UMATILLA PROJECTS REVIEW

A presentation of the multiple-component
Umatilla Basin
Fisheries Restoration Program

May 1, 2007

Prepared by:

Confederated Tribes of the Umatilla Indian Reservation
and
Oregon Department of Fish and Wildlife

Prepared For:

Northwest Power and Conservation Council
and
Independent Science Review Panel

TABLE OF CONTENTS

I. INTRODUCTION

A. Background - Report Request and Purpose

This document, the Umatilla Projects Review (UPR) describes Bonneville Power Administration (BPA) funded fisheries restoration projects in the Umatilla River Basin, Oregon. The Northwest Power and Conservation Council (NPCC) and their science review team, the Independent Scientific Review Panel (ISRP) called for a UPR in their Columbia Basin Fish and Wildlife project funding recommendations for fiscal years 2007 through 2009.

Numerous Fiscal Year (FY) 2007-2009 proposed projects in the Umatilla Basin received final Independent Scientific Review Panel's (ISRP) recommendations of "Not Fundable (Qualified)" or Fundable (Qualified). The ISRP stated the following in regard to projects in the Umatilla Basin: "This complex Umatilla Initiative includes numerous individual projects, most of which are scientifically justifiable only in the larger context of the plan into which they fit. However, for whatever reason, they have been presented to ISRP as individual proposals. The cross referencing in the responses to other proposals where information may be found, is not sufficiently helpful to reviewers to make a meaningful scientific review. ... Umatilla projects are individual parts of what the NPCC has referred to as the "Umatilla Initiative". As such, none of them is a stand-alone project that can be subjected to scientific peer review on anadromous fishes in the Umatilla Basin."

Comments of the NPCC on Umatilla Basin project recommendations included the following: "Most of the coordinated production and habitat projects in the Umatilla subbasin received a "not fundable (qualified)" rating from the ISRP. The panel's recommendations did not result from the identification of technical deficiencies for each particular project; instead, the ISRP concluded that the projects in this subbasin need a thorough review of how they work together. This is a basin with a subbasin plan the ISRP approved and the projects all represent priority elements within that subbasin plan. Despite the "not fundable" aspect of the rating, the panel's explanatory comments do not indicate the ISRP recommends discontinuing or severely limiting the funding for all these projects, as much as the panel seeks a comprehensive review of the basin's activities before the next project review cycle. The Council's final project funding recommendations for these projects thus call for the project sponsors to work with the Council and others to structure an ISRP/Council review of the coordinated subbasin activities in the Umatilla at some point in the next three years."

The UPR organization includes this introduction which summarizes general ISRP concerns, program objectives and the established policy direction for fisheries management in the Umatilla Basin. The second section describes and categorizes the Umatilla fisheries restoration projects with discussion of functional and operational linkages between flow, passage, habitat, hatchery and Research, Monitoring and Evaluation (RM&E) biological and physical components. The third and final section addresses specific ISRP questions that are categorized under passage and flow, habitat, natural production, hatchery and lamprey.

B. Key Questions

The ISPR desires increased understanding of Umatilla Basin project components through development of a UPR that describes the program in a more unified way and provides clarity on linkages between program components and how these are evaluated to determine effectiveness. The following key ISRP concerns and needs are the basis for the organization of this document:

1. Explain the functional and operational linkages between the various flow, passage, habitat, hatchery, an d RM&E components of the Umatilla Basin Fisheries Restoration Program.

2. Describe how RM&E has assessed effectiveness of meeting fish restoration objectives and informed management decisions for all program components.

3. Provide a consolidated documentation of the above needs in order to establish an appropriate (basin) context for scientific review of anadromous fisheries restoration projects in the Umatilla Basin.

A tribal/state team (Confederated Tribes of the Umatilla Indian Reservation, CTUIR and Oregon Department of Fish and Wildlife, ODFW) was formed to develop a UPR which addresses the above needs as requested by the ISPR and NPCC. In initial meetings, the team noted that ISRP strongly supported and complimented the job of the project sponsors in compiling the Umatilla Subbasin Plan (identification of limiting factors and prioritizing necessary actions to address them) but then did not seem to understand the integrated aspects of the Umatilla program when reviewing individual project proposals that were called for in the subbasin plan. The team put forth the following possible reasons for the lack of ISRP understanding:

- Lack of an "integrated understanding" due to the NPCC calling for individual proposals and assigning specific project review responsibilities to various ISRP members with insufficient consistency and cross-coordination between reviewers of numerous projects within the Umatilla subbasin.
- ISRP membership changes through time and the understanding of Umatilla operations by past members may require re-education for new members.
- Referencing or citing of other related projects in the various proposals may not have been expressed clearly enough and ISRP may have not had the time or desired convenience to do the necessary "cross-referencing".
- The lack of face-to-face contact with project sponsors during FY 2007-2009 project reviews (no presentations or site tours) may have impacted understanding of specific projects and general conditions of a subbasin that calls for a suite of interconnected projects.
- The Umatilla salmon and steelhead restoration program is large and complex with many separate components that are necessary to address the current state of "over-development" of the Umatilla Basin and to achieve both fisheries and agricultural goals.

- The Umatilla program is very "artificial" in nature (maintain flows, passage, hatcheries, etc.), has high Operations and Maintenance (O&M) cost requirements, and is not a straight-forward "natural fish in natural habitat" scenario and is therefore more subject to lack of understanding and deeper review.

The lack of understanding of the Umatilla projects was thought to be a combination of all of the above reasons. Addressing these will likely require both development of the UPR and changes or improvements in how the NPCC has the ISRP conducts project reviews in the future. The UPR process was developed to help address the above stated gaps and needs.

C. Umatilla Fisheries Management Strategy and Program Objectives

To understand why the Umatilla Fisheries Restoration Program is managed the way it is, the policy direction set by the fish managers (CTUIR and ODFW) must be understood. After a near-century of dewatering of the Umatilla River and the extinction of salmon runs, the fish managers embraced a comprehensive fisheries restoration program that includes aggressive flow, passage, habitat, hatchery and RM&E components. The ultimate intent of these measures was to restore abundant fish returns while preserving the local agricultural economy. This ambitious restoration approach has been outlined in numerous Umatilla planning documents (Boyce 1986; Umatilla Comprehensive Plan, ODFW and CTUIR 1989; Umatilla Hatchery Master Plan, CTUIR and ODFW 1990; Tribal Restoration Plan, CRITFC 1996; Umatilla Subbasin Summary, CTUIR and ODFW 2001, Umatilla/Willow Subbasin Plan, CTUIR and ODFW 2004).

Current subbasin broad goals and management objectives are contained in the Management Plan section of the most recent Umatilla/Willow Subbasin Plan (CTUIR and ODFW, 2004, pages 5-3 through 5-7) and are presented in Appendix A. The broad goal topics are human use, habitat, population and RM&E. The management objectives include population and environmental status, natural production, hatchery program, flow and passage and fisheries.

Umatilla adult fish return targets have been established to provide for natural production, hatchery broodstock and harvest objectives. Salmon and steelhead adult return objectives were initially established at about 45,000 (31,000 hatchery and 13,500 natural) and have been adaptively modified down to 31,500 (19,500 hatchery and 12,000 natural) in the most recent planning documents (see Appendix A for breakdown of natural and hatchery adult return objectives by species). Fish managers have also established fish management guidelines for spring Chinook which identify disposition (broodstock, harvest, spawning escapement, etc.) and allocation of adult returns under varying total run sizes (Appendix B).

The Umatilla Fisheries Restoration Program is highly artificial with expensive operation and maintenance requirements that are necessary to accomplish fisheries objectives while minimizing the impacts to the local agricultural community. Umatilla hatchery adult return objectives are higher than natural production objectives which is consistent with a policy direction for establishing near-term tributary salmon fisheries for Indians and non-Indians. This management direction is the result of the following unique factors:

- The Umatilla Basin is extremely over-developed and water is over-appropriated. Instead of writing off Umatilla salmon, a policy decision was made to pursue an expensive solution which would keep both fisheries and agricultural interests whole.
- Because the US Government had caused the dewatering and demise of salmon runs, Congress approved funding for the flow restoration through the Bureau of Reclamation. The resulting Umatilla Basin Flow Project represented a major component necessary to implement a comprehensive and highly cost-shared fisheries restoration program.
- The Umatilla River runs through the Umatilla Indian Reservation which is a priority location for creating near-term tribal fisheries.
- Umatilla salmon runs were extinct therefore reintroduction using the hatchery tool had less restriction compared to subbasins with small remaining Endangered Species Act (ESA)-listed salmon runs.

The Umatilla Fisheries Restoration Program is one "spread-the-risk" strategy among several diversified approaches utilized by fisheries managers throughout NE Oregon. Most salmon runs are ESA-listed in this area and managers acknowledged that fishing opportunities would likely not be occurring in the near term where runs are slowly rebuilding. Examples of diverse programs in this area include the John Day River where managers have supported no hatchery intervention, the Grande Ronde Subbasin where safety net captive broodstock hatchery programs are driven by genetic conservation and the Umatilla and Walla Walla extinction examples where the hatchery tool is being used more aggressively for reintroduction and development of near-term fisheries without impacting ESA-listed species.

If reviewers looked at the Umatilla management strategy without awareness that it was a part of a regional diversified approach, it could be viewed as questionably artificial and expensive. Indeed, managers agree that it would not be practical to implement a Umatilla type program everywhere. The Umatilla has provided a unique opportunity to partner with the community and aggressively turn a no-water and no-fish situation into a win-win treaty and sport fishing opportunity without impacting the local agricultural economy. In addition, the program has provided a unique opportunity to reestablish natural spawning populations as well as restore the natural aquatic ecosystem and gain valuable insight through RM&E projects.

D. CTUIR "First Foods" Mission

The Confederated Tribes of the Umatilla Indian Reservation (CTUIR) Department of Natural Resources has organized management functions of cultural and natural resources through a focus on traditionally gathered resources identified as "First Foods". The cultural recognition of the First Foods order is demonstrated in the ritualistic serving order of the native foods in the CTUIR's longhouse, the center of community culture. The physical organization of these resources (First Foods) is manifest in the active physical and ecological processes that connect hill slope and floodplain landscapes. Traditional culture and contemporary science reinforce the First Foods paradigm. Thus explicitly representing the relevance of the First Foods order in planning and project efforts is an important step to ensure that the appropriate products are returned to the Tribal community. Our challenge is to create effective management plans and actions relative to the First foods organizational structure. One could think of the First Foods as a performance measure related to the health of the CTUIR community. At a minimum, the

CTUIR needs to ensure the First Foods are available to serve to the community while long-term goals are developed to include ecologically related foods to create a diverse table setting.

E. Umatilla Projects Review

In consultation with the NPCC, the UPR team identified a strategy with three components for accomplishing a comprehensive Umatilla Projects Review:

- A UPR document that addresses ISRP concerns by clarifying history, operational integration and monitoring and evaluation of various project components.
- Project presentations (by project grouping) by CTUIR and ODFW.
- Project tour by project sponsors in the subbasin.

The primary purpose of this document is to provide Umatilla Fisheries Program background and clarification of four basic functional project groupings (flow restoration/fish passage, habitat enhancement, artificial propagation and RM&E) that will be sufficient to answer ISPR questions.

Since the ISRP did not tour subbasins during the FY 2007-2009 proposal review process, an on-site presentation and tour for the ISRP is planned as a critical part of the UPR process. Project-by-project presentations are not anticipated but rather functional groupings of projects that would help to clarify project integration concerns. Field tours of selected projects would also be scheduled to enhance the ISRP's understanding of the local conditions and project operations. The presentations

II. FISHERIES RESTORATION PROGRAM

A. History and Accomplishments

In 1806, Lewis and Clark reported the presence of a large village at the mouth of the Umatilla River where 700 Indians were anxiously awaiting the arrival of spring Chinook salmon. This was one of the largest villages seen between The Dalles area and the mouth of the Snake River. The largest run of Chinook on record was in 1914 when Indians and non-Indians caught "thousands upon thousands of salmon from spring to fall" at the site of Three Mile Falls Dam (TMD) and Hermiston Power and Light dams (Van Cleave and Ting 1960). These authors report salmon and steelhead runs declined following construction of these dams. Several additional irrigation diversion dams were constructed on the lower Umatilla River in the early 1900's (Figure 1) resulting in further structural and low-flow impacts to fish migration. By the 1920's, salmon had virtually gone extinct. Although depressed, the native steelhead run was able to persist due to the long adult migration period that did not conflict as much with irrigation season.

The Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and the Oregon Department of Fish and Wildlife (ODFW) began working together in the early 1980's to develop Umatilla River fish restoration plans and acquire funding. Through work with various agencies and stakeholders, a cooperative and comprehensive Umatilla Fisheries Restoration Program was

developed. The approach sought to restore spring and fall Chinook and coho salmon and enhance summer steelhead by addressing the problems that lead to the demise of these species. ***A major challenge was to identify a win-win solution which would both restore salmon and preserve local agricultural interests.*** This was accomplished through cooperative planning, resulting in unified support and effective leveraging for financial resources necessary to implement actions. Projects ranged from the Umatilla River mouth to headwaters and included instream flow enhancement, structural passage improvements, hatchery actions, tributary habitat enhancement and monitoring and evaluation. These actions are discussed in the following sections.

General accomplishments from the Umatilla Fisheries Restoration Program have been restored instream flows, new fish ladders and screens at irrigation diversion dams and canals, improved instream and riparian habitat, revitalized natural salmon and lamprey production and annual salmon and steelhead fisheries for both Indian and non-Indians. An overview of fish returns pre and post restoration program are presented in Table 1. ***The presence of salmon and lamprey has helped to fill a near-century gap in the Umatilla aquatic ecosystem and lives of native people who depend on water and fish to sustain a traditional way of life***.

Table 1. Umatilla River Salmon and Steelhead Annual Returns Pre and Post Restoration Program

Program	Spring Chinook	Fall Chinook	Coho	Steelhead	Totals
Pre	0	0	0	1,000 – 3,000	1,000 – 3,000
Current 2000-06	2,514 – 5,885	1,125 – 4,127	5,115 – 22,334	1,977 – 5,663	12,648 – 36,392
Goal	8,000	12,000	6,000	5,500	31,500

B. Participants and Forums

The Confederated Tribes of the Umatilla Indian Reservation was formally established and adopted a constitution in 1949. Since that time, CTUIR has shared management responsibility for fish and wildlife in the Umatilla Subbasin with the Oregon Department of Fish and Wildlife.

Local fish management plans are developed within the framework of regional management of anadromous fish and legal mandates associated with the Power Act, *U.S. v. Oregon* court decision on tribal treaty rights, and the Endangered Species Act (ESA). A number of regional fish management entities, forums, and legal mandates affect the Umatilla subbasin salmon and steelhead programs. The Columbia Basin Fish and Wildlife Authority (CBFWA) is made up of Columbia Basin fish and wildlife agencies (state and federal) and the Columbia Basin tribes. CBFWA's intent is to coordinate management among the various agencies and agree on goals, objectives, and strategies for restoring fish and wildlife in the Columbia Basin. The Columbia River Fish Management Plan (CRFMP) is an agreement among the tribal, state, and federal parties with jurisdiction over Pacific salmon originating in the Columbia Basin that provides procedures whereby the parties co-manage anadromous fish harvest, production, and habitat (CRITFC 1996). The National Marine Fisheries Service (NMFS) has ESA administration and

enforcement authority for anadromous fish. NMFS defines regulations and guidelines for activities that affect listed species in their Biological Opinion documents, and develops and enforces recovery plans for listed species. Specific artificial propagation actions such as smolt production and release locations can be included in *U.S. v. Oregon* agreements, but some local decision making authority exists.

Implementation of actions within the subbasin are carried out by a number of partners. CTUIR, ODFW, Bureau of Reclamation (BOR), Oregon Water Resources Department (OWRD) and four irrigation districts along the Lower Umatilla River are the primary sponsors. To coordinate actions, share results, address specific issues/problems and implement adaptive management, several forums are on-going. The Umatilla Management, Monitoring and Evaluation Oversight Committee is made up of biologists and fishery managers from CTUIR, ODFW, BOR, US Fish and Wildlife Service (USFWS) and NMFS. Its purpose is to create ongoing information sharing and discussion among both managers and biologists. This form is responsible for making adaptive management decisions of fishery related issues and develops the Annual Operation Plan for hatchery operations and aspects of fish passage operations. The River Operations Group includes irrigation districts, ODFW, CTUIR, BOR, OWRD, BPA, USFWS, and NMFS. This group meets monthly to share information and discuss issues pertaining to the implementation of the water exchange project, irrigation operations, and lower Umatilla River fish passage facilities. The Umatilla Basin Project Oversight Committee is a policy body represented by BOR, OWRD, CTUIR, ODFW, BPA, Stanfield , Hermiston, Westland, and West Extension Irrigation Districts (SID, HID, WID and WEID respectively). This group is a forum to discuss policy related issues pertaining to the water exchange project. The existence of these groups was established in the development of the Umatilla Basin Project. Their roles and responsibilities were codified and re-enforced in the Umatilla Hatchery Master Plan.

C. Functional Improvements

1. Instream Flow Enhancement

Throughout much of the 20th century, irrigation diversions dewatered large portions of the lower Umatilla River during juvenile and adult salmonid migration seasons. Dewatering of the lower Umatilla River was a primary factor in the extinction of several species of indigenous salmonids. Trap and haul of both adults and juveniles around the dewatered portion of the river is an element initially built into the program to address passage while flow restoration actions were being developed and implemented. As a result of the flow restoration actions that have been implemented to date, the need for trap and haul operations is minimal. Trap and haul operations are carried out by the Umatilla Fish Passage Operations project.

The need to improve fish passage in the lower river was amplified by the NPPC's 1987 authorization for constructing Umatilla Hatchery to increase adult steelhead and salmon returns to the Umatilla River. In 1988, congress authorized implementation of the Umatilla Basin Project (BOR 1988), a program to enhance flow for fish passage and rearing in the lower Umatilla River. Flow enhancement in the lower Umatilla River is achieved by pumping Columbia River water into irrigation canals in exchange for leaving live flow in the Umatilla

River or rights to water in an irrigation storage reservoir (McKay Reservoir). Locations of irrigation canals, pumps and delivery systems for the "water exchange" are shown in Figure 1.

Current flow restoration provided by Phases I and II is inadequate to meet all fish restoration needs. The Umatilla Basin Project established target flows (Table 2) to provide passage for adult and juvenile salmonids. Water exchange and storage capability produced by the project are not adequate to meet the designed target flows. Thus, the project is currently managed to optimize fishery benefits. Priority order for use of stored water is: 1) Spring – June 30 for adult and juvenile migration; 2) October – mid November 15 for adult homing and migration; and 3) July - September for juvenile rearing. The fishery managers have employed adaptive management as the Basin Project has been implemented, adjusting the timing of when stored water is used to augment flow and increasing the duration of the Phase I exchange.

Table 2. Target flows established under the Umatilla Basin Project.

Time Period	Flow (cubic feet per second)
August 15 – September 30	250
October 1 – November 15	300
November 16 – June 30	250
July 1 – August 15	75

The first priority of the flow enhancement program (Phase I) was to provide adult fish passage to TMD where adult returns could be collected for brood or transported upriver to spawn if flows were inadequate. Phase I, completed in 1993, pumps water into the (WEID) canal in exchange for not diverting water from the Umatilla River. WEID's normal diversion period is mid March through the end of October. The water exchange occurs throughout the use period.

The second stage of the project (Phase II) provided water exchange with the Hermiston Irrigation District (U.S. Feed Canal), and Stanfield Irrigation District (Furnish Canal). Phase II was completed in stages from 1993-1999. A conceptual model of the flow exchange project in relation to typical timing of smolt and adult migrations and hatchery-reared smolt releases is provided in Figure 2.

The U.S. Feed Canal diverts water from the Umatilla River from November through April to fill Cold Spring Reservoir. Water is then released from Cold Springs Reservoir by HID to supply irrigation water to its patrons throughout the summer. This water exchange is operated to maintain the target flows established by the Umatilla Basin Project. Historically, Feed Canal is unique because it periodically dewatered the river during winter low flows prior to the onset of the irrigation season. Today when target flows cannot be met by live flow, then diversion into the U.S Feed Canal is reduced or terminated until flow in the river becomes available to meet the target flow and a surplus is available in sufficient quantity for diversion to resume. During the diversion season, HID accrues credits on a "bucket for bucket" basis for all water that is exchanged. After the diversion season is complete, the BOR then pumps up to the credited amount of water from the Columbia River into Cold Springs Reservoir or a lesser amount that would have been needed to meet their water right. Unused credits reduce pumping costs and are not carried over to a later time.

The Stanfield Irrigation District diverts water from the Umatilla River to serve its patrons from April through October. Historically, some of this water was live flow from the Umatilla River, but most was water stored upstream in McKay Reservoir, under contract with the BOR. As with the Hermiston Irrigation District (HID) exchange, the Stanfield Irrigation District (SID) exchange is operated to maintain the Umatilla Basin Project target flows. When live flows in the river drop below the target, then SID is delivered water from the Columbia River, and diversions of live flow are curtailed. In addition, a quantity of water equivalent to SID's contracted storage in McKay Reservoir is pumped to the Furnish canal. In exchange, the contracted stored water in McKay Reservoir is used to augment flows in the Umatilla River for fish passage and rearing at the discretion of the fishery managers and BOR. This equates to 38% of the water stored in McKay Reservoir (71,534 acre-feet). The stored water is typically released in late spring and early fall when the combined actions of the Umatilla Basin Project are not adequate to meet target flows.

Even though the Umatilla Basin Project is not currently adequate to meet the target flows established, it has provided the significant benefit of almost entirely reducing the need to trap and transport steelhead and salmon (Figures 3 and 4). However, water exchange capabilities are currently inadequate to provide significant summer rearing or homing benefits. A third phase of the project (Phase III) is currently being pursued by CTUIR and the Westland Irrigation District. Phase III water exchange with Westland Canal could provide additional live flow in the Umatilla River during spring and summer and more importantly an additional 45% of the water stored in McKay Reservoir would be available. Current amounts of stored water have generally been adequate to meet adult and juvenile migration needs in the spring and early-summer (priority #1), partially meet adult homing and migration needs in the late-summer and fall (priority #2), but inadequate to meet juvenile rearing needs in the summer (priority #3).

