Volume II, Chapter 1
Introduction

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1.0 Introduction to Subbasin Chapters

1.1 Introduction

Subbasin chapters 2-17 in Volume II provide specific information on fish populations and the factors affecting them. These chapters include a review of existing information as well as the results of technical assessments including partitioning of mortality factors (4-H analysis), fish habitat modeling, and watershed process assessment. This information contributes to our understanding of limiting factors and threats affecting focal species. The information presented in these chapters is summarized in the Management Plan in the form of working hypotheses from which subbasin actions are then identified. Subbasin chapters 3-17 contain the following sections: 1) Subbasin Description, 2) Focal Fish Species, 3) Potentially Manageable Impacts, 4) Hatchery Discussion, 5) Fish Habitat Conditions, 6) Fish/Habitat Assessments, and 7) Integrated Watershed Assessment. Detailed descriptions of each of these sections, their interrelationships among each other, and their relationship to recovery planning objectives are provided below.

The lower Columbia River mainstem and estuary subbasin description (chapter 2) follows a different format than all other subbasins for three primary reasons: 1) a lack of habitat data consistent with the other subbasins, 2) the unique role of the lower mainstem and estuary for all salmonid populations in the Columbia River basin, and 3) the joint planning and recovery effort with the State of Oregon. The lower Columbia River mainstem and estuary subbasin description presents the following information: a subbasin description/overview, focal fish and wildlife species descriptions, mainstem and estuary habitat forming processes, mechanisms of habitat change, comparisons of historical and current habitat conditions, interaction between focal species and subbasin habitats, ecological relationships with native and nonnative species, recognition of current knowledge gaps, and a series of hypothesis statements that attempt to describe our current understanding of the lower mainstem and estuary ecosystem.

1.1.1 Subbasin Description

The subbasin description presents an overview of subbasin geography, including topography, geology, climate, land cover, and land use characteristics. Information on topography and geology was obtained from a variety of existing reports, including WDFW reports, USFS reports, WDOE Watershed Planning documents, and Washington Conservation Commission Limiting Factors Analyses (LFAs). Climate information was obtained from existing reports as well as from the Western Regional Climate Center database (http://www.wrcc.dri.edu/). Information on land ownership that is displayed in the pie chart and in the land ownership map was originally compiled by the Department of Natural Resources (WDNR). Land cover presented in the land cover pie chart was originally derived from Landsat imagery following the methods described in Lunetta et al. (1997). This information was summarized by 7th field watershed (referred to as subwatersheds in our discussions) and then aggregated up to the subbasin scale for presentation purposes. The 6 land cover categories are defined in Table 0-1. Land use maps were compiled using data from the National Land Cover Dataset (NLCD) (Vogelmann et al. 2001).

Table 0-1. Definition of land cover categories presented in Subbasin Description sections.

Land Cover Category	Description
Late Seral	Coniferous crown cover greater than 70%. Greater than 10% crown cover in trees greater then or equal to 21 inches diameter breast height (dbh).
Mid-Seral	Conferous crown cover greater than 70%. Less than 10% crown cover in trees greater then or equal to 21 inches diameter breast height (dbh).
Early Seral	Conferous crown cover greater than or equal to 10% and less than 70%. Less than 75% of total crown cover in hardwood tree/shrub cover.
Other Forest	Less than 10% coniferous crown cover (can contain hardwood tree/shrub cover; cleared forest land, etc.)
Non-Forest	Urban, agriculture, rangeland, barren, glaciers
Water	Lakes, large rivers, and other water bodies

Adapted from Lunetta et al. 1997.

1.1.2 Focal Fish Species

Information on focal fish species are presented in a Fact Sheet format, beginning with fish distribution maps followed by bulleted descriptions of fish distribution, life history traits, diversity, abundance, productivity and persistence, hatchery practices, and harvest rates. Fish distribution maps were created from GIS data compiled by Washington State's Salmon and Steelhead Habitat Inventory and Assessment (SSHIAP) program. Edits were performed on fish distributions where better or more recent information was available. Information contained in the fish fact sheet descriptions was obtained from a variety of published reports by the WDFW and other various sources.

1.1.3 Potentially Manageable Impacts

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

This approach represents the relative order of magnitude of key limiting factors. It does not constitute a fine-scaled mechanistic analysis of limiting factors and dynamics of every listed population. The question was not whether a factor might be responsible for a 50% or 55% impact with a confidence interval of 5% or 50%. Rather, we needed to know whether a factor represented a 5% or 50% or 90% impact.

