewis River chum (not yet a program), lower Columbia coho	EF Lewis chum and coho.	Abundance, spatial distribution	• Risk of low number of natural spawners • Ecologically appropriate brood stock.	• Establish an appropriate brood stock to supplement and decrease risks to the East Fork Lewis chum population. Chum abundance will increase with East Fork Lewis habitat improvements resulting in expanded distribution in the Cascade strata. • Supplementation, strategies in key East Fork Lewis tributaries will assist in "kick-starting" natural coho recovery, coinciding with habitat improvements and harvest management actions.
• Research, monitoring , and evaluation of performance of the above actions in relation to expected outcomes • Performance standards developed for each actions with measurable criteria to determine success or failure • Adaptive Management applied to adjust or change actions as necessary	** Monitoring and evaluation, adaptive management	All species	All species	Hatchery production performance, Natural production performance	• All of above	• Clear standards for performance and adequate monitoring programs to evaluate actions. • Adaptive management strategy reacts to information and provides clear path for adjustment or change to meet performance standard

* Extension or improvement of existing actions-may require additional funding

** New action-will likely require additional funding

L.5.6. Harvest

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

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

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

Fishery actions specific to the subbasins are addressed through the Washington State Fish and Wildlife sport fishing regulatory process. This public process includes an annual review focused on emergency type regulatory changes and a comprehensive review of sport fishing regulations which occurs every two years. This regulatory process includes development of fishing rules through the Washington Administrative Code (WAC) which are focused on protecting weak stock populations while providing appropriate access to harvestable populations. The actions consider the specific circumstances in each area of each subbasin and respond with rules that fit the relative risk to the weak populations in a given time and area of the subbasin. A summary of fishery regulatory and protective actions in the East Fork Lewis River are displayed in Table L-18.

Regional actions cover species from multiple watersheds which share the same migration routes and timing, resulting in similar fishery exposure. Regional strategies and measures for harvest are detailed in Volume I. A number of regional strategies for harvest involve implementation of actions within specific subbasins. In-basin fishery management is generally applicable to steelhead and salmon while regional management is more applicable to salmon. Harvest actions with significant application to the East Fork Lewis River populations are summarized in Table L-19.

Table L-18. Summary of regulatory and protective fishery actions in the East Fork Lewis basin

Species	General Fishing Actions	Explanation	Other Protective Fishery Actions	Explanation
Fall Chinook	Closed to retention	Protects wild fall Chinook. No hatchery produced fall Chinook in the East Fork Lewis	No fisheries for other salmon	Further protection of wild fall Chinook spawners
Chum	Closed to retention	Protects wild chum. Hatchery chum are not released in the East Fork Lewis for harvest	No fisheries for other salmon	Further protection of wild chum spawners
Coho	Closed to retention	Protects wild coho. Hatchery coho are not released in the East Fork Lewis for harvest.	No fisheries for other salmon	Further protection of wild coho spawners
Winter steelhead	Retain only adipose fin-clip marked steelhead	Selective fishery for hatchery steelhead, unmarked wild steelhead must be released	Steelhead fishing closed in the spring and minimum size restrictions in affect	Spring closure protects adult wild steelhead during spawning and minimum size protects juveniles
Summer steelhead	Retain only adipose fin-clipped steelhead	Selective fisheries for hatchery steelhead, unmarked wild steelhead must be released	Steelhead fishing closed in the spring and minimum size restrictions in affect	Spring closures protect adult wild steelhead during spawning and minimum size protects juveniles

Table L-19. Regional harvest actions from Volume I with significant application to the East Fork Lewis River Subbasin populations.

Action	Description	Responsible Parties	Programs	Comments
	Monitor chum handle rate in tributary winter steelhead.	WDFW	Columbia Compact	State agencies would include chum incidental handle assessments as part of their annual tributary sport fishery sampling plan.
	Develop a mass marking plan for hatchery tule Chinook for harvest management and for naturally-spawning escapement monitoring.	WDFW, NMFS, USFWS, Col. Tribes	U.S. Congress, Washington Fish and Wildlife Commission	A regional marking program for tule fall Chinook would provide regional selective fishing options. This program would not affect sport harvest in the East Fork Lewis as there is no hatchery production in the basin.
	Monitor and evaluate commercial and sport impacts to naturally-spawning steelhead in salmon and hatchery steelhead target fisheries.	WDFW, ODFW	Columbia Compact, BPA Fish and Wildlife Program	Includes monitoring of naturally-spawning steelhead encounter rates in fisheries and refinement of long-term catch and release handling mortality estimates. Would include assessment of the current monitoring programs and determine their adequacy in formulating naturally-spawning steelhead incidental mortality estimates.
	Continue to improve gear and regulations to minimize incidental impacts to naturally-spawning steelhead.	WDFW, ODFW	Columbia Compact, BPA Fish and Wildlife Program	Regulatory agencies should continue to refine gear, handle and release methods, and seasonal options to minimize mortality of naturally-spawning steelhead in commercial and sport fisheries.
	Maintain selective sport fisheries in ocean, Columbia River, and tributaries and monitor naturally-spawning stock impacts.	WDFW, NMFS, ODFW, USFWS	PFMC, Columbia Compact, BPA Fish and Wildlife Program, WDFW Creel	Mass marking of lower Columbia River coho and steelhead has enabled successful ocean and freshwater selective fisheries to be implemented since 1998. Marking programs should be continued and fisheries monitored to provide improved estimates of naturally-spawning salmon and steelhead release mortality.

L.5.7. Hydropower

No hydropower facilities exist in the East Fork Lewis Subbasin, hence, no in-basin hydropower actions are identified. East Fork Lewis River anadromous fish populations will benefit from regional hydropower measures recovery measures and actions identified in regional plans to address habitat effects in the mainstem and estuary.

L.5.8. Mainstem and Estuary Habitat

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

L.5.9. Ecological Interactions

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

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