The Umatilla Fish Passage Operations Project (No. 198802200) is a joint project between CTUIR and ODFW that provides critical oversight of Umatilla Basin Project implementation. While some aspects of the project are routine in nature, such as management of exchange activities, other aspects of the project (flow augmentation from McKay Reservoir) require adaptation to flow conditions that vary year to year in order to optimize passage and rearing conditions. CTUIR and ODFW biologists work closely with BOR and the Oregon Water Resources Department (OWRD) to ensure that the Umatilla Basin Project is operated according to operational plans and in consideration of varying environmental conditions. Without this oversight, the adaptive management paradigm could not be implemented.

Flow restoration needs in the upper Umatilla Subbasin are not addressed by the water exchange project. Little flow restoration has been established to address problems in the upper Umatilla and tributary streams. Low flow caused by withdrawals and watershed-scale degradation limits rearing habitat and impedes passage in many tributaries. Oregon Water Trust currently negotiates voluntary donations, leases, or permanent purchases of water rights in areas expected to provide the greatest benefit to fish and water quality. ODFW and Oregon Water Resources Department (OWRD) have established priorities for flow restoration as part of the Oregon Plan for Salmon and Watersheds (Measure IV.A.8). These priorities will be used by the Oregon Watershed Enhancement Board as one criterion for determining statewide funding priority of

fish restoration projects. Local watershed councils and other entities may also use these priorities in their process for allocating project funds.

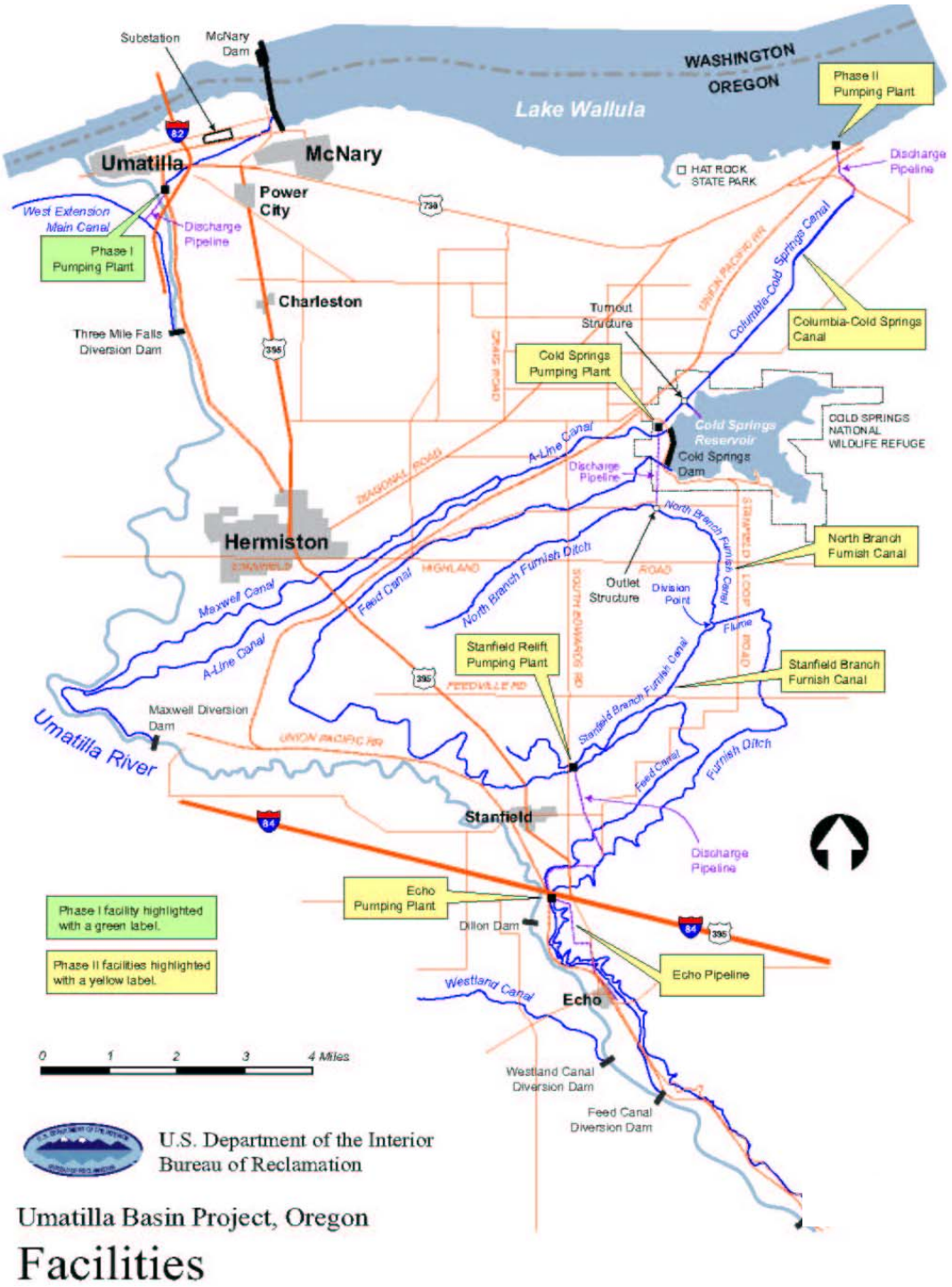


Figure 1. Location of irrigation canals and dams in the lower Umatilla mainstem, and Phase I and Phase II water exchange pump stations and delivery systems for pumping Columbia River water into the canals.

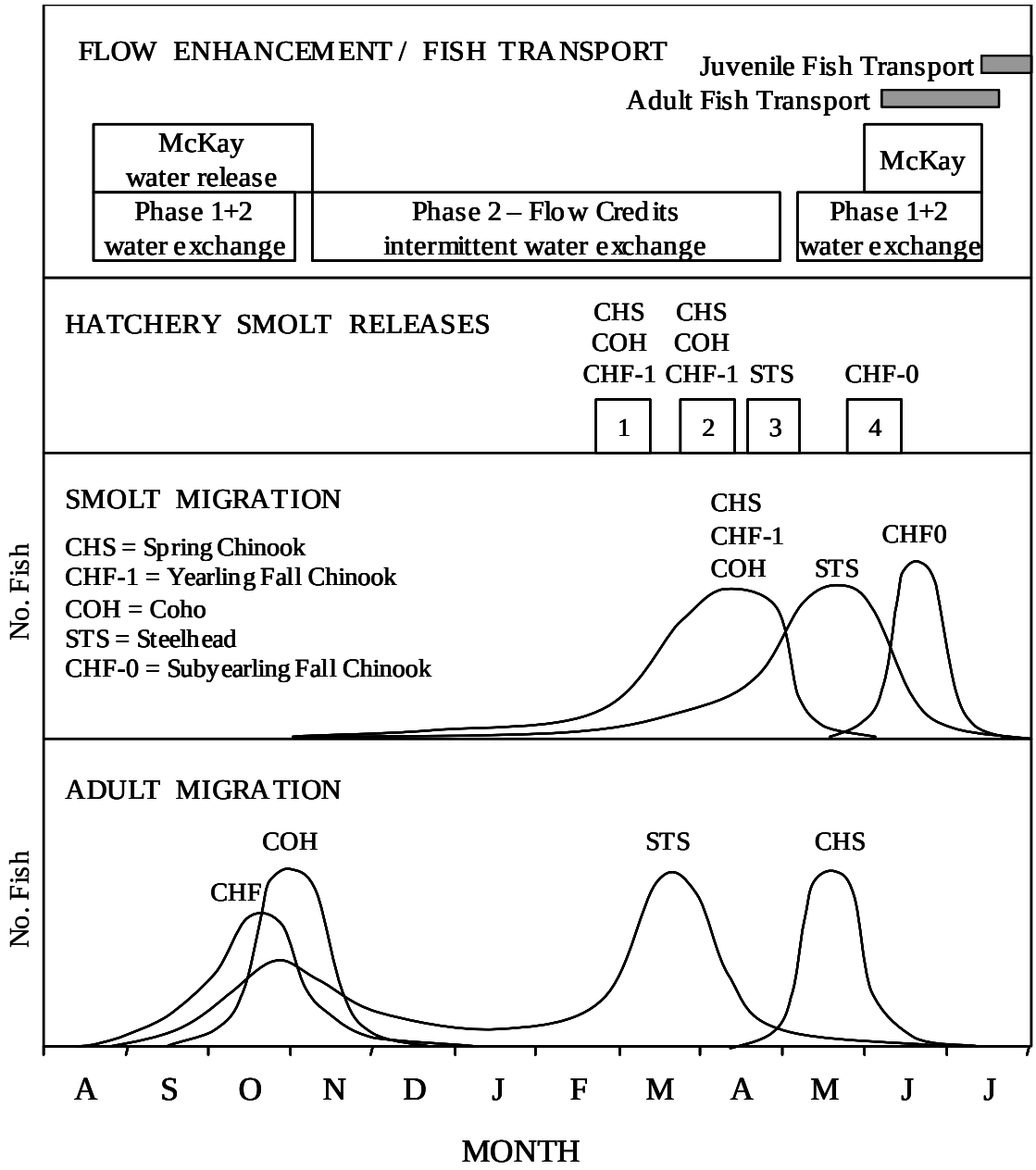


Figure 2. Generalized illustration of the timing of flow enhancement, fish transport, hatchery-reared smolt releases, and smolt and adult steelhead and salmon migrations in the Umatilla Subbasin. Flow enhancement involves exchange of live Umatilla River flow for Columbia River water pumped into irrigation canals in the lower Umatilla River (river miles 3-35) and release of water stored in McKay Reservoir for fisheries benefits (river mile 52). Fish transported through the lower river are primarily the tail ends of the adult spring Chinook salmon and juvenile subyearling fall Chinook salmon migrations. Hatchery smolts are released from acclimation facilities or direct stream-released at sites located between river miles 48.5 - 79.5. Smolt and adult migration timing is to TMD , and will vary somewhat each year depending on environmental conditions. In particular, return timing of adult steelhead may be shifted towards spring during low flow years.

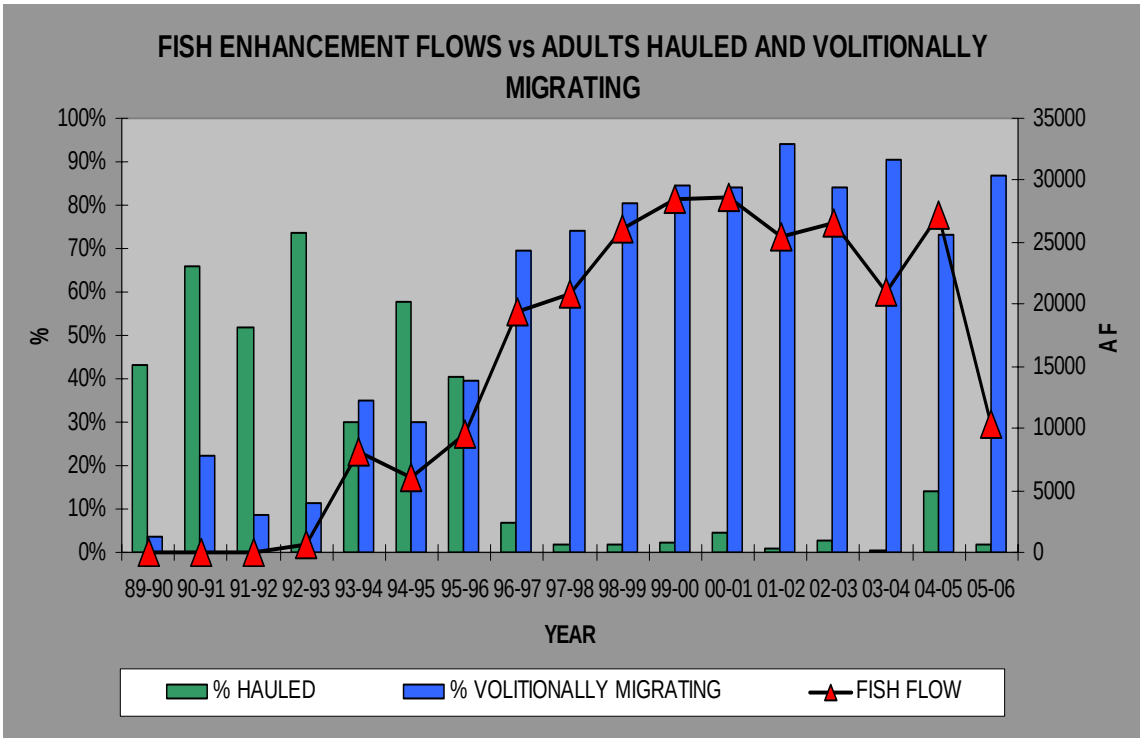


Figure 3. Percent of adult returns volitionally migrating and trap-and-hauled in relation to acre-ft of supplemental water that Phase I and II flow restoration provided for in-stream migration.

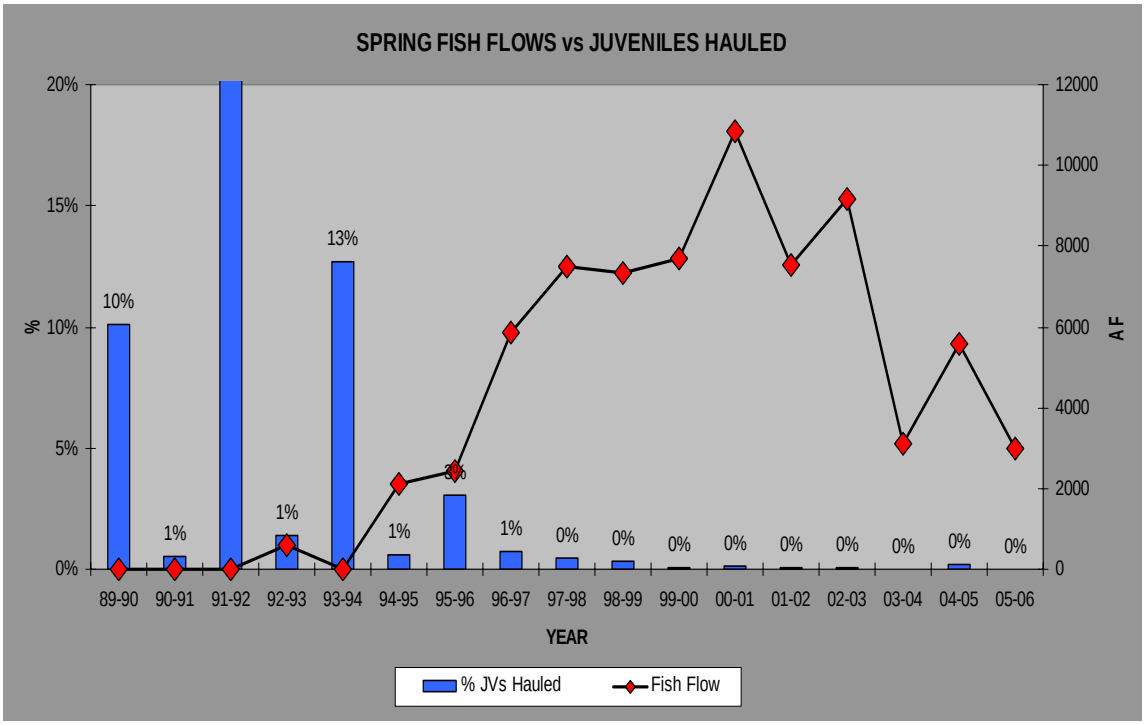


Figure 4. The percent of juvenile salmonid out-migrants trapped and hauled in relation to acre-ft of supplemental water that Phase I and II flow restoration provided for in-stream migration.

2. Passage Improvement

Steelhead and salmon still encounter passage impediments while migrating through the mainstem Umatilla River and tributaries in the Umatilla Subbasin. Many passage improvement projects have been implemented in the subbasin since the mid-1980's. Passage restoration activities were first focused on the most severe problems in the lower mainstem Umatilla River. The river channel was deepened through shallow bedrock reaches below TMD in 1984. New fish ladders and water diversion screening were installed at the WEID, HID, Westland Irrigation District (WID) and Stanfield Irrigation District diversions from 1988 to 1994. Effectiveness of these passage improvements has been evaluated. Juvenile passage evaluation was conducted by ODFW (Knapp and Ward 1990, Knapp 1992, Cameron and Knapp 1993, Walters et al. 1994, Cameron et al. 1994, 1995, 1997), adult passage evaluation was conducted by CTUIR (Kutchins 1990, Kissner 1992, 1993, Volkman 1994, 1995, Contor et al. 1996, 1997), and Nigro and Ward (1986) evaluated channel modification below TMD .

In order for the large passage facilities in the lower Umatilla River to provide optimal passage, these facilities must be maintained and operated according to criteria or adapted for special situations. To accomplish this, the Umatilla Passage O&M (No. 198343600) and Umatilla Fish Passage Operations (N0. 198802200) were created. These projects were designed in such a way so that those that operate the diversion facilities and CTUIR and ODFW biologists must work together on a daily basis. This model was chosen by BPA as the best means to facilitate cooperation among these groups that have differing interests. The Westland Irrigation District implements the Umatilla Passage O&M One of the purposes of the Umatilla Fish Passage Operations project is to provide biological oversight of how these facilities are operated and maintained on a daily basis to ensure optimal passage conditions exist. River conditions affect passage at these facilities (i.e. flow, debris load, and sediment/bedload-transport/deposition) and change on a regular basis. These dynamics require changes in how the facilities are operated and changes in maintenance priorities. While irrigation district employees are qualified to maintain the facilities, they are not qualified to make decisions regarding how to operate the facilities in an optimal biological manner for fish. Thus, the Fish Passage Operations Project provides guidance and instruction with regard to facility operation.

Passage impediments that have not been fully addressed are now primarily located in tributary streams. Table 3 lists the location, severity, and recommended restoration action for known passage impediments.

Table 3. Known passage impediments in the mainstem Umatilla River and tributaries in the Umatilla Subbasin.

Stream	RM[a]	Barrier Type	Composition	Height (m)	Degree	Plan
Umatilla River	1.5	Modified Channel	Concrete	0.7	Partial	Modify
Umatilla River	2.4	Irrigation Dam	Concrete	1.0	Partial	Modify
Umatilla River	28.8	Feed Canal Irrigation Dam	Concrete	1.5	Partial	Modify / Remove
Umatilla River	49.0	Irrigation Dam	Unknown	1.2	Unknown	Remove
Jungle/Windy Spring	0.1	Culvert	Steel	0.15	Partial	Modify
McKay Creek	6.0	Earthen Dam	Earth/Concrete	40	Complete	Leave
Butter Creek	7.9	Flash Boards	Wood	2.3	Complete	Modify
Butter Creek	27.2	Irrigation Dam	Concrete	1.4	Complete	Modify
Butter Creek	43.0	Irrigation Dam	Concrete	1.2	Complete	Modify
Johnson Creek	0.3	Culvert	Wood	0.8	Partial	Modify
Stewart Creek	0.6	Bridge	Concrete	0.4	Partial	Modify
Birch Creek	0.5	Pipe Casing	Concrete	1.4	Partial	Modify
Birch Creek	5.0	Irrigation Dam	Concrete	1.2	Partial	Modify/ Remove
Birch Creek	10.0	Irrigation Dam	Concrete	1.0	Partial	Modify
Birch Creek	15.0	Irrigation Dam	Concrete	1.0	Partial	Remove/ Modify
W. Birch Creek	3.8	Bridge	Concrete	1.2	Partial	Modify
W. Birch Creek	3.5	Irrigation Dam	Concrete	2.1	Partial	Modify
W. Birch Creek	5.5	Irrigation Dam	Concrete	1.4	Partial	Modify
W. Birch Creek	8.5	Irrigation Dam	Concrete	Unknown	Partial	Modify/ Remove
W. Birch Creek	9.0	Irrigation Dam	Concrete	Unknown	Partial	Modify/ Remove
W. Birch Creek	?	Culvert	Steel	Unknown	Unknown	Unknown
E. Birch Creek	9.0	Irrigation Dam	Concrete	0.8	Partial	Modify/ Remove
Stewart Creek	0.6	Bridge	Concrete	0.4	Partial	Modify
Wildhorse Creek	0.1	Irrigation Dam	Concrete	0.7	Partial	Modify
Wildhorse Creek	18.8	Road Bridge	Concrete	1.0	Partial	Modify
Greasewood Creek	0.4	Irrigated Dam	Concrete	0.6	Partial	Modify
Mission Creek	0.9	Channel Shift	Bedrock	0.5	Partial	Modify
Mission Creek	3.3	Bridge/Culvert	Steel	0.7	Partial	Modify
Coonskin Creek	0.3	Road Bridge	Concrete	0.5	Partial	Modify
Coonskin Creek	0.9	Water Pipe	Concrete	1.1	Partial	Modify
Whitman Springs	0.1	Culvert	Steel	0.5	Complete	Modify
Red Elk Canyon Creek	0.2	Culvert	Steel	0.8	Partial	Modify
Tributary at Minthorn effluent	0.1	Culvert	Steel	0.5	Partial	Modify
Trib. at RM 1.5 of SF Umatilla River	0.1	Culvert	Steel	0.5	Complete	Modify
Camp Creek	.25	Irrigation Dam	Concrete	1.3	Partial	Remove
Trib. at Umatilla River RM 81.2	0.1	Culvert	Steel	0.6	Partial	Modify
Twomile Creek	1.25	Culvert	Steel	Unknown	Unknown	Modify

[a] *RM = river mile.*

3. Habitat Enhancement

Salmonid habitat in the Umatilla Subbasin has been considerably degraded over the last century. Extensive vegetation removal and disturbance associated with urban development, cultivation, forestry, transportation corridors, flood control and navigation has occurred and continues to occur in the subbasin. Approximately 70% of the Umatilla River has been levied or channelized and 70% of

all Umatilla tributaries are in need of riparian improvement. The result is an aquatic landscape which suffers from inadequate stream flow, excessive temperatures, structural impediments, inadequate riparian corridors, simplified and reduced instream habitat, and excessive erosion (e.g., Shaw and Sexton 2000; CTUIR 1996; Crabtree 1996; CTUIR ODFW 1990, and CTUIR and ODFW 2004). These factors have jeopardized stronghold habitats, reduced the number of adult fish returning to spawn, and have contributed to decreased smolt-to-adult returns for anadromous species. Despite these problems, limited high quality salmonid habitat continues to persist in the subbasin. Habitat conditions generally follow an elevation gradient, with higher quality habitat in the upper portion of the subbasin, while lowland portions contain the most degraded habitat. The Umatilla National Forest (USFS 2001) recommended that the lower North Fork of the Umatilla, Coyote Creek, upper North Fork of the Umatilla, upper North Fork of Meacham Creek, Pot Creek, Ryan Creek and Bear Creek be managed as salmonid refugia because of their high quality habitat.