Only the subset of factors we can potentially manage were included in the analyses – natural mortality factors beyond our control (e.g. naturally occurring ocean mortality) are excluded. For instance, tributary habitat changes, estuary habitat changes, fishing, hydro and hatchery effects are all obviously human impacts. Natural mortality in freshwater, the estuary, and the ocean that occurs independent of human effects was factored out. Although it can only minimally be managed by humans, predation by fish, birds, and marine mammals was included

in the analysis because of the widespread public interest in the magnitude of the predation effect relative to human factors.

For the purposes of Volume I, the results of the mortality factor analyses were presented for each species across all subbasins to evaluate ESU-level mortality factors and identify those factors where survival improvements would have the greatest effect on ESU recovery. For the purposes of Volume II, the mortality factors analyses have been re-organized for consistency with the subbasin analyses.

1.1.4 Hatchery Discussion

A brief summary of species-specific hatchery programs is presented for each subbasin; the primary source of information was the most recent available Hatchery and Genetic Management Plan (HGMP) for each program. The hatchery discussions are divided into the following sections: genetics, interactions, water quality/disease, mixed harvest, passage, and supplementation. The genetic section identifies what is known about the broodstock source of each hatchery program as well as the occurrence of egg, fry, or smolt transfers to or from other hatcheries. The interactions section discusses possible interaction scenarios between hatchery-hatchery juveniles, hatchery-wild juveniles, and hatchery-wild spawners. The water quality/disease section identifies the water source for the hatchery, operational controls used to maintain water quality, and the disease monitoring procedures utilized by the hatchery to minimize disease transmission within and outside of the hatchery. The mixed harvest section describes the specific fisheries that hatchery programs contribute to and indicates how hatchery fish are targeted in the presence of wild fish. The passage section describes the collection systems at each hatchery and discusses passage challenges for returning broodstock. The supplementation section identifies how each hatchery program aligns with species-specific supplementation programs within the subbasin.

1.1.5 Fish Habitat Conditions

This section presents a background of the general condition of stream habitat and watershed processes within subbasins. Stream habitat and landscape conditions that are believed to be potentially impacting aquatic resources are described. This section does not include an analysis of the relative importance of habitat conditions or the significance to fish at the population scale, which is the focus of the following 3 sections (see descriptions below). Information has been obtained from a variety of sources, including Limiting Factor Analyses (LFAs) conducted by the Washington State Conservation Commission, US Forest Service watershed analyses, Washington Deptarment of Ecology Watershed Planning documents, as well as from the assessments described in the following 2 sections.

1.1.6 Fish Habitat Assessments

Fish Habitat Assessments present the results and analysis of EDT fish habitat modeling. The section is divided into 3 sub-sections: 1) Population Analysis, 2) Restoration and Preservation Analysis, and 3) Habitat Factor Analysis. A more thorough description of the functions of the EDT model, its application to recovery planning, and sources for additional information are presented in Vol. VI.

1.1.6.1 Population Analysis

Estimation of fish population levels under a given set of habitat conditions is one of several EDT applications. EDT provides an effective alternative for estimating fish population levels where census data is incomplete. This is particularly useful in recreating a historical baseline. EDT results have been corroborated with specific fish census data where available. Even where census data is unavailable for a species or subbasin, EDT provides a robust means of relating changes in fish population levels to changes in habitat conditions.

EDT describes fish population levels in terms of productivity, abundance, and diversity. Productivity is a population's capacity to replace itself (represented in EDT as the inherent number of adults produced in the next generation per spawner). Abundance is the realized habitat capacity (represented in EDT as the equilibrium number of adult spawners produced when the available habitat is fully seeded). Diversity in EDT is an index based on the percentage of theoretically possible life history pathways that are viable under the specified habitat conditions. Because EDT is fish life cycle-based, it also provides estimates of smolt productivity and abundance that are useful for describing effects of subbasin spawning and rearing habitats independent of out-of-basin fishery, mainstem, estuary, and ocean concerns. Smolt abundance reflects the equilibrium (realized) number of smolts produced and smolt productivity reflects the number of smolts produced per spawner.

EDT estimates were generated for historic (template), current (patient), and "Properly Functioning" (PFC) habitat conditions. The historical/template condition is defined as pre-non-Native American/European influence and represents a hypothetical optimum. The current/patient condition represents the immediate past few years. PFC represents favorable habitat conditions for salmonids throughout the basin based on criteria identified in NMFS (1996). PFC conditions are less optimum than the pristine historical template but are assumed to ensure population persistence (i.e. avoid extinction).

1.1.6.2 Restoration and Preservation Analysis

This section presents the results of the EDT restoration and preservation analysis. Restoration and preservation analysis is based on the same fish abundance, productivity, and diversity information derived for population analysis from historical/template and current/patient habitat conditions. Restoration and preservation analysis provides a greater level of detail as it identifies reaches based on their preservation value and restoration potential. Restoration and preservation analysis results are specific to each fish species because of the different fish habitat requirements of each.