Habitat restoration activities in the Umatilla Subbasin have been conducted by a variety of local, state, and federal agencies. The CTUIR, ODFW, and U.S Forest Service (USFS) are the primary sponsors of BPA funded habitat restoration projects in the subbasin. In general, lead responsibilities for restoration activity is CTUIR on the reservation, USFS on the National Forest, ODFW in Birch Creek, and the Soil and Water Conservation District (SWCD) in Butter Creek. The USFS has completed BPA funded restoration actions in the subbasin. Habitat restoration actions by these entities have included tributary passage remediation, channel reconstruction, bank stabilization, instream structures, riparian fencing and planting, land acquisition, and off-stream livestock watering. Table 4 summarizes these habitat restoration actions and the number of stream miles affected.

The ODFW and CTUIR have recently collaborated to develop a five year implementation plan. Using the 2004 Umatilla\Willow Subbasin Plan as the basis (ODFW and CTUIR 2004). The Subbasin Plan is a comprehensive document consisting of three main components: the Assessment, the Inventory, and the Management Plan. The Subbasin Plan describes, in detail, the limiting factors to aquatic resources documented within the Umatilla Subbasin, resulting from agriculture, forestry practices, livestock grazing, transportation corridors and urbanization. The wide variety of limiting factors (including reduced instream flow; increased water temperatures; loss of riparian vegetation and function; erosion and sedimentation; and stream channelization), the severity of their impacts and the broad geographic extent of their effects, reveal the need for continued Habitat Improvement efforts (protection and restoration) on the part of both the ODFW and CTUIR Programs. Most recently a comprehensive suite of prioritized tributary habitat actions that address the key threats and primary limiting factors was completed as part of the Recovery Plan for Oregon's Mid-Columbia River Steelhead

This *Five-Year Action Plan for the Development and Maintenance of Habitat Improvement Projects in the Umatilla Subbasin: 2006-2010* (Five-Year Plan), is designed to act as the logical extension of the Subbasin Plan, by helping to advance recommendations outlined in the Management Plan through the development of on-the-ground Habitat Improvement projects.

As part of this plan, the two BPA funded habitat projects in the basin (ODFW – 198710002, CTUIR – 19871001) have delineated areas where each project is to develop and implement projects (Figure 5). The plan also describes the limiting factors for each area as identified by

Ecosystem Diagnostics and Treatment (EDT) modeling and the appropriate management strategies for correcting these, as identified in the Subbasin Plan.

Table 4. Summary of habitat restoration projects conducted in the Umatilla Subbasin since 1980.

Project location	Project length	Project description[a]	Implementing agency[b]
Lower Meacham Creek & tributaries	4.5 miles	CR, BS, IS, RF, RSP	CTUIR
Upper Umatilla River	3.2 miles	BS, IS, RF, RSP	CTUIR
Boston Canyon Creek	0.3 miles	RF, RSP, IS	CTUIR
Wildhorse Creek	2.0 miles	IS, RF, RSP	CTUIR
Greasewood Creek	1.5 miles	IS, RF, RSP	CTUIR
West Fork of Greasewood Creek	0.3 miles	RF, RSP	CTUIR
Spring Hollow Creek	0.6 miles	IS, RF, RSP	CTUIR
Mission Creek	0.4 miles	RF, RSP	CTUIR
Buckaroo Creek	1.6 miles	RF, RSP	CTUIR
Squaw Creek	4.0 miles	RF, LA	CTUIR
McKay Creek	0.6 miles	RF, RSP	CTUIR
Lower Umatilla River	0.2 miles	BS, RSP	CTUIR
Butter Creek	27 miles	BS, RF, RSP, OSW	SWCD
Birch Creek	6.0 miles	CR, BS, IS, RF, RSP, PI	ODFW
East Birch Creek	2.8 miles	CR, BS, IS, RF, RSP	ODFW
Upper Meacham Creek	2.2 miles	RF, RSP, IS	ODFW
Upper Umatilla River	3.0 miles	BS, IS, RSP	ODFW
South Fork Umatilla River	3.5 miles	IS, CR, BS	USFS
Thomas Creek	2.5 miles	IS, BS	USFS
Spring Creek	6.6 miles	CR, BS, RSP	USFS
Meacham Creek	1.0 miles	IS	USFS
Upper Umatilla River	1.0 miles	IS, BS	USFS
Pearson Creek	3.0 miles	CR, BS	USFS
TOTAL RESTORED LENGTH	78 miles		

[a] *CR = channel reconstruction, BS = bank stabilization, IS = instream structures, RF = riparian fencing, RSP = riparian seeding and planting, PI = passage improvements, LA land acquisition, OSW = off stream watering.*

[b] *CTUIR = Confederated Tribes of the Umatilla Indian Reservation, SWCD = Soil and Water Conservation District, ODFW = Oregon Department Fish and Wildlife, USFS = United States Forest Service.*

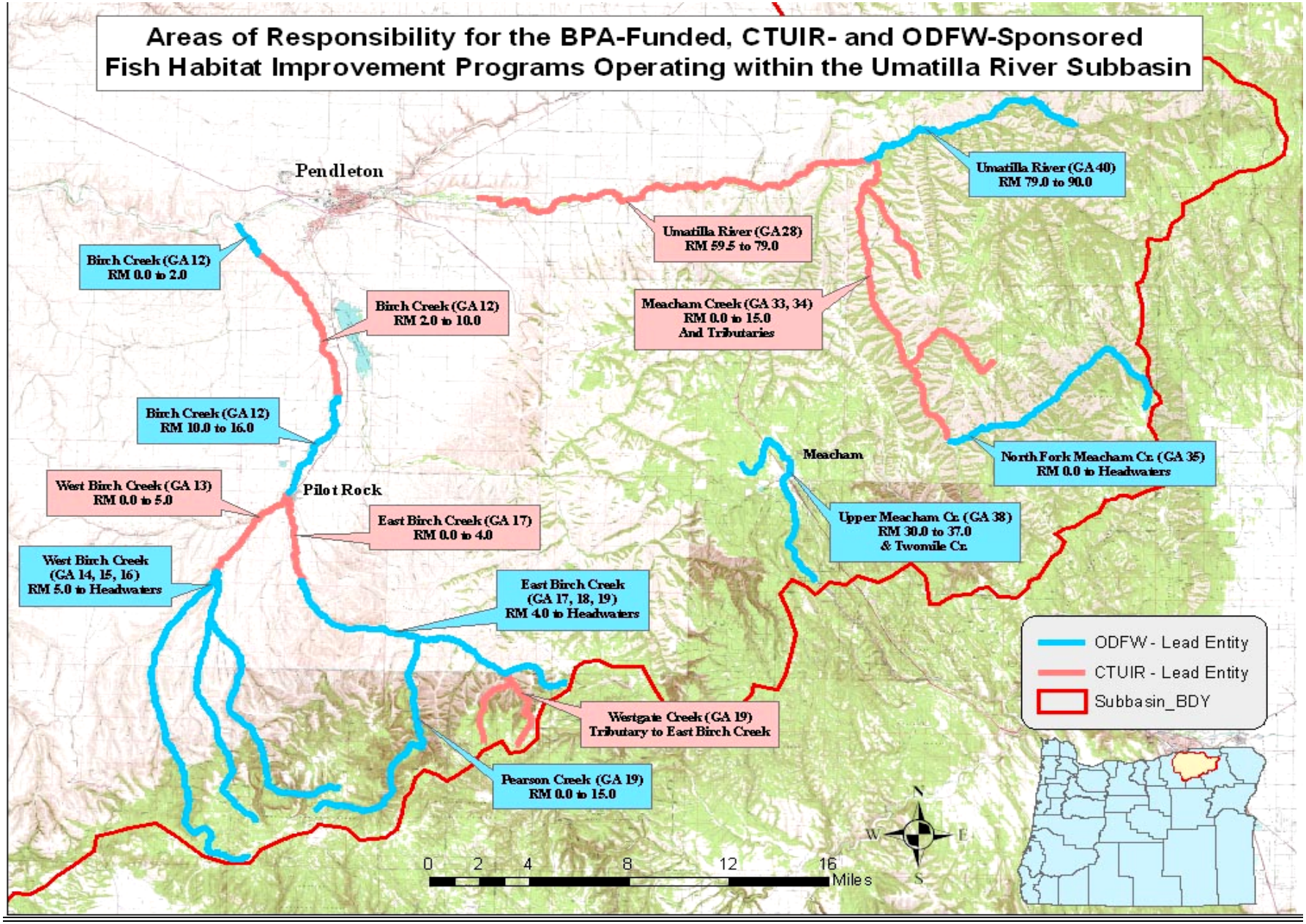


Figure 5. Areas of responsibility for the BPA funded, CTUIR and ODFW sponsored fish habitat improvement projects operating the Umatilla Subbasin.

4. Hatchery Components

There are three O&M projects which comprise the hatchery component of the Umatilla Subbasin Fish Restoration Program; Umatilla Hatchery Operation and Maintenance and Fish Liberations Project (No. 198903500e) which funds operation of the primary production facility for the basin and juvenile transportation, Umatilla Hatchery Satellite Facilities Operation and Maintenance Project (No. 198343500) which operates the satellite acclimation and broodstock facilities, and Umatilla Fish Passage Operations Project (No. 198802200) which provides for collection and transport of broodstock.

Artificial production within the Umatilla Subbasin includes summer steelhead, spring and fall Chinook salmon, and coho salmon programs. Umatilla Hatchery, constructed and operated under the Fish and Wildlife Program by ODFW, is the central production facility for the Umatilla Subbasin Fish Restoration Program. It is located on the Columbia River near the town of Irrigon, Oregon.

The Umatilla Hatchery was designed with both oxygen supplemented (Michigan) and standard (Oregon) raceways to evaluate newly emerging oxygen supplementation technology (CTUIR and ODFW 1990, Westers et al. 1986, Severson et al. 1986, Gowan 1986). The relatively warm well water supply for the hatchery also provided an opportunity to evaluate accelerated growth rearing profiles for production of subyearling spring- and fall-released spring Chinook salmon. These evaluations have been completed and the hatchery is currently managed as a production facility. The accelerated growth rearing profiles were unsuccessful, and most production is now reared in Michigan raceways to maximize efficiency of water use. Limited water supply has reduced fish production capabilities below the anticipated 165,000 pounds. Current production at the facility is 89,000 lbs and the hatchery produces summer steelhead, spring Chinook salmon, and subyearling fall Chinook salmon.

Other facilities that produce smolts for the Umatilla River include Bonneville Hatchery, which produces yearling fall Chinook salmon, and Cascade Hatchery and Lower Herman Creek Ponds, which produce coho salmon. The summer steelhead, spring Chinook salmon, and subyearling fall Chinook salmon programs are funded by BPA as part of the Northwest Power and Conservation Council's Fish and Wildlife Program. The yearling fall Chinook salmon program is funded under the U. S. Army Corps of Engineers John Day Mitigation Program, and the coho are produced under the Mitchell Act.

In addition to the juvenile release programs, an adult fall Chinook salmon-outplanting program was initiated in 1996. Surplus Upriver Bright stock from Priest Rapids and Ringold Springs hatcheries are released into the mid-Umatilla River (river mile, RM 37 or RM 56) to increase numbers of spawning adults for natural production. The operational goal of the program is to release 1,000 adults annually. Actual releases have ranged from 200 to 970 (Table 5). This activity is funded under the Fish Passage Operations project.

Table 5. Fall Chinook salmon adult outplants released into the Umatilla River (river mile 37 or 56) to supplement natural spawning, 1996-2003.

Year	Number of adults released
1996	708
1997	940
1998	200
1999	891
2000	471
2001	943
2002	980
2003	737
2004	612
2005	0
2006	0

Another integral part of the artificial production program includes juvenile acclimation and adult holding and spawning satellite facilities (Figure 6). These facilities are all operated by CTUIR. There are five acclimation facilities in the subbasin; Bonifer Pond (RM 81), Minthorn Springs (RM 64), Imeques C-mem-ini-kem (RM 80), Thornhollow (RM 74), and Pendleton (RM 56). The first acclimation facility (Bonifer) was constructed and began operations in 1983. With the completion of the Pendleton facility in 2000, most hatchery production groups released into the subbasin are now acclimated.

Smolts transferred to acclimation sites are reared for approximately three weeks, then allowed to volitionally release for one week before being forced out of the facility. There are also three adult holding and spawning facilities. Summer steelhead are held and spawned at Minthorn, fall Chinook salmon at TMD , and spring Chinook salmon at South Fork Walla Walla. The Umatilla Subbasin Hatchery Program is summarized in Table 6.

The Umatilla Fish Passage Operations project is responsible for in-basin collection and transport of broodstock. Currently summer steelhead and fall and spring Chinook are collected for brood at TMD and transferred to their respective holding facilities. Broodstock are collected across a representative cross-section of the run based on run timing over the most recent five year period. Summer steelhead brood are primarily natural adults while the Chinook broodstock are primarily comprised of hatchery adults but also incorporate natural fish.

All steelhead and Chinook salmon with a unique rearing or release strategy in the hatchery program receive a mass mark to identify their hatchery-reared origin. Yearling fall Chinook receive a blank wire tag as a mass mark while other production groups or adipose fin-clipped. A portion of each hatchery group are also coded wire tagged and given and external fin clip to identify presence of the tag for monitoring their total adult production, smolt-to-adult survival, out-of-subbasin stray rates, and contributions to harvest and spawning. Coho are coded wire tagged, but not mass marked.

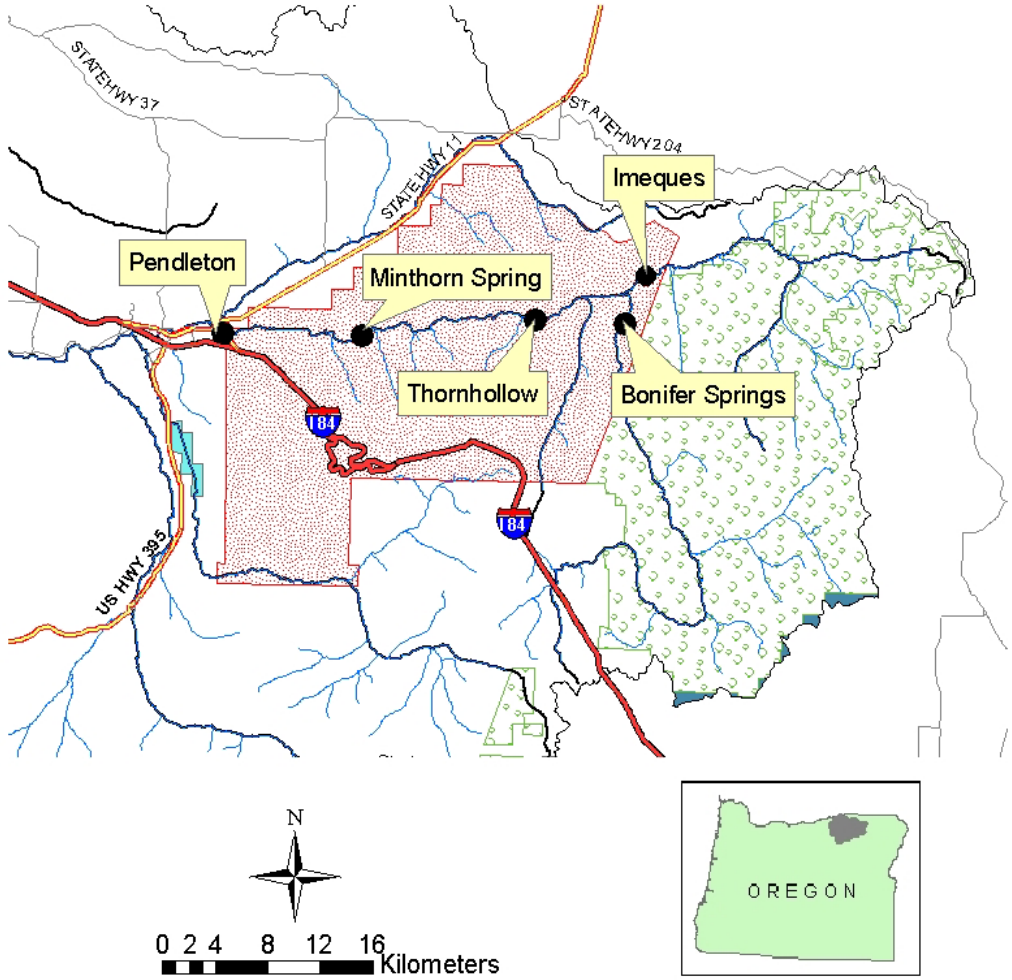


Figure 6. Location of acclimation facilities in the Umatilla Subbasin.

The ODFW Northeast Region Fish Pathologist based in La Grande monitors fish health at Umatilla Hatchery and its satellite acclimation and spawning facilities (funded by project No. 198903500). Fish reared at Bonneville Hatchery are monitored by fish pathologists responsible for the facility. The pathologists collaborate informally, in Umatilla Management and Monitoring Oversight Committee (UMMEOC), and through the Annual Operating Plan (AOP) development process. Information from all sources are pooled and reported by the Umatilla Hatchery Fish Health Monitoring and Evaluation Project.

The current program releases 150,000 steelhead smolts in the upper subbasin (Table 6). Broodstock (100 naturally-reared and 20 coded wire tagged hatchery-reared) are collected from September through April at TMD (RM 3.7) on the lower Umatilla River. Twenty hatchery-reared fish are used in brood to reduce removals of naturally-reared fish from the run and buffer production losses when holding mortality is higher than normal. Naturally-reared fish are spawned preferentially, and any unused hatchery-reared brood are released upriver to spawn naturally. Collections are scheduled proportionate to the average run timing of naturally-reared steelhead during the previous five years with the intent of incorporating a representative cross-section of their life history diversity into the brood. Brood fish are immediately transported upstream to the Minthorn adult facility (RM 63.8)

where they are held until spawning. Spawning procedures follow the Integrated Hatchery Operations Team (IHOT) guidelines (IHOT 1994). A 3x3 matrix is utilized for spawning whenever possible to increase the number of genetic crosses.

Table 6. Summary of the current Umatilla Subbasin steelhead and Chinook salmon hatchery program showing smolt releases planned for 2007.

Race - Species	Stock	Brood source	Spawning location	Incubation location	Rearing location	Acclimation site	Time of transfer to acclimation	Direct stream release	Release time	Planned released	Target size (fish/lb)
Summer steelhead	Umatilla	Umatilla River	Minthorn adult facility	Umatilla Hatchery	Umatilla Hatchery	Pendleton RM 56	Early-April		Late-April	50,000	4.5 -5.0
						Minthorn RM 64	Early-April		Late-April	50,000	4.5 -5.0
								Meacham Creek RM 81	Late-April	50,000	4.5 -5.0
										150,000	
Spring Chinook salmon	Carson	Umatilla River	South Fork Walla Walla adult facility	Umatilla Hatchery	Umatilla Hatchery	Imeques RM 80	Mid-November		Mid-December	210,000	15
						Imeques RM 80	Mid-November		Mid-March	150,000	15
						Imeques RM 80	Mid-January		Mid-March	450,000	15
										810,000	
Fall Chinook salmon (subyearlings)	Upriver Bright	Priest Rapids Hatchery	Three Mile Falls Dam adult facility	Umatilla Hatchery	Umatilla Hatchery	Thornhollow RM 74	Early-May		Late-May	300,000	50
								Umatilla R. RM 49	Late-May	300,000	35
										600,000	
Fall Chinook salmon (yearlings)	Upriver Bright	Umatilla River	Three Mile Falls Dam adult facility	Umatilla Hatchery	Bonneville Hatchery	Thornhollow RM 74	Mid-February		Mid-March	240,000	10
						Thornhollow RM 74	Mid-March		Mid-April	240,000	10
										480,000	
Coho	Tanner Creek	Cascade Hatchery	Bonneville Hatchery	Cascade Hatchery	Cascade Hatchery	Pendleton RM 56	Mid-February		Mid-March	250,000	15
							Mid-March		Mid-April	750,000	15
		Oxbow Hatchery	Bonneville Hatchery	Oxbow Hatchery	Lower Herman Ck	Pendleton RM 56	Mid-February		Mid-March	500,000	15
										1,500,000	

[a] *RM = River mile.*

Matrices emphasize natural x natural crosses whenever possible, however, hatchery-reared fish may be used if needed. Males are used only once. Coded-wire tags are read prior to spawning to avoid use of out-of-subbasin strays. Offspring are reared at Umatilla Hatchery at high density in one series of Michigan raceways (3 raceways per water reuse series). One raceway of about 50,000 smolts is released at each of three upriver release locations. The release in the lower two miles of Meacham Creek is intended to increase adult returns to that tributary for supplementation while reducing the risk of hatchery-reared juveniles residualizing in summer juvenile rearing areas higher in the watershed. Management intent of releasing smolts from the Minthorn and Pendleton acclimation sites is to both enhance in-subbasin fisheries (particularly in the upper river) while supplementing spawner abundance in the smaller tributaries above Pendleton that produce steelhead. All release sites are located above Birch Creek to reduce the risk of hatchery-reared adults returning to Birch Creek, which is managed as a natural steelhead sanctuary.