Results are typically displayed in a graphical format that is often referred to as a ladder or tornado diagram. For each reach, there is a preservation value and a restoration value for each of the three population performance parameters – productivity, abundance, and life history diversity. The values presented are normalized by reach length and represent the change in population performance per 1000 meters stream length. Values were normalized to avoid potential bias due to reach length. Preservation value is estimated as the percent decrease in salmon performance if a reach was thoroughly degraded. Reaches with a high preservation value should be protected because of the disproportionately high negative impact on the population that would result from degradation. Restoration value is estimated as the percent increase in salmon performance if a reach is completely restored. Addressing degraded habitat conditions in a reach with a high restoration potential would provide a greater benefit to the population than in

a reach with low restoration potential. Many reaches have both high preservation and high restoration value. These tend to be highly productive reaches, where relatively modest changes in habitat quality can have a significant effect on population performance. In these reaches, management strategies should work to both preserve existing functional attributes and restore degraded attributes.

Reaches have been ranked and categorized into High (H), Medium (M), and Low (L) groupings based on their potential to contribute to population viability. Reach rankings were determined by summing the potential change values for preservation and restoration across the 3 performance measures (i.e. summing the values for all bars of the ladder diagram for each reach). Reach rankings therefore reflect the contribution of the reach to current AND potential population performance.

Reaches were also given a recovery emphasis designation. A designation of P indicates that preservation measures should be emphasized within the reach. A designation of R indicates that restoration measures should be emphasized. A designation of PR means that both preservation and restoration are equally important.

1.1.6.3 Habitat Factor Analysis

The Habitat Factor Analysis assesses the relative impact of various stream channel attributes on a particular fish population. Key limiting habitat conditions are identified by comparing current/patient habitat conditions with optimum conditions in the historical/template baseline. This analysis illustrates the specific habitat factors that, if restored, would yield the greatest benefit to population abundance. The habitat factor analysis depicts a greater level of detail than the reach analysis in that it looks at the specific habitat factors rather than the aggregate effect of all habitat factors.

The standard EDT habitat factor output, which is NOT presented in this volume, presents the effect of habitat attributes on life stage survival for each life stage and each reach. These results are displayed in what are commonly termed “consumer report diagrams”. While this level of detail is useful for practitioners who are implementing specific recovery measures in specific reaches, it is too detailed for an effective comparison of habitat impairments across reaches in a basin. In order to expand the analysis to the population-scale, we combined all life stages within a reach and weighted the reach values according to the relative contribution of the reach to overall population abundance. The result is a chart with sized dots representing the relative degree to which habitat factors within a reach are serving to suppress population abundance. This chart can be used to determine the degree of population-scale impact of a particular habitat factor in a particular reach. Habitat factor impacts can be compared within and among reaches.

1.1.7 Integrated Watershed Assessment

The Integrated Watershed Assessment (IWA) is a GIS-based screening tool used to examine the current condition of key watershed processes that directly or indirectly influence habitat conditions affecting fish populations in the lower Columbia Region. The focus on watershed processes allows for both an understanding of likely current conditions, and prediction of future conditions based on projected trends in land use or landscape condition. Because the functionality or impairment of watershed processes and additional contributing factors are identified at local as well as watershed scales, the results of this analysis are suggestive of the general categories of habitat protection and restoration measures that could be applied in recovery planning.

While multiple watershed processes are important determinants of watershed health and instream habitat quality, the delivery and routing of sediment, water, and woody debris into and through the stream channel are viewed to be fundamental. The condition of these watershed processes can be measured by modeling sediment supply, hydrology, and riparian condition within the watershed. These three measures form the core of the IWA for the following reasons:

- They are fundamental drivers of watershed health
- Their condition can be inferred from available GIS data
- Additional natural and human-derived factors affecting these processes, readily derived from available GIS data sets, can be rated against known thresholds

The IWA is conducted at the subwatershed level, with process conditions identified as Functional (F), Moderately Impaired (M), or Impaired (I). Subwatersheds are 3,000-12,000 acre drainage areas defined as management units by the LCFRB for recovery planning purposes. A rating of F indicates that the current condition of that subwatershed process is comparable to natural conditions and is most likely providing beneficial conditions for fish habitat. A rating of M indicates that current conditions may be a source of limiting factors for fish habitat. A rating of I indicates highly degraded conditions that are most likely to be a source of limiting factors. Hydrology, sediment and riparian conditions are analyzed at the local level (i.e., within the subwatershed, not including upstream drainage area), and at the watershed level (i.e., integrating the entire drainage area upstream of each subwatershed). This information, in combination with predicted future trends of land use conditions in the watershed, can be used to prioritize actions in the context of recovery planning.

1.1.8 References

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