Carson stock spring Chinook salmon have been released in the Umatilla Subbasin since 1986. The current program is to acclimate and release 810,000 yearling smolts annually into the upper mainstem Umatilla River (Table 6). Beginning in 1996, Carson stock spring Chinook salmon returning to the Umatilla River have been the primary broodstock source for the Umatilla Subbasin hatchery program. The operational goal for the program is to collect all 560 brood fish at TMD. Broodstock are collected from mid-April to the end of June proportionate to the average timing of spring Chinook salmon run during the previous five years with the intent of incorporating a representative cross-section of life history diversity in the brood. Brood collection is not selective for hatchery- or naturally-reared returns. Brood fish are immediately transported upstream to the South Fork Walla Walla adult facility (upper Walla Walla River) where they are held until spawning. Spawning is 1:1 with segregation of family groups during incubation to minimize production losses if high disease levels are later detected in spawned females. All smolts are currently produced at Umatilla Fish Hatchery. Production that formerly occurred at Little White Salmon Hatchery was transferred to Umatilla Hatchery due to poor health and survival from fish reared at Little White Salmon. This shift is complete beginning with the 2006 brood. This shift will be accomplished by rearing all production at Umatilla Hatchery in oxygen-supplemented Michigan raceways coupled with early (fall) transfer of some of these fish to the Imeques acclimation site (Table 6). The fall transfer provides a buffer against water shortage at Umatilla Hatchery as biomass increases during the later stages of rearing and seasonal lows in water availability occur in winter or spring. Smolts are released from the Imeques acclimation facility at RM 80 of the Umatilla mainstem in December, March and April. Holding capacity of the facility is inadequate to release all production at the same time. Imeques is located at the lower end of productive spring Chinook salmon spawning and summer rearing areas in the Umatilla mainstem and just above the Meacham Creek confluence. This location was selected with the intent of optimizing spawner contributions to Meacham Creek while potentially developing spatial segregation of hatchery-reared fish spawning near the acclimation facility and naturally-reared adults spawning in the prime habitat higher up in the watershed.

The current fall Chinook program is to release 600,000 subyearlings and 480,000 yearlings (Table 6). Releases are from Mid Columbia Bright and Upriver Bright stocks. Upriver Progeny returning to the Umatilla River, collected and spawned at TMD , have been the primary brood source for the yearling program since 1997. Eggs for the subyearling program are principally provided from fish

spawned at Priest Rapids Hatchery, with Bonneville and Little White Salmon as secondary options. The number of brood collected at TMD for the yearling program is 380 adults. Collection of an additional 450 adults would be required to provide a local brood source for the current subyearling program. In past years, adult returns were too low to meet brood needs for the subyearling program because subyearling smolt production was 4.5 times higher than current levels of returning adults could support. Co-managers temporarily downsized the subyearling program in 2000 due to very low smolt to adult survival (SAS) and high production costs associated with NMFS Biological Opinion (BiOp) mandate to mark all fall Chinook salmon in the Umatilla Subbasin hatchery program with a wire tag to protect ESA listed stocks of fall Chinook salmon in the Snake River Basin. A portion of Umatilla returns stray to the Snake River, where presence of a wire tag in these adults allows managers to remove these fish from broodstock. Managers consider the reduction in the subyearling program as a temporary action that will allow evaluation of alternative production strategies for improving SAS. Currently, a production strategy of releasing larger-sized smolts lower in the river (just below the cool water inputs from McKay Creek) is being tested against the past production strategy of smaller-sized smolts released higher in the subbasin. Also, imprinting subyearlings on McKay Creek influenced water might possibly improve homing back to the subbasin because Umatilla River flow is primarily from McKay Reservoir water releases in late-summer and early-fall when the adult fish are returning (Volkman 1994). Utilization of adults that return to TMD for brood might also be a means of reducing out-of-subbasin straying. Both yearlings and subyearlings are reared in standard Oregon raceways. Oregon systems were chosen for rearing subyearlings at Umatilla Hatchery because water shortages are not an issue during their rearing and a larger size-at-release is easier to attain in Oregon systems than Michigan systems. Current locations of acclimation sites for release of fall Chinook salmon are higher in the subbasin than the areas where most natural spawning occurs (below Pendleton). Potential locations for acclimation sites lower in the subbasin were previously considered but no suitable sites were identified due to topography or landownership constraints.

D. Program Component Linkages

While the Umatilla Restoration Program is comprised of numerous individual projects funded primarily by BPA and BOR, is has been constructed as an integrated program of actions to accomplish the primary goals of restoring and/or enhancing natural production and harvest of salmon and steelhead in the Umatilla Basin. The Umatilla Restoration Program is described in whole or in part in several documents including Boyce 1986, CTUIR and ODFW 1990, and NPCC 2004. The program is built around four main elements intended to address limiting factors. These elements are hatchery production, flow restoration, passage improvement, and habitat enhancement. Through the various planning exercises used to develop the Umatilla Restoration Program, managers have chosen to implement this diversity of actions in concert to accomplish Program goals (Table 7). While this may decrease the experimental utility of the Program, this aggressive suite of actions is expected to provide the highest probability of achieving management actions with reasonable certainty. Although specific experimentation is secondary to achieving management objectives in the Umatilla, providing information for adaptive management is considered important and the success of adapting should be apparent in the list of adaptive management actions provided below (Table 8).

Table 7. Umatilla restoration project relation to program elements.

Project	**Number**	**Sponsor**	**Hatchery**	**Flow**	**Passage**	**Habitat**	**M & E**
Hatchery Satellite Facility O & M	198343500	CTUIR	X				X
Hatchery O & M	198903500	ODFW	X				
Iskuulpa Watershed Project	199506001	CTUIR				X	
Passage O & M	198343600	WID			X		
Fish Passage Operations	198802200	CTUIR/ODFW	X	X	X		X
Power Repay	198902700	CTUIR		X			
Anadromous Fish Habitat	198710001	CTUIR			X	X	X
Fish Habitat Improvement	198710002	ODFW			X		X

Table 8. Adaptive Management Actions

Year	Identified Issue/Problem	Action
1984	Dispersed flow across bedrock below TMD not conducive for fish passage	River channel modified below TMD to improve fish passage
1992	Steelhead reared at high density suffer severe fin erosion	Smolt production lowered from 210,000 to 150,000 to reduce rearing densities
1992	Hatchery steelhead returns become adequate to provide harvest opportunities	Steelhead harvest in the non-tribal fishery is restricted to hatchery origin fish only
1993	River flow inadequate for adult fish passage from Columbia River to TMD	Completion of Phase I water exchange improves adult passage to TMD
1994	Outdated adult and juvenile passage facilities at irrigation diversion in the lower river	Completed construction and evaluation of modern fish passage facilities
1994	Poor smolt-to-adult survival (SAS) for subyearling spring Chinook released in spring and fall	Discontinued hatchery production and releases of subyearling spring Chinook
1996	Preliminary study results identify oxygen supplemented rearing as the preferred strategy to increase adult production of fall Chinook	All fall Chinook production at Umatilla Hatchery shifted to oxygen-supplemented Michigan raceways, study initiated to determine optimum rearing density
1996	Early broods of spring Chinook salmon reared at Umatilla Hatchery (UH) suffer periodic disease outbreaks	Completion of the South Fork Walla Walla adult spawning facility provides local managers the ability to implement more stringent disease screening protocols
1996	Poor SAS for yearling spring Chinook reared at UH – suspected issues with rearing in constant warm water temps	Initiated evaluation of earlier transfer of smolts to acclimation facility (November vs. January transfer time)
1996	Spawning ground and juvenile fish surveys identify the majority of natural spring Chinook are spawning and summer-rearing in the high quality habitat above the Imeques acclimation facility--	This area is closed to Chinook fishing in the tribal and non-tribal fisheries
1999	Low SAS and suspected issues with disease and rearing conditions	Discontinued production of yearling spring Chinook from Carson NFH
1999	Low SAS, straying concerns, and high costs of wire-tagging all smolt production	Reduced fall Chinook subyearling program for 2.67 M to 600 K and initiated evaluation of alternative rearing and release strategy to improve SAS and possibly reduce straying
2000	Increased spring Chinook run, and inconsistent harvest in the upriver non-tribal fishery	Spring Chinook fishery opened below TMD
2000	Low catch of hatchery steelhead in upriver non-tribal fishery	Shifted release of one group of hatchery steelhead lower in the river (from Bonifer to Pendleton acclimation site)
2002	Study results identify oxygen supplemented rearing as the preferred strategy to increase adult production of spring Chinook	All fall Chinook production at Umatilla Hatchery shifted to oxygen-supplemented Michigan raceways
2003	Poor juvenile outmigration and SAS for small grade hatchery steelhead released from the Bonifer acclimation pond	Discontinued size grading at hatchery, and changed to a direct stream release near the Bonifer acclimation site
2004	Poor SAS and elevated disease levels for spring Chinook reared at Little White Salmon Hatchery (LWSH)	Fall transfer of smolts to acclimation site increases rearing capacity at Umatilla Hatchery – 150 K of LWSH smolt production shifted to UH, reduced rearing density of the remaining 200 K at LWSH
2006	Poor SAS and elevated disease levels for spring Chinook reared at Little White Salmon Hatchery (LWSH)	Shifted remaining smolt production at LWSH to UH
2006	Mass marking of spring Chinook provides opportunity for selective harvest	Harvest of unmarked spring Chinook prohibited in the non-tribal fishery

E. Research Monitoring and Evaluation

1. Introduction

The Umatilla Monitoring and Evaluation (M&E) program was established as part of the Umatilla Basin Project and the Umatilla Fisheries Project. The roles of the program are defined in the Umatilla Hatchery Master Plan. The Umatilla M&E Program was structured based on:

1) a before-and-after design to document progress and problems in achieving Umatilla Program objectives
2) a life-cycle approach to support limiting factors analysis and adaptive management of the program
3) specific controlled studies to identify best hatchery practices early in the program implementation

The fish restoration program was established at a time when Chinook and coho were extirpated from the Umatilla, and before Middle Columbia steelhead or bull trout were listed under the ESA. From the broad perspective, the conservation aspects of the program were necessarily of lower priority. Instead, the Umatilla M&E Program was initially developed to support the goals and objectives of the Northwest Power Act (i.e. production in a time of paucity), and has attempted to accommodate additional information needs associated with the goals of the ESA (i.e. fine-scale viability analysis). In general the Umatilla M&E Program is structured to support adaptive decision making through collaborative planning. As depicted in Figure 7, the intent is to connect M&E activities to the ongoing Vision, Objectives, Strategies, and Projects in the Umatilla, and to support regular assessment through data collection, analysis, and reporting.

Today the Umatilla M&E Program is faced with the challenges of supporting the needs of the local managers as well as the essential fish information requirements of the ESA, and informing the hatchery-related concerns of the ISRP and NMFS, without sacrificing the status reporting and before-after intent of the original design. Although these requirements are not logistically incompatible, limited fiscal resources make it difficult to support these demands in concert. For example, it is not possible to simultaneously monitor and evaluate the natural production of spawners, outmigration survival, hatchery production, and the local impacts of habitat actions on spawner-to-parr productivity and capacity simultaneously on the much reduced current budget from BPA.

However, the program has begun to adapt to changing information needs by compiling data essential for steelhead ESA viability assessment and recovery planning, compiling life history, productivity and abundance data for spring Chinook salmon,implementing a small before-after-control-impact design in one of the habitat treatment areas, and by sponsoring the study of the relative reproductive success of salmonids through the Salmonid Progeny Marker project. The text below outlines the history of the Umatilla M&E Program, presents some of its general findings, and describes connections between the current M&E effort and the Umatilla Management Program. The clarity and utility of

this information to the ISRP will depend almost entirely upon a continuous reminder of the Umatilla Program objectives and priorities: reintroduction, ecological functions, harvest, and natural production.

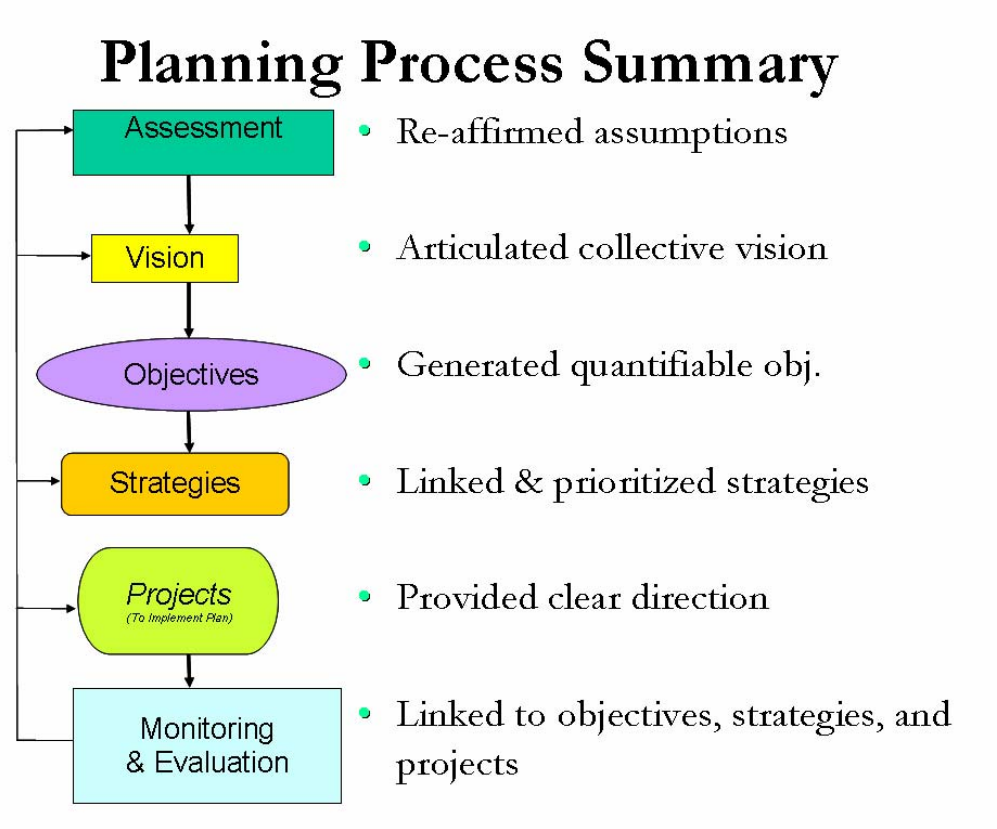


Figure 7 Conceptual model of the Umatilla Basin planning process and management strategies modified through ongoing assessments.

2. History

Monitoring and evaluation prior to the formal development of the Umatilla Fisheries Program included adult return counts beginning in 1966, coded-wire tag monitoring of hatchery fish releases beginning in 1984, and redd counts beginning in 1988 for steelhead and 1989 for Chinook salmon.

The Umatilla Hatchery Master Plan (CTUIR and ODFW 1990) was the primary management plan that outlined RM&E activities in addition to hatchery and natural production goals prior to development and adoption of the current Umatilla River / Willow Creek Subbasin Plan (CTUIR and ODFW 2004). The original Master Plan called for the formation of four M&E projects to provide information on critical uncertainties that were expected to be needed to adaptively manage the program in the future.

The four M&E Projects created were the ODFW Umatilla Hatchery M&E Project (#199000500) in 1992, CTUIR Natural Production M&E Project (#199000501) in 1992,

ODFW Juvenile Salmonid Passage M&E Project (#198902401) in 1989, and CTUIR Adult Salmonid Passage M&E Project in 1992.

Hatchery M&E objectives were to evaluate efficacy of: 1) oxygen supplemented rearing at Umatilla Hatchery, 2) release of smolts at varying life stages, 3) varying rearing densities at Umatilla Hatchery, 4) acclimated vs. direct stream releases, and 5) Non-tribal steelhead and salmon fisheries in the Umatilla River to monitor the River.

Natural Production M&E objectives were to assess: 1) natural production potential of Chinook salmon relative to program goals, 2) whether supplementation will enhance natural production of Umatilla natural steelhead, 3) whether supplementation changes genetic diversity or life history characteristic of native Umatilla steelhead, and 4) to monitor the tribal steelhead and salmon fisheries in the Umatilla River.

Passage M&E Project objectives were the evaluation of the effectiveness of river channel modifications below TMD and modernization of juvenile and adult fish passage facilities at the five largest irrigation diversions located in the lower Umatilla River.

The CTUIR Adult Salmonid Passage Evaluation Project was implemented from 1994-1996, then sunsetted. The ODFW Juvenile Salmonid Passage Evaluation Project was implemented from 1989-1994 and then transitioned into the current ODFW Smolt Outmigration and Survival M&E Project (#198902401) in 1995.

The primary objectives of the Smolt Outmigration and Survival M&E Project are to estimate smolt abundance of natural-produced steelhead and Chinook salmon near the Umatilla River mouth. Secondary objectives include assessment of smolt migration survival and timing relative to environmental conditions and management actions in the Umatilla Actions to restore or enhance natural fish production in the Umatilla River Subbasin date back to the mid-1960's. It is important to note that the estimates of natural-produced smolt abundances near the river mouth did not become available until well after habitat enhancement efforts and hatchery fish releases began and at about the same time the Phase I and II flow enhancement program was incrementally implemented from 1993-1999. M&E objectives for the Hatchery, Natural Production, and Smolt Outmigration and Survival M&E projects were recently redefined as part of the Subbasin Planning process. These objectives are outlined in Figures A-D in Appendix C and detailed in the Umatilla Subbasin RM&E Plan (Schwartz and Cameron 2006).

3. Environmental Status

Aquatic environmental assessments historically (1980 to present) have been funded by a broad range of agencies including BPA. Coordinated environmental monitoring has included water chemistry sampling (Oregon Department of Environmental Quality, ODEQ) water temperature monitoring (BPA, CTUIR, ODFW, BOR, ODEQ, and USFS), fish toxin assessments (The Environmental Protection Agency , EPA and CTUIR), suspended sediment monitoring (CTUIR and USFS), bedload movement (USFS), and stream habitat assessments (ODFW, USFS and CTUIR). These above mentioned data

sets have been carefully developed over time and were extremely useful during the Maximum Daily Load (TMDL) process as well as in the development of fish consumption rate recommendations, subbasin assessments and planning, and flow augmentation evaluations and planning. Environmental information was combined with juvenile and adult performance data and used in the EDT model to describe watershed health, and identify limiting factors and habitat restoration priorities.

Current BPA funded projects do not include aquatic environmental assessments other than some temperature monitoring through 2007. However, the current RM&E plan includes objectives to conduct physical and biological assessments throughout watersheds that will have a variety of management strategies and anthropogenic modifications ranging from heavily developed regions to sub-watersheds that have remained fairly pristine during the last 200 years.

4. Population Status

Population status monitoring encompasses a broad range of sampling activities for annual collection of key performance metrics needed to track spatial and temporal trends in Umatilla fish populations. The Umatilla Program has developed one of the longest population status data sets in the Mid-Columbia Region beginning with adult return counts in 1966, redd counts in 1982, hatchery fish survival in 1984, and smolt monitoring in 1995. This information is used to assess population status (Table 1). For example, the co-managers provided essential abundance, life history and spatial structure information to the Interior Columbia Technical Review Team (ICTRT) and completed a detailed assessment of Mid-Columbia River (MCR) summer steelhead population status and recovery planning (in prep).

Population status data is collected by the Passage Operations, Hatchery, and Natural Production M&E projects. Population status information is aggregated and analyzed by these three projects, and presented in terms of the abundance and distribution of adult returns, spawners on the spawning grounds, and smolts. Productivity metrics calculated include egg-to-smolt, smolt migration, and smolt-to-adult survival, and subbasin scale smolt-per-spawner and progeny-parent productivity. Key assessment models developed from the monitoring include smolt-per-spawner vs spawner abundance stock-recruitment and Ricker and Beaverton-Holt smolt production vs spawner abundance stock-recruitment.

Adult returns are monitored using video and direct surveys at the TMD counting facilities (Figures 8-14). The Fish Passage O&M Project performs a central function in adult monitoring by operating the fish ladder at TMD , video enumeration, and collecting all biological data and samples at the trap. These activities are coordinated with management and M&E staff thru development of an Annual Operating Plan (AOP) or modified at monthly Umatilla Management Monitoring and Evaluation Oversight Committee (UMMEOC) meetings.

Spawners are monitored using spawner/carcass surveys at index reaches to determine their distribution (Figures 15-17) and density (Figure 18). Fall Chinook and coho spawner/carcass surveys have been limited or absent in recent years due to budget constraints from BPA. Summer steelhead spawner surveys have been limited to index sites only due to funding constraints.

In the past, smolts were monitored at the West Extension smolt monitoring facility, however that project is no longer funded. The abundance and timing of natural and hatchery outmigrants is assessed in relation to environmental conditions and fish passage facility and flow enhancement operations (Figure 16 in Appendix C, from the comprehensive RM&E) In addition fish are tagged and recovered at this facility to estimate survival above and below TMFD, especially for the hatchery components. The Umatilla steelhead smolt migration and survival data is the only Mid Columbia steelhead dataset and serves as the basis for the Remand life cycle survival matrix model. These dare are invaluable to the NMFS assessment of the impacts of Columbia River hydrosystem management on Mid-Columbia steelhead stocks.

Run reconstructions are done annually, and spawner-recruit curves are updated regularly. Smolt-per-spawner evaluations are done every 1-3 years depending on the availability of staff to complete these analyses (Figures 12-14 below and Figure 29 in Appendix C, from comprehensive RM&E report). The hatchery impacts on natural production are discussed below in the Natural Production M&E section.

Figure A in Appendix C depicts our M&E objectives for both environmental and population status monitoring detailed in the Umatilla RM&E Plan (Schwartz and Cameron 2006). Primary components of planned population status monitoring include EMAP sampling of spawners and juveniles, smolt trapping and PIT tagging at TMD , and adult trapping and video enumeration at TMD to monitor trends in abundance, migration timing, survival, and life history.

The current activities, planned activities, and funding levels are not synchronized. Funding was not obtained for EMAP monitoring for status and trends of environmental conditions, juvenile distribution and abundance, smolt production, and adult spawner/carcass distribution and abundance. The ODFW has provided supplemental funding thru June 2007 for the fieldwork portion of smolt monitoring with hope the Bi-Op remand will mandate continuation of this activity.

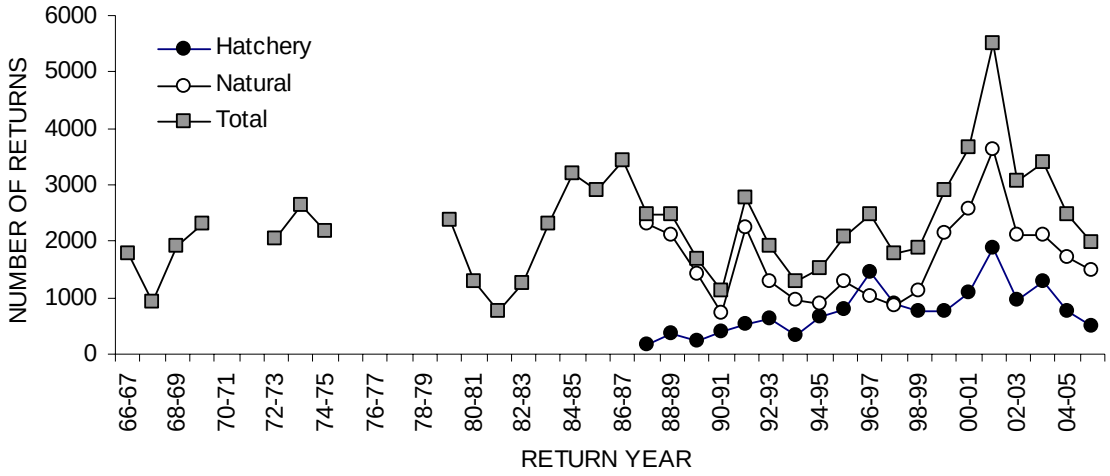


Figure 8. Summer steelhead returns to Three Mile Fall Dam (river mile 3.7) on the lower Umatilla River (1966-67 to 2005-06). Counts were obtained using an electronic counter prior to 1988, and by trapping or video enumeration from 1988-2006.

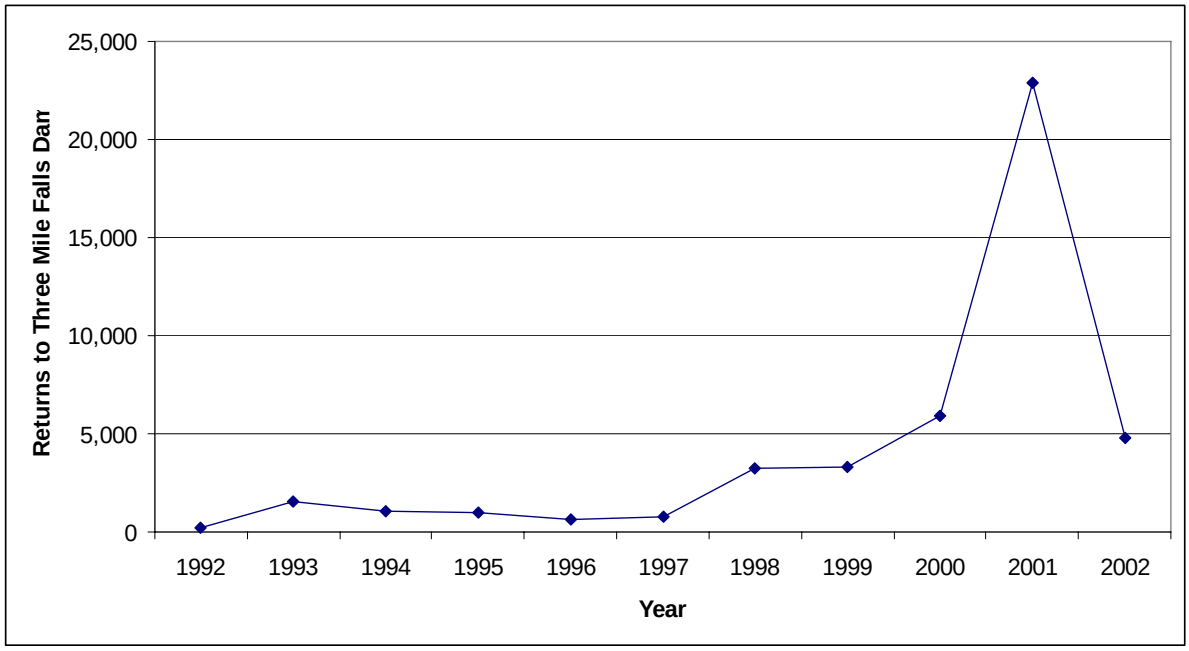


Figure 9 Adult coho returns to TMD (river mile 3.7) on the lower Umatilla River, 1992-2002.

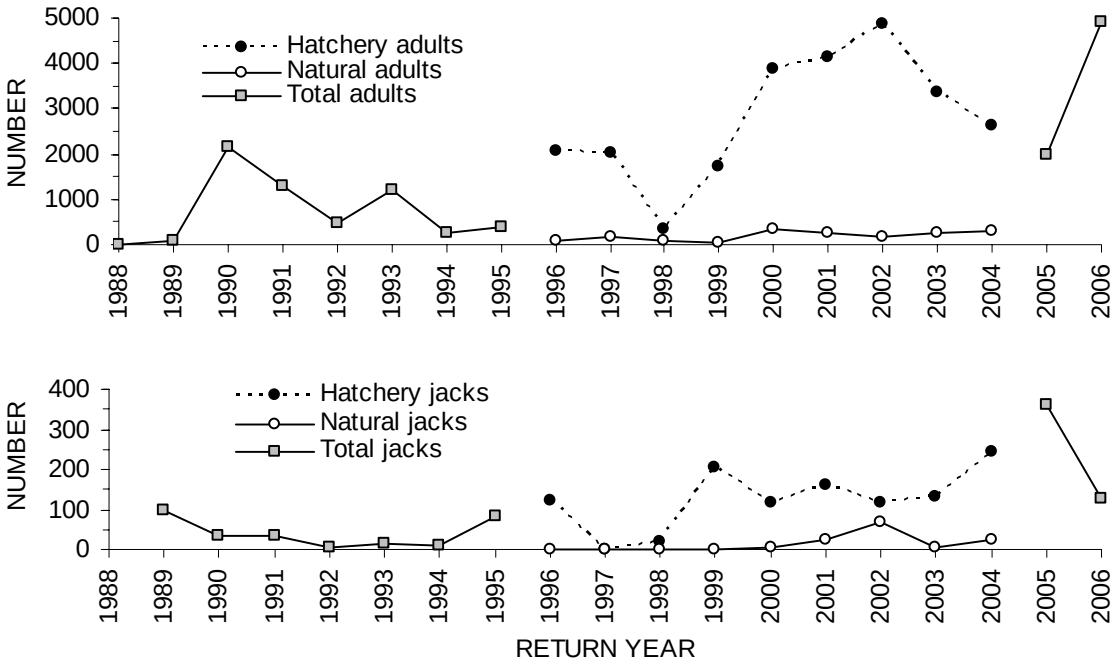


Figure 10. Adult and jack spring Chinook salmon returns to TMD (river mile 3.7) on the lower Umatilla River, 1988-2002.

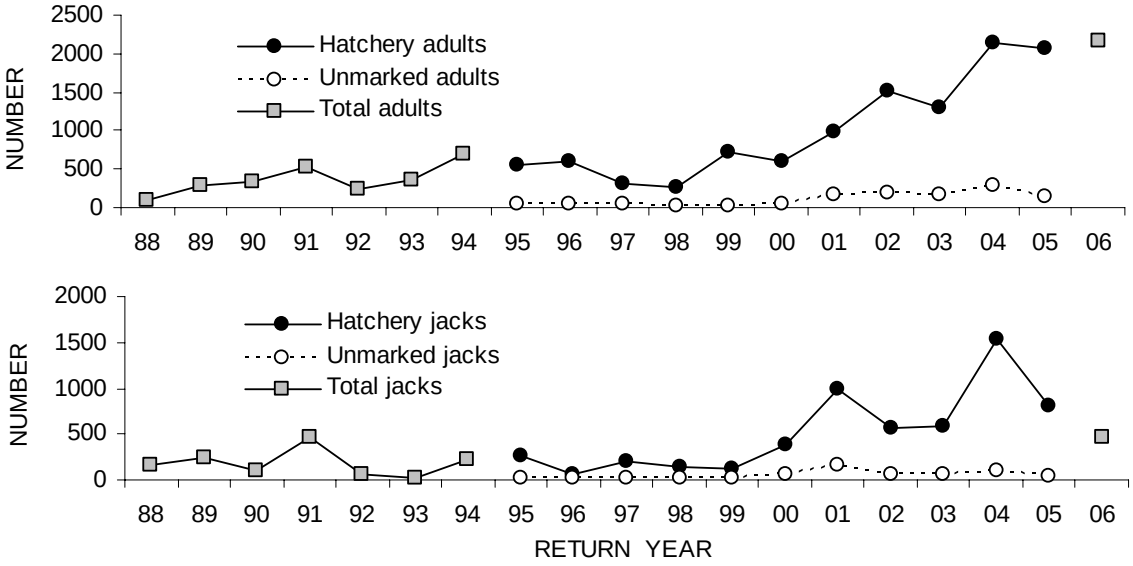


Figure 11 Adult and jack fall Chinook salmon returns to TMD (river mile 3.7) on the lower Umatilla River, 1988-2006.

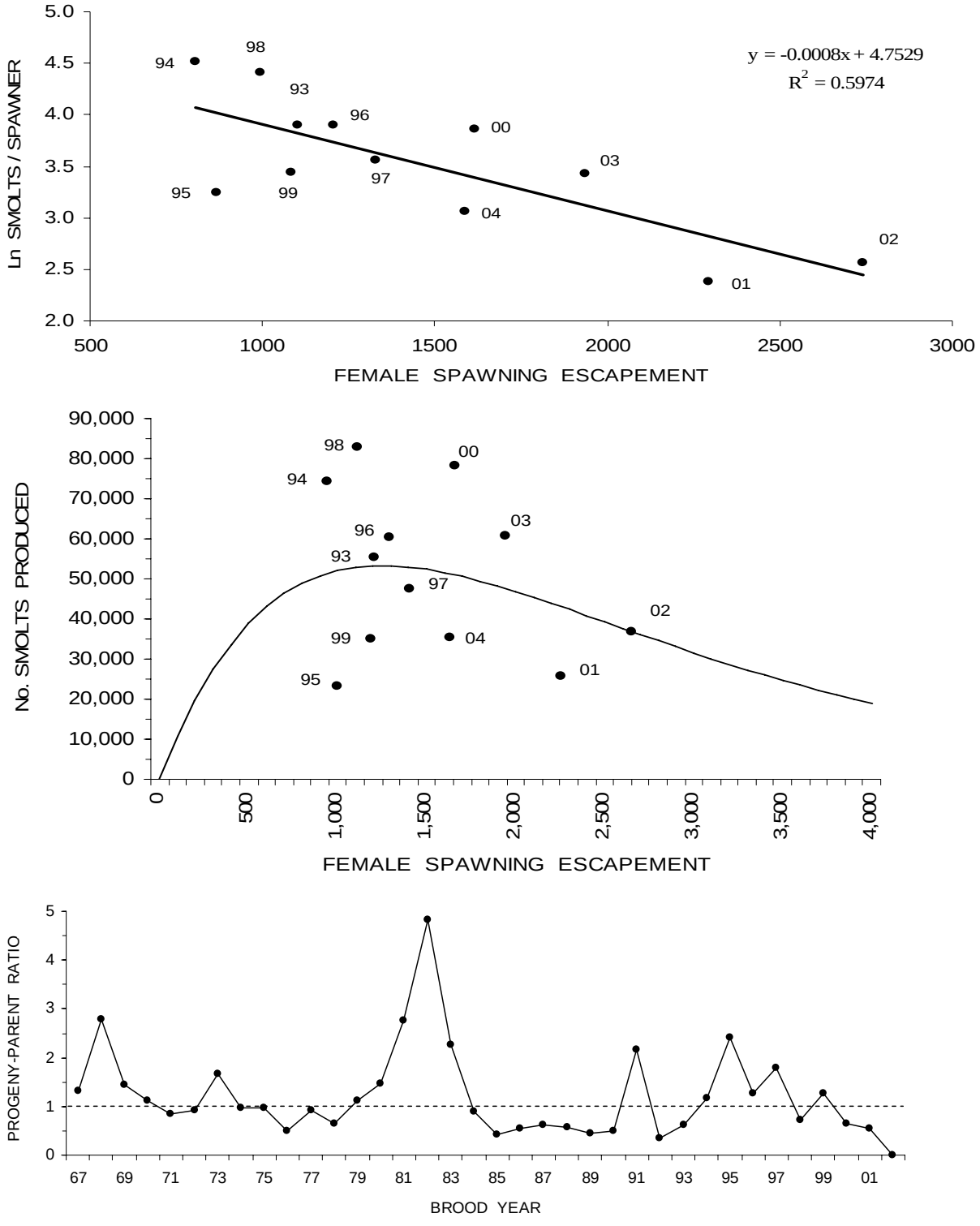


Figure 12 Smolt per spawner and progeny-parent stock recruitment trends for natural produced Umatilla summer steelhead.

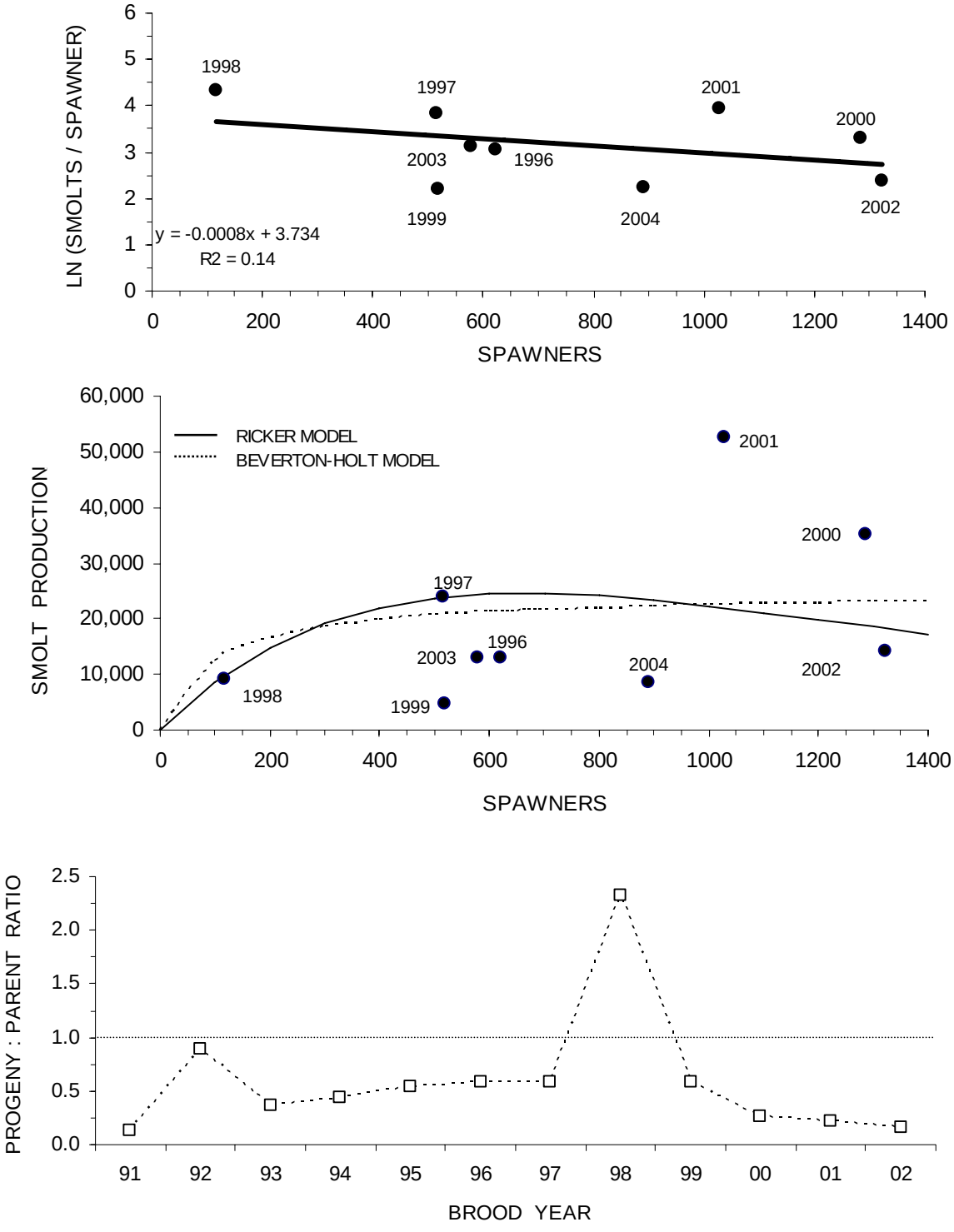


Figure 13 Smolt per spawner and progeny-parent stock recruitment trends for natural produced Umatilla spring Chinook salmon.

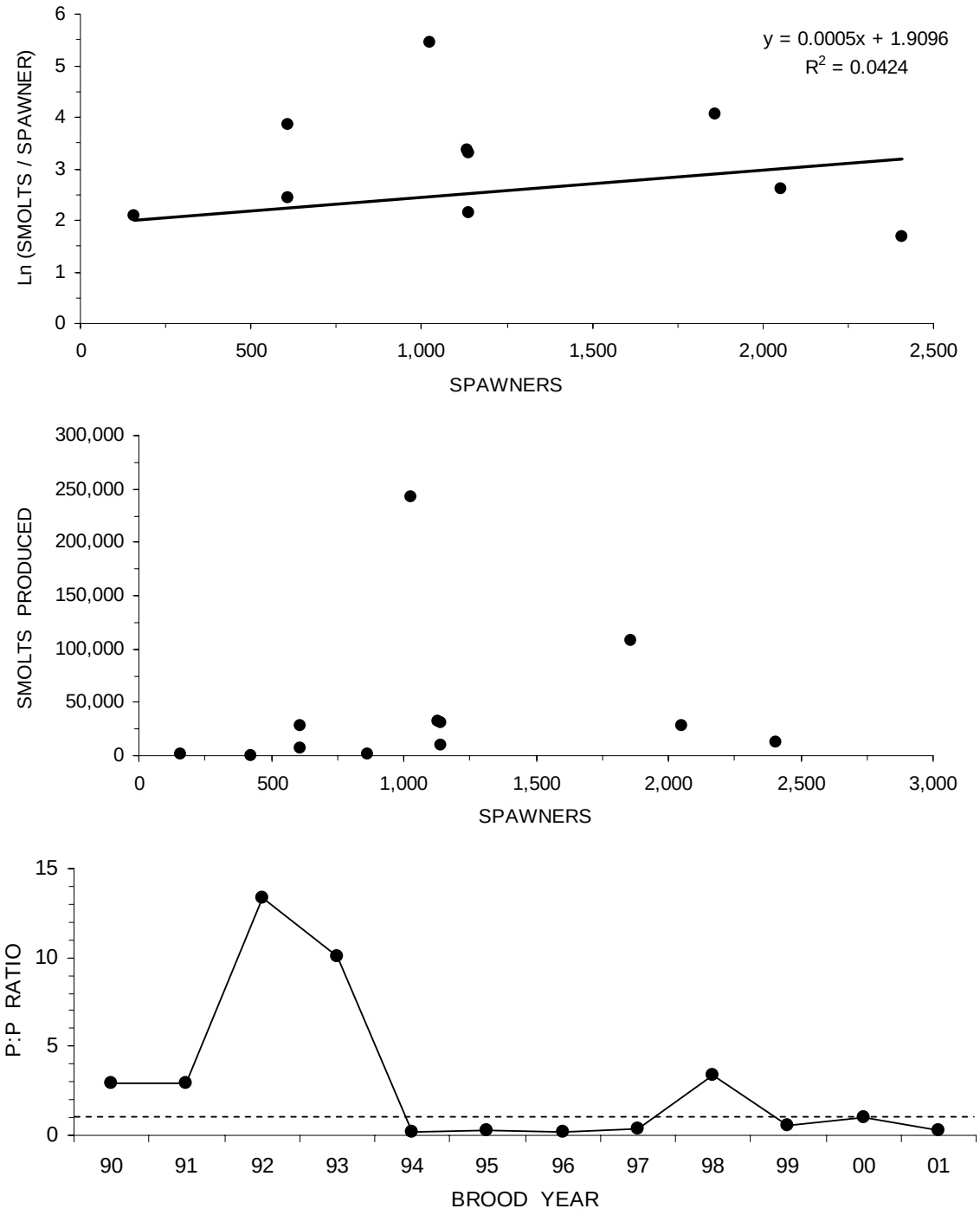


Figure 14 Smolt per spawner and progeny-parent stock recruitment trends for natural produced Umatilla fall Chinook salmon.

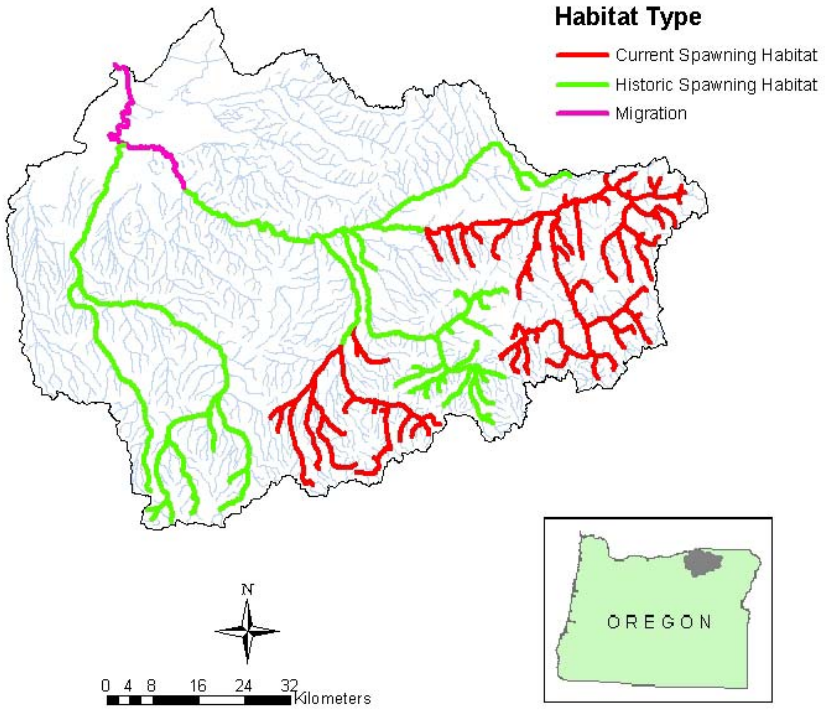


Figure 15. Current and historic summer steelhead spawning and summer rearing habitat in the Umatilla Basin.

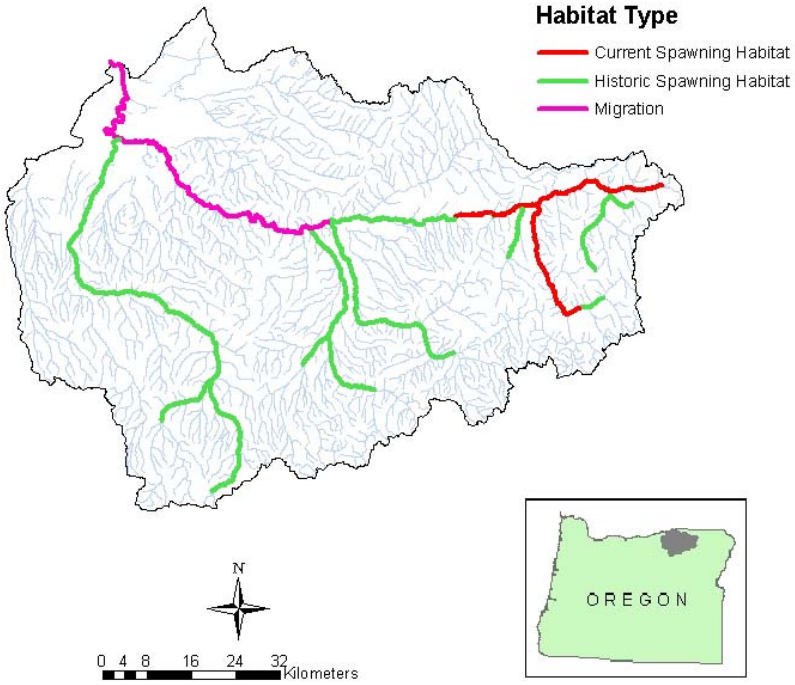


Figure 16. Historic and current spring Chinook salmon and spawning and rearing habitat in the Umatilla Basin.

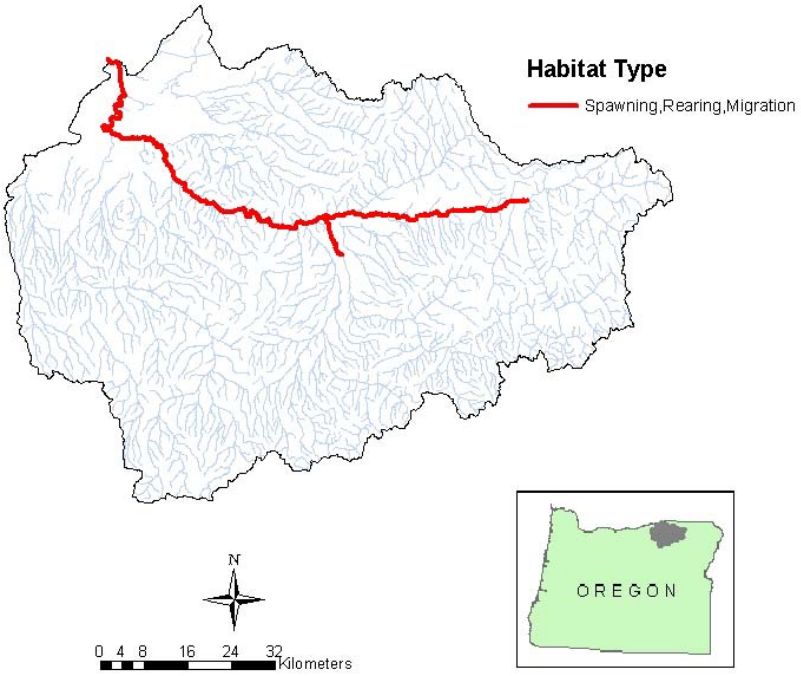


Figure 17. Current fall Chinook and coho salmon habitat use in the Umatilla Subbasin

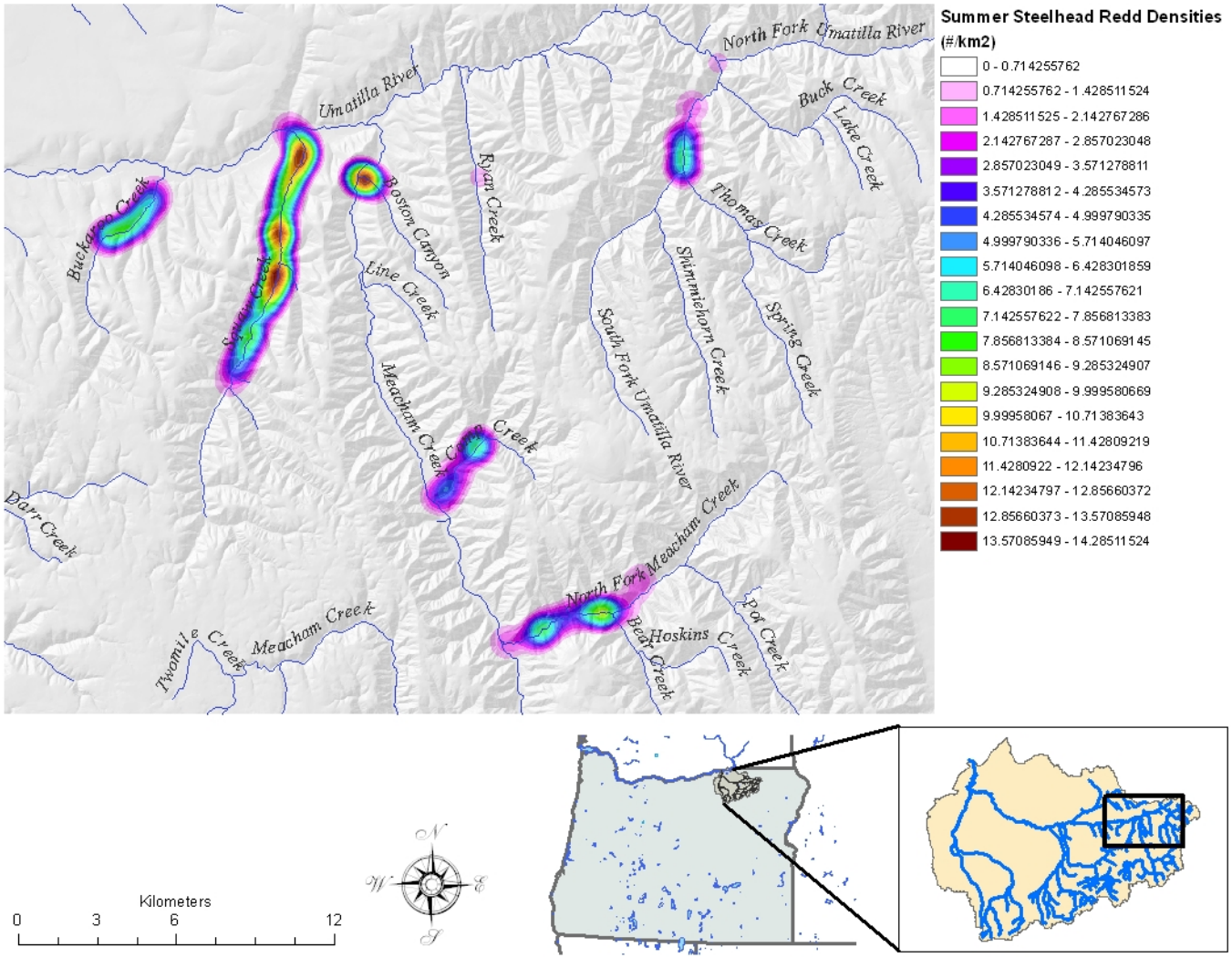


Figure 18 Density and distribution of summer steelhead redds enumerated during 2005 surveys.

5. Migration Survival and Homing

As depicted in the introduction of this section, the adaptive management of flow and passage conditions requires feedback from the M&E program. Flow and passage influence survival through the Umatilla River and may affect delayed mortality associated with the hydrosystem and ocean entry. Flow and passage conditions can also directly affect homing to and straying from the Umatilla River. With little or no flows to the mouth adults cannot locate or navigate to the spawning grounds. Baseline estimates of adults and juvenile passage, adult homing, and adult migrant survival rates were collected early in the Umatilla Program. Specific components of these have been investigated in greater detail as bottlenecks have been identified and when passage fixes have been implemented. This approach parallels the before-and-after, status and trends, and limiting-factors design of the Umatilla M&E Program as a whole.

Management actions taken to improve migration survival of juvenile and adult steelhead and Chinook salmon in the Umatilla River include fish passage facility redesign and construction, water exchange pumping, release of stored water from McKay Reservoir, and fish transport. Five RM&E objectives were developed in the RM&E Plan (Schwartz and Cameron 2006) to assess the effectiveness of these management actions (Figure B, Appendix C). The first actions taken early in the Umatilla Program were river channel modification below TMD to improve fish passage thru shallow bedrock reaches and reconstruction of out-dated fish passage facilities at the five large irrigation diversions in the lower Umatilla River. Effectiveness evaluations were conducted shortly after the channel was modified, and were completed in 1992 (Nigro and Ward 1986, Kissner 1992). Results indicated river channel modification was effective for passing fish to TMD. The RM&E did not include further evaluation of this action.

Evaluation of juvenile fish passage thru reconstructed juvenile fish bypasses and adult fish ladders was completed in 1995 (Knapp and Ward 1990, Knapp 1992, Cameron and Knapp 1993, Walters et al. 1994, Cameron et al. 1994, 1995, 1997). Results indicated most facilities were effective for passing juvenile fish safely with minimal delay if operated within criteria and maintained properly. Juvenile fish passage problems were identified at TMD. Injury, mortality, and delay were identified in the adult ladder and attraction to the fish passage facility on the opposite shore was shown to be poor. These studies produced recommendations to facility operators for structural, operational, and maintenance improvements. Further evaluation of juvenile fish passage at the TMD was included in our RM&E Plan but not funded in 2007 (Figure B, Appendix C, RM&E Objective 12b).

Evaluation of adult passage thru reconstructed fish ladders was completed in 1996 (Volkman 1994, 1995, Contor et al. 1996, 1997). Evaluations indicated most of the fish ladders were effective for passing adults. Delay caused by poor attraction to the ladder at Feed Canal was identified and remedial action recommended. River channel reconfiguration has been proposed at Feed Canal Dam to improve adult attraction to the fish ladder but has not been funded. The Fish Passage Operations project has recommended in their annual report that an updated adult passage evaluation be conducted to evaluate more recent morphology changes in the lower river especially in relation to Boyd Hydro, Dillon, and Feed. We recommended this effectiveness evaluation in the RM&E Plan in conjunction with additional adult Chinook salmon passage monitoring to the spawning grounds (Figure B, Appendix C, Objective 12b).

Current passage impediments are now primarily located in tributary streams. We do not propose passage evaluations in tributaries at this time. Future evaluations in tributaries will be proposed if concerns over the effectiveness of specific passage improvement projects are raised by co-managers.

Efficacy of utilizing flow enhancement as a means of providing instream passage for salmonids as opposed to trapping and transport has been evaluated in a constrained framework. Unlike smolt transport evaluations in the Snake River, there are some inherent experimental design constraints that preclude a treatment-control approach in the Umatilla River. The main constraint is the inability to simultaneously create conditions representative of flow enhancement and transport operations. When flow enhancement is in effect, river flow and temperature, and particularly fish densities in the smolt holding pond at the Westland Juvenile Fish Passage Facility (river mile 27) are not representative of trapping operations without flow enhancement. Conversely, when flow is not enhanced, there is no river flow below the Westland facility to release in-river migrating groups to compare with transported groups. Additionally, the existing smolt trap at Westland Canal is grossly undersized for the numbers of fish that would be collected in a non-flow enhanced scenario. If the management approach truly relied solely on transport, the smolt trapping facility would need to be redesigned and substantially enlarged, and additional staff and transport vehicles would be needed.

Study design constraints for adults are not quite as severe as with smolts. Adult trapping operations do not vary between flow enhancement and transport operations other than more adults would be trapped and transported more often during the latter. The main constraint in evaluating the impacts of flow and passage improvements on adult homing and passage is that ***most fish are not able to get to TMD at times without flow enhancement***. In the future, we will conduct an assessment comparing adult migration patterns and survival of transported and instream migrating fish proposed in the RM&E Plan if funded (Figure B, Appendix C, Objective 10b). This objective was given a low priority rating by the co-managers because it does not directly address problems of passage and survival, and the managers do not view sole reliance on trap and transport as a viable management option. In other words, rather than studying the impacts of trap and haul, the managers would prefer to improve productivity and capacity so that trap and haul can be minimized or eliminated.

Before-and-after assessment of the effectiveness of flow enhancement for improving homing of adults to the Umatilla River is ongoing based on adult returns. We have developed a continuous data series dating back to 1984. The focus has been on fall Chinook because of their greater tendency to stray and impact the Snake River ESU. Our observational trend analysis suggests that flow enhancement has improved homing but acclimation did not. Results are reported in the Umatilla Comprehensive Report (Grant et al. 2007).

The plan is to continue to include basic reporting of abundance and timing of smolts and adults migrating thru the Umatilla River during flow enhanced and non-flow enhanced conditions (or the number transported, Figure B, appendix C, Objective 10b). Acquisition and reporting of these data for smolts will not be possible in the future because funding was not obtained for smolt monitoring. Experimental assessments of passage conditions or the contribution of homing and outmigrant survival to the overall productivity and capacity of the system will also not be assessed in the future.

6. Natural Production

Natural production objectives were originally established in the Umatilla Hatchery Master Plan for multiple reasons. The reintroduction of Chinook and coho was believed to benefit not only harvest, but also the host ecosystem processes due to the influx of energy and marine nutrients that carcasses and juveniles bring. Umatilla steelhead are endemic, and the maintenance of natural production was identified as a high priority to ensure that localized genetic resources were sustained.

The current design for adult return, spawner, carcass, habitat, and water quantity/quality performance requires a long-term commitment to the before-and-after, status and trend, and limiting-factors elements upon which it was based. Local co-managers continuously refine, revise, and revamp operations based on feedback from the Umatilla RM&E Program. However, with some notable exceptions, the program operations are not directly dependant upon the outcome of any one single experiment. In general the Umatilla is managed more as a production system than as an experimental system, because the restoration activities are directed at specific production goals rather than at learning per se. The Natural Production M&E project was designed to provide feedback regarding local performance, and to integrate this understanding with global knowledge regarding best management practices (BMP). Therefore, adaptation, learning, and progress are central to the Umatilla's effort. As new local or global knowledge regarding BMPs is established the co-managers engage directly in discourse regarding change.

Monitoring and evaluation of natural origin salmonids and aquatic habitats within the Umatilla Subbasin began initially in the mid 1980s with spawner surveys, habitat surveys, creel of harvest, smolt trapping, and field studies of the distribution and density of juveniles. Through these efforts the co-managers developed status and trend data for annual abundance and distribution of spawners, parr densities, outmigration timing and survival, adult returns, run composition (via age and growth analysis), and harvest. Natural Production work has been extensively integrated with Passage O&M and ODFW RM&E projects to enhance their efficiencies. Field efforts are reviewed during monthly meetings of the Umatilla Management and Monitoring and Evaluation Oversight Committee (UMMEOC). UMMEOC is comprised of state and tribal fish managers, hatchery managers, research project leaders, habitat project leaders, and extends invitations to BPA, USFWS, USFS and NMFS representatives. For example adult return data was collected by the Fish Passage Operation Project and evaluated by both the Hatchery and Natural Production M&E teams based brood year assignments derived from coded wire tags for hatchery adults and scale age and growth data for naturally produced returns. Spawning and parr abundance and distribution data was collected by the Natural Production M&E project. Outmigration and harvest information was collected cooperatively between several projects to optimize logistical efficiencies.

The natural production M&E program was originally designed by Jim Lichatowich (1992) and was salmonid centric and organized by habitat types and life history stages (mainstem, tributaries, spawning, rearing, out-migration, adult returns, and harvest). The early plan focused on developing annual trend data in terms of both abundance, distribution and survival estimates for each life history stage (egg to parr, parr to smolt, smolt to adult, adult to redd, redd to egg) to satisfy the before-and-after design and status trend upon which it was founded. The 1992 Lichatowich plan included both stated and implied null hypotheses regarding salmonid spawning, egg to parr survival, parr densities and distributions, parr to smolt survival, outmigration survival and timing, smolt to adult survival and "the genetic diversity, long term

fitness, and productivity of native steelhead". The more recent Umatilla RM&E plan expanded, improved and prioritized the objectives and framework of the original plan. Although an understanding of the reproductive success and fitness of hatchery fish spawning in the wild is important to the co-managers, it is not the central component of the Umatilla program. The Chinook and coho program are built upon re-introductions, and the summer steelhead program exceeds all regional standards in terms of its use of BMPs. Therefore, field and laboratory activities are focused more on the questions of what is working where, and what life stages are suffering in correlation with which limiting factors.

The Natural Production M&E project worked with the co-managers to survey and analyze all of the salmonid habitat in the Umatilla subbasin. In 2004 this data was compiled and used to populate the Umatilla EDT model. The results suggest significant degradations in essential fish habitat persist (Figure 19). The results were used to focus habitat actions on areas where near-term responses in biological performance could be expected, and to focus actions on the limiting factors in these geographic areas where the potential for improvement was high. Passage obstructions were similarly assessed and evaluated, but not depicted.

In parallel, the Natural Production M&E project surveyed the distribution and densities of juveniles on the rearing grounds. These surveys included many of the reaches where habitat surveys were conducted (Figure 20) in sub-watersheds (Figure 22). Perhaps not surprisingly, many of the reaches with high EDT productivity estimates also had higher densities of salmonids (Contor, 2003).

For the past decade the Umatilla Natural Production M&E project has monitored temperature and pre-spawning mortality of spring Chinook in the Umatilla. Many spawners appear to be attracted to reaches that have high water temperatures late in the holding season, and just prior to the spring Chinook spawning period. This late season loss can dramatically reduce the smolt-per-spawner productivity, depending on the density-dependant limiting factors of the pre-smolt phases. We found a significant exponential fit between stream temperatures and the pre-spawning mortality rate (Figure 21). The relationship was built on the maximum summer water temperature by reach, and the percent of carcasses that were observed to have greater than 10% of their eggs remaining. This information has been presented to the co-managers, submitted for peer-reviewed publication, and has directly informed the importance, nature, and placement of habitat actions on the upper Umatilla, especially Meacham Creek.

The Natural Production M&E project has documented improved Chinook, steelhead, and coho performance in the wild since the inception of the Umatilla Project. In addition we have documented increased harvest of these stocks (see below). The before-and-after design of this project is as valid and scientifically appropriate for its objectives today as it was at its inception.

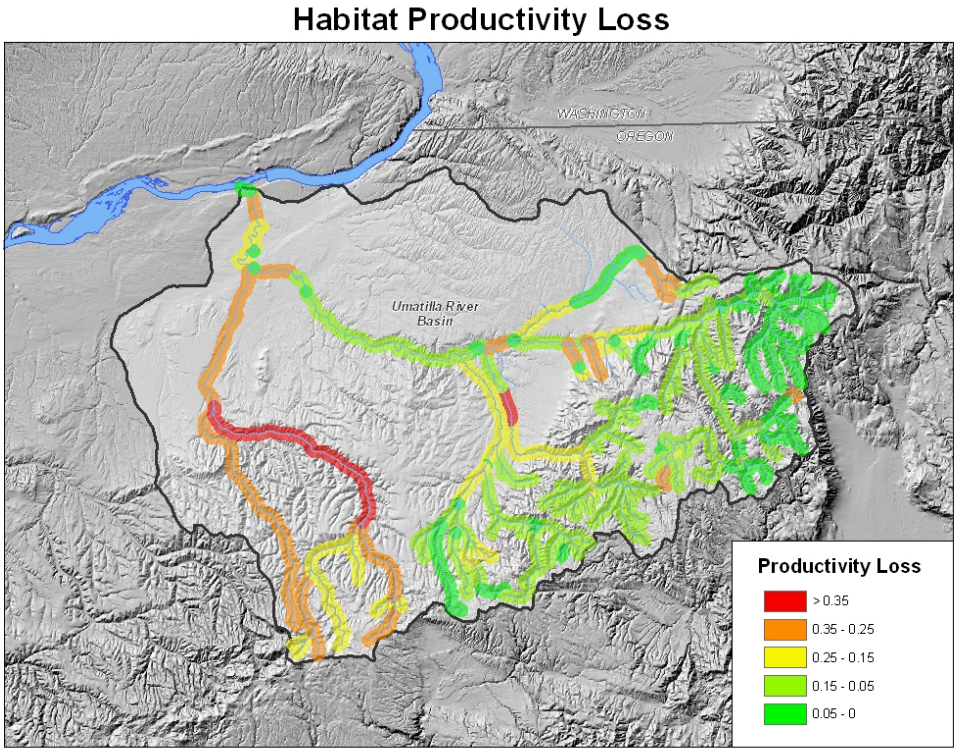


Figure 19. Loss of summer steelhead habitat productivity in the Umatilla Subbasin based on the Umatilla Ecosystem Diagnosis and Treatment Model.

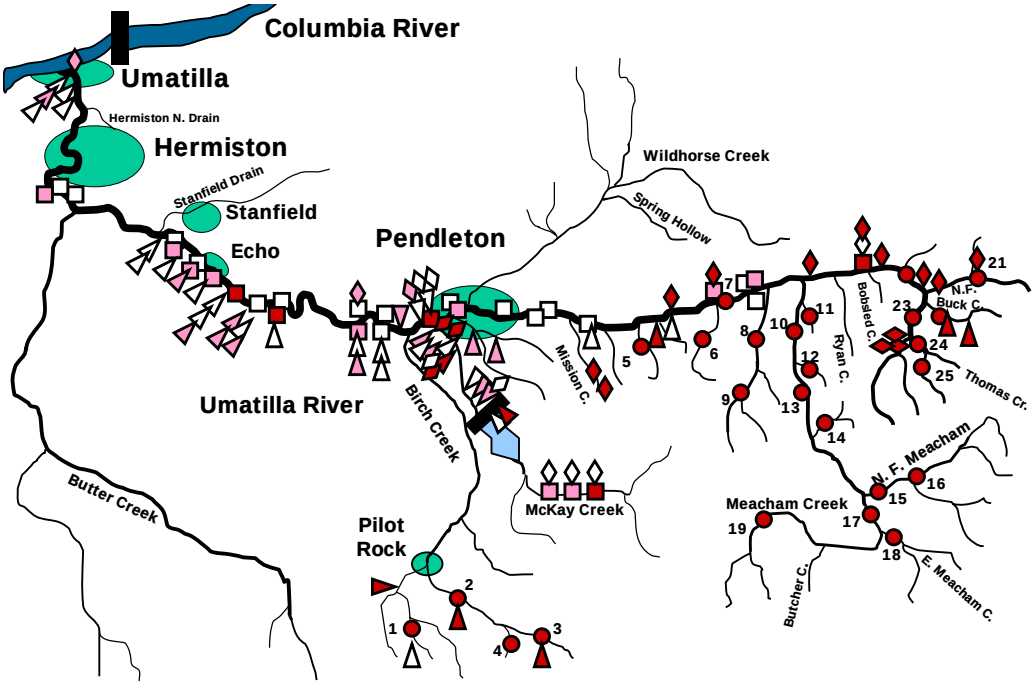


Figure 20. Summary of juvenile summer steelhead collected from the Umatilla River Basin, 1999-2002 by location. Circles represent index sites (1999-2002). Squares, triangles and diamonds represent presence absence surveys conducted during 1999, 2000 and 2001 respectively. Dark symbols denote moderate to high numbers. Lightly colored symbols represent low numbers.

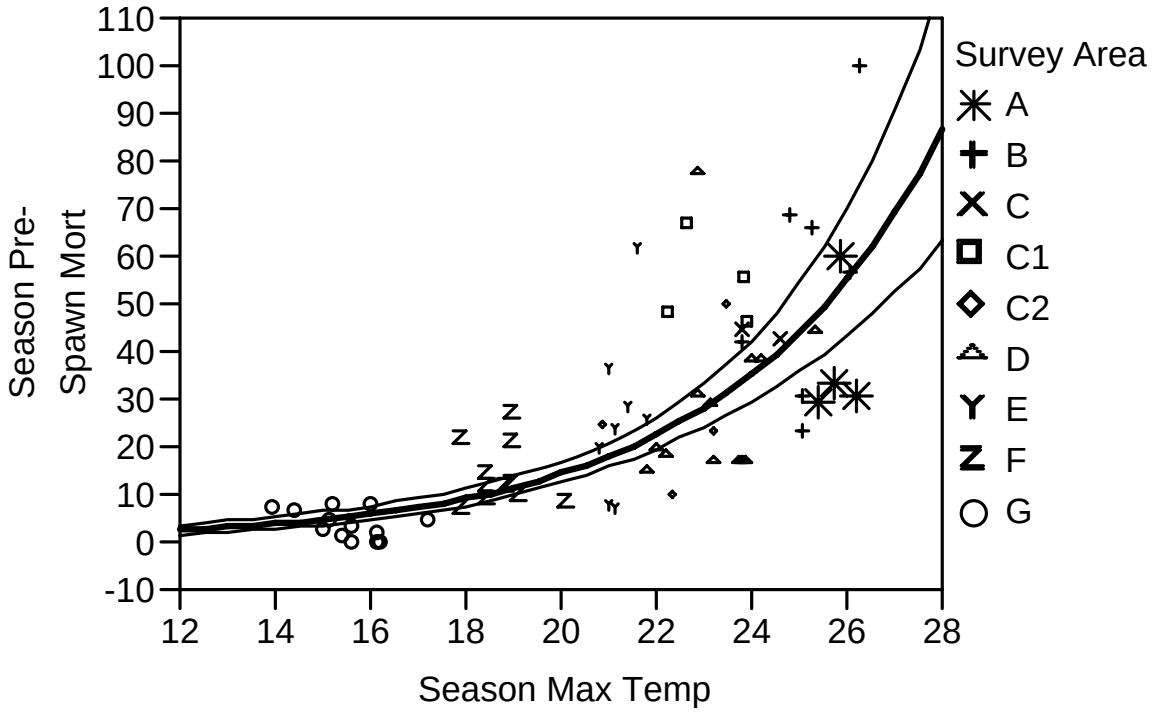


Figure 21 Relationship between the maximum stream temperature (Celsius) and pre-spawning mortality (%) for spring Chinook in the Umatilla River.

More recently the ISRP and other scientific bodies have raised serious questions regarding the impacts of hatchery spawners on natural production. In the Umatilla these questions are being assessed without significantly disrupting the production aspects of the program. Project 20020300 was sponsored by CTUIR to "Develop a Progeny Marker for Salmonids to Evaluate Supplementation". The project has developed and tested a strontium marker for salmonids that can be used in parallel to, or in replacement of, genetic samples. The elemental marker is injected in pre-spawning female adults, and is transferred to the otoliths of its progeny. This is especially important for steelhead because some matings include resident rainbow trout that confound genetic pedigree analysis.

In 2007-2008 the progeny marker project will begin field testing a strontium marker in tandem with DNA sampling. The project will use a picket weir to collect adult steelhead returning to Iskuulpa Creek, a tributary to the Umatilla River. Based on direct observations of spawners, Iskuulpa supports both a healthy hatchery-spawned and naturally-reared return. Adults will be opercle punched at the weir. Downstream migrants (kelts), carcasses, and reds will be sampled as well. In the summer, fingerlings, parr, and resident fish will be collected from the rearing areas of Iskuulpa Creek. Some of these will have a strontium mark in the otolith, whereas some will not. The difference between these two, adjusted for the number of marked vs. unmarked fish at the weir and the contribution from resident fish, will provide an estimate of the relative success of hatchery versus natural females in producing parr. This project is part of the NPCC Independent Scientific Advisory Board's comprehensive suite of projects to evaluate the effects of supplementation. Its results will be used in the future to adapt and improve the Umatilla and other supplementation programs. In addition, the completion of abundance and productivity time

series datasets for all of Oregon's Mid-C steelhead populations will allow for a side by side comparison of Umatilla steelhead with un-supplemented reference populations in the John Day Basin.

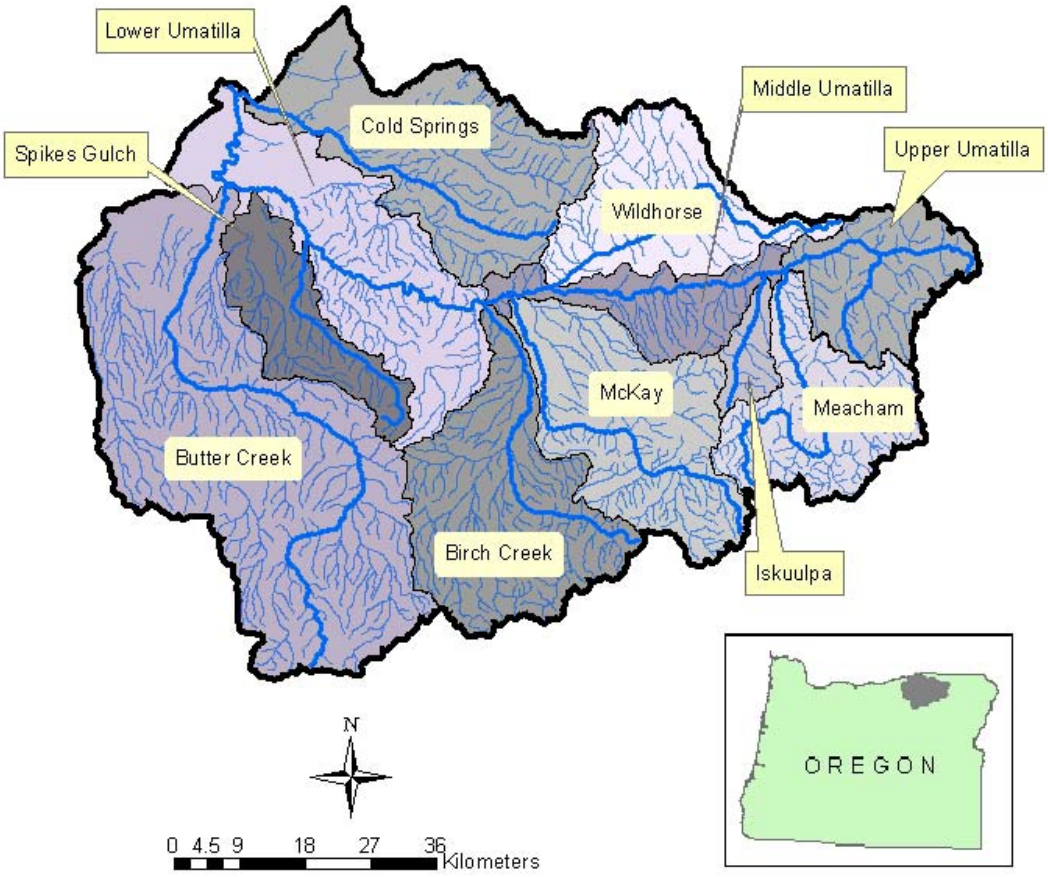


Figure 22. Major watersheds of the Umatilla Subbasin. Upper Umatilla contains both the North and South Forks.

Planned Research, Monitoring and Evaluation - The recently updated comprehensive RM&E plan is extensive, peer reviewed, and was favorably reviewed by ISRP during 2005. The comprehensive RM&E plan was specifically written to provide detailed information of prioritized M&E objectives, experimental designs, methods and protocol. The comprehensive RM&E Plan was developed from numerous planning processes starting with the original Umatilla Basin Project Master Plan in the 1980s, four subbasin planning efforts, and direct input from local and regional managers, the ISRP, BPA staff, and Council staff.

The RM&E plan encompasses several projects, including the Umatilla Salmonid Outmigration and Survival project (BPA project #198902401), Umatilla Hatchery Monitoring and Evaluation Project (BPA project #199000500), Umatilla Salmonid Natural Production Project (BPA project #199000501), as well as the Lamprey and Mussel Projects. These primary RM&E projects work

closely with the Umatilla Fish Passage Project, Umatilla Flow Enhancement Projects, Hatchery Programs, and Umatilla Fish Health Monitoring projects

Many of the monitoring and evaluation activities described in the plan are in place. However, several currently unfunded activities are proposed in this plan to address key information gaps. These proposed activities include reinstatement of basic monitoring (status monitoring of habitat and juveniles in rearing areas), modification of ongoing monitoring, critical uncertainty research, and innovative study approaches. A process for prioritization of M&E activities and funding was undertaken by co-managers and funding agencies following ISRP review of Subbasin management and M&E plans. Therefore the M&E Plan identifies the priority of the ongoing and proposed RM&E activities.

One priority of the program is to develop a study which addresses the impacts of habitat restoration on salmonid production (productivity and capacity). A subbasin-wide study of this nature is not practical due to the size of the system, and the mosaic of land-owners and land-uses including public, private, and tribal parties. Instead a smaller-scale habitat study was designed. Actions in Meacham creek were developed in cooperation with the EPA and railroad interests whose footprint dominate the landscape. Meacham is therefore serving as a treatment watershed that will receive extensive habitat treatments in the coming years (Figure 22). The North Fork of the Umatilla is pristine wilderness and will serve as a control for the Meacham Study. The South Fork of the Umatilla has a forest road going through it that will not be improved, and will serve as an out-group for the experiment. There are replicate reaches within each of these watersheds, but no replicate watersheds due to the limited number of tributaries in the watershed of a size similar to Meacham Creek. All though this design is not ideal, it does represent a habitat experiment in the purest sense. However, no funds have been provided by BPA to support this work. Regardless of the design, the co-managers will be unable to incorporate this long-term habitat experiment in the Fish and Wildlife program unless funds are made available to support the field and analytical work. Some additional details are referenced below.

Another central element of the Umatilla RM&E Plan involved ecological interactions. In general Pacific Northwest scientists are very familiar with the direct impacts of habitat, harvest, hydrosystems, and hatcheries on direct mortality. They are less familiar with the indirect impacts of treatments on productivity or capacity through ecological interactions. The co-managers planned to propose a study of the interactions outlined in sections 2-5 of Table 9. The approach was to survey watersheds with strong single-species indicators (Section 1), and relate these to higher order interactions. In theory this would provide some insight into the potential for ecological improvements to benefit single-species production. This study was considered to be of lower priority than other more pressing needs such as smolt monitoring.

Table 9. Metrics of current RM&E plan.

1. Single Species Metrics	3. Food Web Metrics	5. Systems Analysis Metrics
a. Abundance b. Distribution c. Habitat d. Growth Rates e. Length-Frequency Relationship f. Fecundity and Productivity g. Population Trajectories h. Genetics i. Harvest **2. Community Metrics** a. Diversity b. Multi-Species Interaction Rates c. Competitive Interaction Rates d. Natural Mortality	a. Food Web Structure b. Connectivity c. Food Chain Length d. Link Density e. Omnivory and Cannibalism f. Predator/Prey Ratios **4. Aggregate Metrics** a. Flux b. Ascendancy c. Capacity d. Efficiency e. Guild Composition f. Guild Production	a. Exergy b. Emergy c. Ecosystem Production d. Ecosystem Mass e. Resilience f. Persistence g. Resistance h. Stability i. Free Energy j. Information Content

7. Habitat Enhancement Effectiveness Monitoring

The CTUIR Habitat Enhancement program in the Umatilla River Subbasin began in the late 1980's as an effort to address aquatic habitat deficiencies with emphasis on the physical environment supporting anadromous salmonid fish species. Actions were employed to address parameters limiting the specific salmonid species of steelhead (Oncorhynchus mykiss), spring and fall Chinook salmon (Oncorhynchus tschawytscha) and coho salmon (Oncorhynchus kisutch). The main targeted parameters for improvement have included water quality (mainly temperature and sedimentation), riparian area condition, spawning and rearing habitat quantity and quality, migration corridor access and condition, and physical geomorphic condition. In addition to measuring project effectiveness, habitat related monitoring has been used to determine baseline conditions, identify and prioritize project areas, verify implementation compliance, and provide information for improvement of future actions (adaptive management).

Biological and physical monitoring information collected through the CTUIR, USFS, and ODFW Monitoring and Evaluation programs has had a significant role in prioritizing geographic target areas for restoration activity. Biological inventories have provided information about key salmonid species presence, population densities, and population health. This data also provided important information about the distribution and uses of different portions of the Umatilla River system by various life history stages of salmonid species. The physical information collected through these M & E programs focused on measuring the quantity and quality of salmonid habitats by using a habitat survey methodology described by K. Moore *et. al.* (Moore, Kelley M.S., Jones, Kim, K. Dambacher, Jeffrey M. 2002. Methods for Stream Habitat Surveys version 12.1: Oregon Department of Fish and Wildlife, Aquatic Habitat Inventory Project. Corvallis, OR 97730.) and measuring stream temperature using fixed location thermistors. Together this information has been used by the Habitat Program to inform decisions on selecting areas where salmonid habitat is deficient and salmonid use is important.

Habitat effectiveness monitoring by the CTUIR Habitat Program has continued to be conducted for the general purpose of measuring the success of fisheries habitat projects and providing information to the planning and design process for new projects. The main parameters measured have included stream temperature (using continuously recording thermographs at fixed locations along with FLIR data across a wider spatial scale), suspended sediment (using automated ISCO samplers to collect and combine 4 daily water samples analyzed for turbidity, total suspended sediment, and conductivity), vegetation condition and survival, and physical channel and floodplain conditions (measured by habitat surveys, physical land surveys, and fixed photographic points). Secondary monitoring completed on a less frequent schedule and sporadic locations also included aquatic macro invertebrate sampling. The information gained from the DrDSE project also provided information to habitat restoration project planning in the context of restoring complete floodplain function. The DrDSE results have provided information, data, and remote sensing tools and techniques for better understanding the conditions and processes in alluvial valleys.

Table 10 shows the monitoring parameters and measurement frequency for the Umatilla Project. There has also been coordination with the CTUIR Natural Production M&E project to utilize additional long-term thermistors located along the mainstem Umatilla River and biological inventory information for anadromous salmonids in the Umatilla River Basin to attempt to show causative changes in population extent and use. For example, in Meacham Creek (the high priority targeted CTUIR habitat enhancement location), deployment of thermographs and juvenile abundance monitoring was conducted to develop pre-project baseline data. As the project is implemented and completed, collection of data will continue periodically to monitor changes in Meacham Creek as well as comparisons of non-projects areas elsewhere in the Umatilla Basin.

Table 10. Umatilla Fisheries Habitat Project monitoring regime.

Monitoring Objective	Monitoring Parameter	Sample Frequency (years)
Physical Effectiveness	Photo Points	1
Physical Effectiveness	Water temperature (temporal)	1
Physical Effectiveness	Water temp (spatial FLIR)	10
Physical Effectiveness	Ambient Air temp	1
Physical Effectiveness	Woody Debris	5
Physical Effectiveness	Channel morphology (cross-sections, longitudinal profile)	5
Physical Effectiveness	Vegetation grids	5
Physical Effectiveness	Land Use	5
Physical Effectiveness	Bank Stability	5
Physical Effectiveness	Substrate	5
Physical Effectiveness	Percent Shade	5
Baseline/Effectiveness	Water temperature (temporal)	1
Baseline/Effectiveness	Channel morphology (LiDAR)	10
Biological Trends	Aquatic macro invertebrates	5
Biological Trends	Juvenile abundance[1 2]	1
Biological Trends	Adult use/redd counts[1]	1

[1]Monitoring through coordination with Natural Production M&E project
[2]Currently not funded

Recent monitoring efforts have begun to utilize a more advanced approach to developing projects with an integrated monitoring plan that is specific to the project actions. This strategy will follow a before-after-control-impact (BACI) approach, a paired watershed approach, or a retrospective study depending on the availability of data and the initiation setup of the project actions. Effectiveness monitoring parameters for each project will be defined by the objectives in an effort to measure the success of achieving each objective. The Meacham Creek Restoration Project is an example where a modified BACI approach is being employed. The limiting factors for anadromous salmonid populations have been identified in Meacham Creek as stream temperature, habitat quality, and habitat diversity. In addition channel stability, floodplain connection, and riparian vegetation condition have been identified as issues that may be degraded or not properly functioning. A monitoring plan has been developed for the purpose of measuring effectiveness of restoration actions for objectives that address these limiting factors and issues. The physical measures included in the plan are stream temperature (both spatial and temporal), suspended sediment, flow discharge, physical land surveys (cross-sections and longitudinal), and a hyporheic flow assessment using techniques learned from the DrDSE project Biological parameters measured as macro invertebrate sampling, juvenile salmonid sampling, and redd counts in an attempt to detect change due to restoration actions. An attempt will be made to coordinate the sampling within the Meacham Creek Watershed with sampling throughout the Umatilla River Subbasin in order to show changes in the salmonid population and not just shifts in use.

Future effectiveness monitoring efforts will continue to utilize a scientifically credible approach and an improved project planning strategy. Efforts will also continue to strengthen the coordination between the Habitat Restoration program and the M&E program.

8. Hatchery Monitoring and Evaluation

Formal Hatchery M&E for the Umatilla program first began in 1984. Initially, the CTUIR Umatilla Hatchery Satellite Facilities O&M Project reported coded-wire tagging and recovery. After implementation of the Master Plan, the ODFW Hatchery M&E Project became responsible for this task. Pathology monitoring was included as a subcomponent of the Hatchery M&E. Initial focus of Hatchery M&E was optimizing rearing strategies at the newly constructed Umatilla Hatchery. Results of early studies were used to adaptively manage the hatchery program. Chinook salmon rearing was shifted to oxygen-supplemented raceways (steelhead were already reared in oxygen-supplemented raceways), and spring and fall releases of subyearlings were discontinued for spring Chinook salmon. Preferred rearing density for adult production was determined for subyearling fall Chinook salmon but not implemented because smolt production was downsized and priorities shifted to low density rearing to maximize smolt-to-adult survival. Additional evaluation of acclimation was not pursued because managers shifted their focus to evaluation of higher priority needs that arose as the program matured. Managers and M&E staff addressed these new needs by developing two evaluations (Figure D, Appendix C, RM&E Plan objectives 8a1 and 8a2) to assess new strategies for improving hatchery performance.

The first four broods of spring Chinook salmon reared at Umatilla Hatchery survived poorly. In response, managers and M&E staff developed an evaluation (Figure D, Appendix C, RM&E Plan Objective 8a2) to assess if extending the duration of time spent in a natural temperature regime during the final stages of rearing can improve their smolt-to-adult survival. Treatments

are a group transferred from the relatively warm and constant temperature hatchery to the surface water supplied acclimation facility in November and controls are normal production transferred in January. Initial results have been reported in the Umatilla Comprehensive Report (Grant et al. 2007). The strategy did not significantly change smolt-to-adult survival, but provides the benefit of increasing rearing capacity at Umatilla Hatchery by reducing biomass during the peak water demand period of fall and winter. This has provided managers the opportunity to shift all smolt production at Little White Salmon Hatchery to Umatilla Hatchery. This management change has improved overall smolt-to-adult survival which has averaged three times higher for smolts reared at Umatilla Hatchery than at Little White Salmon Hatchery.

In 2000, managers reduced production of subyearling fall Chinook salmon at Umatilla Hatchery from 2.97 million to 600 thousand due to low smolt-to-adult survival and high costs of associated with wire-tagging all of the releases. The downsizing is considered temporary until a means of increasing survival without increasing straying to unacceptable levels is identified. Managers and M&E staff collaboratively developed an evaluation (Figure D, Appendix C, RM&E Plan Objective 8a2) that assesses whether a programmatic change of larger size-at-release and direct-stream release lower in the subbasin could increase smolt-to-adult survival and keep straying into the Snake River ESU within acceptable limits. Results are very preliminary, but the programmatic change has initially shown potential for increasing smolt-to-adult survival (45%) and substantially reducing straying. Aside from ESA benefits, reduced straying can substantially increase adult return to TMD , because on average 44% of Umatilla fall Chinook returns reaching the mouth of the Umatilla River stray to the upper Columbia and Snake rivers. Reduced straying would not normally be expected from releases lower in the river, but the Umatilla River has some uncommon attributes. Flow in the Umatilla River is primarily from stored water releases from McKay Reservoir in September and October when most of the fall Chinook salmon return in the Columbia River passes the mouth of the Umatilla River. Our “past program control” is acclimation and release 21.5 miles upstream of McKay water inputs at river mile 52, whereas treatments are released a couple of miles downstream of McKay water inputs.

More recently, hatchery M&E objectives were redefined and prioritized by the Umatilla M&E Plan which was developed and adopted as a component of the Umatilla Subbasin Plan. Hatchery M&E objectives (Figure D, Appendix C, M&E Plan Objectives 7a, 9c, 9a2, 7b, 4a, 9b, 6b, 6a, 9a1) include primarily observational monitoring, data reporting, and assessments. This core monitoring provide local and regional resource specialists a complete accounting of smolt production, smolt release information, smolt migration timing and survival, smolt-to-adult survival, adult production, adult return, brood collection timing, spawning contributions, harvest, and straying of all hatchery production groups. Local managers rely on this information to determine whether the hatchery program is meeting management goals or protocols and help identify components of the program that might be improved by adaptive management. The two ongoing evaluations described above are examples of how the core monitoring information was used to identify program areas in need of improvement. Juvenile release and migration and adult straying information is used to plan timing of flow enhancement for the Umatilla Program. The juvenile information is also regularly requested by the Fish Passage Center throughout spring to assist Columbia River hydrosystem managers with in-season adjustments. Our relatively long data series of juvenile migration timing and survival of hatchery fish thru the Columbia River filled a critical need in the Mid-Columbia steelhead stock assessment and recovery planning process. Project staff coordinates with the Washington Department of Fish and Wildlife

(WDFW) Snake River Lab regularly to exchange coded-wire tag release and recovery data, and assist with run reconstruction of ESA-list Chinook salmon stocks.

Fish health monitoring provides critical information needed to manage hatchery operations. Project staff prescribe treatments or recommend remedial actions when fish health issues occur. It maintains a continuous record of disease incidence and severity during hatchery rearing, at smolt release and brood spawning that is used in part to assess effectiveness of disease management. Natural fish are sampled for disease and parasites when Natural Production M&E or Smolt Outmigration M&E encounter mortalities.

Future work may involve comparison of acclimation versus direct stream releases with Chinook salmon. Yearling fall Chinook released in March have two times higher smolt-to-adult survival than fish released in April, but acclimating all production in March is not feasible because all sites are filled to capacity. Similarly, shifting spring Chinook production from Little White Salmon Hatchery to the warmer Umatilla Hatchery has resulted in a need to release all production in or before March as opposed to our past March and April release strategy. Most Hatchery M&E objectives identified in RM&E Plan were funded for 2007-2009. However, we would collaborate with Natural Production M&E to conduct genetic assessments of natural steelhead (RM&E Plan Objective 3b, Figure C, Appendix C) and hatchery steelhead residualism studies if these objectives are funded in the future (RM&E Plan Objective 1d, Figure A in Appendix C).

9. Fisheries Monitoring

Management actions have restored a significant Chinook fishery in the Umatilla River. The spring Chinook fishery consistently attracts participants from distant Eastern Oregon communities, Washington, Idaho, and sometimes Montana and Wyoming. The hatchery steelhead program has allowed non-tribal tribal fisheries managers to implement a selective fishery which has substantially reduced mortality of natural steelhead. Tribal harvest patterns have voluntarily shifted to primarily hatchery steelhead largely due to educational outreach by creel surveyors. Complete marking of hatchery spring Chinook has also allowed protection of natural fish in the non-tribal fishery. Roving creel surveys have been conducted in the Umatilla River since 1990 for spring Chinook and 1992 for fall Chinook and steelhead. The surveys provide mangers information on locations, timing, composition and amounts of catch and harvest, angler demographics, and gear types that are needed for adaptive management and ESA reporting requirements. Surveys below TMD are particularly important for determining run size to the mouth of the Umatilla River for Chinook salmon which is annually requested by the Columbia River Technical Advisory Committee for their ESA reporting requirements. Adaptive management that has occurred includes changes in season duration, timing, location, and increased bag limits and boat ramps to expand fishery opportunities, and restrictions of gear types to reduce fish injury and mortality and improve law enforcement capabilities. Fishery monitoring has also allowed managers to track whether the fishery expands, stabilizes, or contracts over time and assess if changes in smolt release location (steelhead lower in the river) enhance the fishery.

Within-season estimates of tribal spring Chinook harvest-by-reach are developed based on the roving creel surveys (Figure 23). In addition, post-season interviews are conducted via mail. Collectively, these indicate a long-term steady improvement in the spring Chinook fishery,

recent improvements in the fall Chinook and coho fisheries, and no change in the steelhead fishery. The Umatilla River has provided frequent spring Chinook salmon fishery with both Indian and non-Indian seasons open during 14 of the last 18 years. Total annual harvest during open fisheries has ranged from 105 to 1,279

Staff also produces preseason Umatilla River run forecasts to assist with annual management of fisheries and broodstock collection. In addition, continual in-season run forecast adjustments, harvest estimates, and catch patterns are produced to manage the spring Chinook fishery in real time.

Contributions of Umatilla fish to out-of-subbasin fisheries has been tracked since the mid-eighties using coded-wire tag methodology. Fall Chinook in particular provide substantial contributions to out-of-subbasin fisheries. Approximately 65-75% of all fall Chinook produced are harvested in ocean and Columbia River fishery. Out-of-subbasin harvest is lower for spring Chinook (20%) and steelhead (16%) and occurs almost exclusively in the Columbia River. Coded-wire tag recoveries from hatchery fish have provide a surrogate we use for estimating harvest of natural fish in out-of-subbasin fisheries (assuming equal susceptibility in non-selective fisheries). Out-of-basin harvest information is utilized in U.S.-Canada treaty negotiations and Regional Mark Committee annual planning.

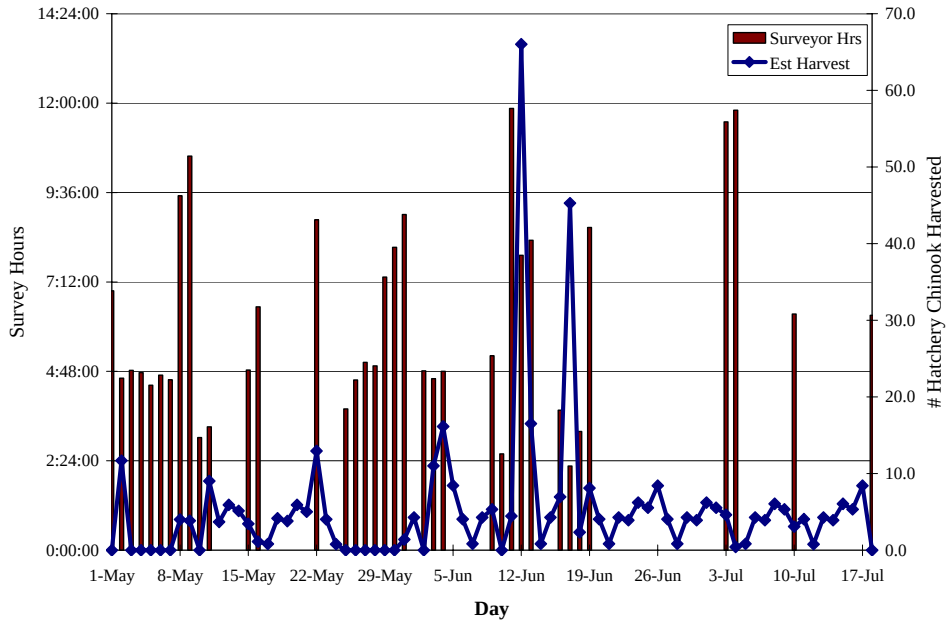


Figure 23. Creel survey effort and estimated tribal harvest during the 2004 spring Chinook fishery.

10. Pacific Lamprey Research and Restoration

Pacific Lamprey (*Lampetra tridentata*) are a critical cultural resource for tribal members. Restoration of Umatilla lamprey populations will both provide harvest opportunities and will recover the ecosystem functions that lamprey provide. Pacific lampreys are vital components of intact ecosystems that have been affected directly and indirectly by dams, habitat deterioration, and possibly food web shifts in the ocean. Native American tribes have been concerned about lamprey decline and the lack of harvest opportunities in the Columbia Basin for years (Close et al. 1995; Jackson et al. 1996; Jackson et al. 1997). Since at least

1988, CTUIR tribal elders noted and discussed declining populations of "eels," and the possibility of restoration in various ceded area streams with Umatilla Tribal Fisheries Staff.

To initiate the restoration of Pacific lamprey in the Umatilla Subbasin, CTUIR developed a restoration plan approved by the Northwest Power and Conservation Council (NWPPC) in 1999. In 2000, the CTUIR initiated a lamprey research and restoration pilot project in the Umatilla River that has continued to the present. The long-term goal of this project is to restore natural production of Pacific lampreys in the Umatilla River to self-sustaining and harvestable levels. The Umatilla River basin was chosen by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) as the initial pilot project for several reasons, 1) the Umatilla River historically produced fishable numbers of lampreys, 2) recovery efforts for salmonids in the basin may help with overall recovery of Pacific lampreys, and 3) current population levels of Pacific lampreys are extremely low.

Since initiation of the CTUIR lamprey project in 1995, work has occurred under three general objectives. Project accomplishments and timeframes are indicated under each objective below:

1) Document historic and current abundance of Pacific lamprey in the Columbia River and tributaries in northeast Oregon.

- 1995 – completed Status Report of the Pacific lamprey in the Columbia River Basin
- 1996 – participated with US Army COE to start lamprey counts at Bonneville Dam
- 1998 – assessed abundance in NE Oregon tributaries by sampling tributaries.
- 1996-1999 – gained historic knowledge of abundance and use by tribal elder interviews and ODFW employees.

2) Perform research to address critical uncertainties for Columbia River Pacific Lamprey.

- 1996-1997 - assessed clinical indicators of stress in lamprey
- 1996-1997 – assessed radio tagging using stress indicators
- 1998-1999 – evaluated adult homing affinity in lower Columbia River
- 1998 – developed genetic database for determination of lamprey population structure in the Columbia Basin
- 1999 – Assessment of Mitochondrial DNA marker variation among Columbia and Willamette basins
- 1999 - assessed methods for population assessment for upstream-migrating adults and preliminary culture techniques.
- 2000 - assessed the influence of spatial patterns of habitat related to larval abundance
- 2002 - assessed possible migratory pheromones produced by larval Pacific lamprey and stored in gall bladders
- 2000-2003 - assessed the ability of adult Pacific lamprey to detect sea lamprey pheromones
- 2003-2007 - identified structure and function of lamprey stress hormone.
- 2003 - assessed microsatellite markers developed for sea lamprey on Pacific lamprey
- 2005 - assessed AFLP markers to detect populations of Pacific lamprey
- 2005-present – assessed passage of adult lamprey at low head diversion dams in Umatilla River using radiotelemetry
- 2006 - developed microsatellite markers for Pacific lamprey
- 2006 - examined larval and spermiating Pacific lamprey washings for pheromones
- 2007 - testing identified possible pheromones using EOG on Pacific lamprey and behavior tests in the Umatilla River

3) Restore Pacific lamprey to the Umatilla River.

- 1999 – completed Umatilla Basin Pacific Lamprey Restoration Plan
- 2000-present – outplanted spawning-ready adults

- 1998-present – monitored larval lamprey densities
- 1996-present – monitored young adult outmigrants using screw trap
- 2000-present – monitored adult returns by portable assessment traps

The CTUIR would like to restore Pacific lampreys to the Umatilla River basin as part of our ongoing efforts to rebuild ecosystem diversity, function, and traditional cultural opportunities in the system. Current project objectives are: 1) estimate the numbers of adult lampreys entering the Umatilla River, 2) investigate the olfactory cues lamprey use to orient in the Umatilla Subbasin, 3) monitor passage success to spawning areas, 4) develop structures to improve passage success, 5) increase larval abundance in the Umatilla River by continuing to outplant adult lamprey, 6) monitor larval population trends in the Umatilla River by conducting electrofishing surveys, and 7) estimate the numbers of juvenile lampreys migrating out of the Umatilla River.

Since initiation of the project, more than 2,000 spawning ready adult Pacific lamprey collected at mainstem dams (Bonneville, John Day and The Dalles) have been outplanted to the upper reaches of the Umatilla River. As a result larval densities, which were documented to be absent in the upper watershed prior to outplanting, have increased significantly (Figure 24). Where initial surveys in 1998 provided evidence that larval lamprey were not present in the system, after five years of supplementation efforts, we find that larval lampreys are persisting at all upper index sites (Figure 25), providing evidence that habitat may not be the limiting factor for successful recruitment. In contrast, we have not seen a similar success in naturally returning adult spawners, and in fact have counted less than 10 naturally returning adults over the 5-year period. For the long-term goals of this restoration effort to be a success we must ensure that migrating adults can reach their spawning grounds naturally.

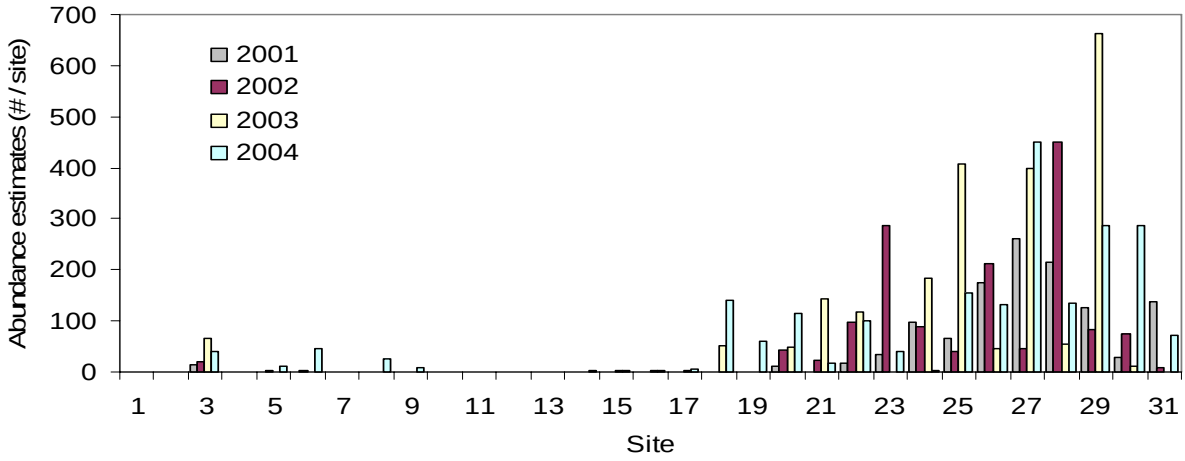


Figure 24. Larval lamprey estimates (# / site) at index sites in the Umatilla River for 2001-2004.

Figure 25. Index sites where larval lampreys were detected in 2004 (green circles), and where lampreys were not detected (red squares).

Pacific lamprey in the Columbia River drainage are affected by many of the same threats facing anadromous salmonids: reduced access to spawning habitat, degradation of spawning and rearing areas, losses of emigrating juveniles to turbine entrainment, and non-indigenous predators. Previous research in the Umatilla River has established that there are functional upstream spawning and rearing habitats for Pacific lamprey (Figures 24 & 25, Howard and Close 2003, Howard et al. 2004). However, the mechanisms guiding lamprey into Umatilla River and the ability of lamprey to pass through the migratory corridor to reach spawning grounds remains of concern. The proposed work will address these unknowns.

While large hydropower projects are clearly obstacles to upstream movement of adult lamprey, there are indications that smaller structures (e.g., low-elevation dams, weirs, and irrigation diversions) may also restrict lamprey access to spawning areas. There are six low elevation dams that may obstruct adult Pacific lamprey passage in the Umatilla River

In 2005 we initiated a pilot radiotelemetry study to determine whether this technology could be used to assess the effects of low elevation structures on adult lamprey passage in the Umatilla River. Preliminary data indicate that low-elevation structures in the Umatilla River are obstacles to lamprey movement and that the combination of these obstacles, low water flow, and elevated temperature may prevent any lamprey that enter the Umatilla River from ever reaching desirable spawning habitat (above river kilometer 30).

We propose to elaborate on the pilot work by identifying obstacles to lamprey passage and providing aids to passage where they are most needed. The pilot project indicated that low-elevation structures are likely obstacles to lamprey movement, particularly during periods of low discharge. We will continue to examine passage of radio-tagged lamprey and identify structures with poorest lamprey passage efficiency. We also propose to these structures with devices to aid lamprey passage (as in Moser et al. 2005). We will then monitor passage of radio-tagged lamprey to determine whether the modifications were successful.

The CTUIR's Pacific Lamprey Research and Restoration Project is part of the overall goal to recover an intact, fully functioning ecosystem in the Umatilla River. The CTUIR has other BPA funded projects focusing on restoration of Umatilla Basin for salmonids (structural passage improvements, instream flow enhancement, and habitat enhancement) which are expected to also benefit lamprey. In addition, the Power Repay Project began funding an extended operation of Phase I exchange pumps to provide

instream passage conditions in the lower Umatilla River during the adult Pacific Lamprey summer migration period. Lamprey trapping and radio tracking will be used to evaluate the effectiveness of this action.

11. Freshwater Mussels

Freshwater mussels were historically abundant in the Columbia Bain and can provide a myriad of ecosystem services that benefit other aquatic species, including salmonids. Freshwater mussels have been harvested for food and shell material by Native Americans for over 10,000 years and are considered an important cultural resource. Freshwater mussels are critically endangered world-wide, and in the Umatilla River Basin tribal and federal agencies are currently working to restore freshwater mussel populations as part of their ongoing efforts to rebuild ecosystem diversity, function, and traditional cultural opportunities in the basin. The Umatilla Subbasin Summary is unique in that it specifically calls for strategies that will enhance the potential to restore freshwater shellfish, and the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) has recently completed a three-year study to aid in those restoration efforts. The findings of this study will have utility in other Columbia drainages. However, additional studies are needed to facilitate the reintroduction of freshwater mussels into the Umatilla Basin and other drainages.

As a result of CTUIR efforts, various aspects of freshwater mussel distribution and ecology in the Umatilla River system and nearby drainages have been assessed (Brim Box et al. 2004). These studies have provided empirical information on the historical and current status and distribution of freshwater mussels in this system, and have provided the first genetic data on Columbia River freshwater mussels. They studies have also documented that multiple genera and species of freshwater mussels, although historically extant in the Umatilla River and its tributaries, are now rare or extirpated from the entire river system. These data provide important and sometimes surprising information about freshwater mussels with respect to monitoring, habitat conditions, and basin-wide genetic variation, all of which are highly relevant to a successful restoration program. Based on these preliminary results, we propose a directed continuation and extension of this research program. In particular, additional information are needed on regional phylogenetic subdivision, population genetic structure, demographic history, habitat requirements, host fish relationships, and functional importance before effective management and reintroduction strategies can be developed for the Umatilla River and other rivers in the Columbia Basin.

12. Integration and Summary

The Umatilla Monitoring and Evaluation Program was developed based on a before-and-after, status and trends, and limiting-factors analysis design. The program was built upon the objectives of managers, and the logistical inputs of scientists (Figures A through E in Appendix C). It emphasizes a connection between objectives, assumptions, and field/laboratory/analytical work. The recent Umatilla RM&E plan provides greater integration with more recent conservation issues, management objectives, and field activities. Future additional work, including the implementation of a higher-resolution experimental design, EMAP surveys, and direct study of the impacts of hatcheries and habitat on natural production will require careful planning and, perhaps more importantly, additional resources. Figures A-E in Appendix C outline the planned relationships between objectives and outcomes, as well as the gaps between currently funded and unfunded activities.

III. SPECIFIC RESPONSES TO ISRP CONCERNS

A. ISRP's General Concerns about the Umatilla Program

> *….The Umatilla Program is too complex to adequately review in an annual process and needs a more intensive review including a site visit and presentation and discussion of results. Such a site review should be comprehensive enough to include an assessment of program goals and measurable objectives, results to date based on whether the program is leading to increased natural production (preliminary data to date do not show this is happening), design and structure of the M&E program, and importance of entire O&M elements. Also, there is a need to show how co-manager's programs are working together (or at least in communication).*

The Umatilla Program is inherently complex, and is difficult to review in the context of a basin-wide project review. The Umatilla Program is the an All-H restoration program, and has elements that touch on virtually every area of the Fish and Wildlife Program and Plan. The program was formulated and founded within a comprehensive review by NPCC and BPA, and codified in numerous agreements including the Umatilla Hatchery Master Plan and the Umatilla Basin Project with BOR to restore/enhance fisheries, natural populations of salmon and steelhead, and provide cultural and social benefits..

The goals of the program are diverse, and they differ from those in some other systems where the same suite of co-managers operate. Natural production is one of the important goals, however, not the singular, goal of the Umatilla program. The program should be reviewed in the context of broad sense recovery including ecological, social and cultural goals. The pre-program history can provide additional context for the ISRP review. Before the Umatilla program was initiated:

1) the Umatilla River was virtually dry for extended periods of the year
2) there were virtually no Chinook salmon in the Umatilla River
3) there were no coho salmon in the Umatilla River
4) the Umatilla steelhead population was in decline
5) the status and distribution of rearing and resident salmonids in the Umatilla was virtually unknown
6) the condition of Umatilla stream and riparian habitat was virtually unknown
7) the river was peppered with barriers that were completely impassible during certain flow conditions
8) with the exception of resident trout fisheries, Umatilla harvest, especially tribal harvest, was virtually absent from the system

In less then two decades all of these shortfalls have been reversed. Much of this has been accomplished through cooperation and communication locally. The co-managers meet regularly in:

1) the Umatilla Management and Monitoring Oversight Committee
2) the River Operations Group
3) the development of Annual Operation Plan for the Umatilla Hatchery and passage operations
4) the development of pre-season and within season harvest regimes

This ISRP review and the comments and criticism of the ISRP are welcomed; especially those that address increased collaboration, communication, and integration through contractual, structural, and reporting changes. The following text provides detailed responses to questions raised by the ISRP to support progress on this front. The utility and clarity of these responses will be maximized by a constant

reminder of the program goals: reintroduction, harvest, improved ecological function, *and* natural production.

B. ISRP's Concerns Regarding Flow and Passage Projects

1. Power Repay

An overriding question has to do with evaluation of effectiveness (in benefiting fish) of one of the primary measures being undertaken, ostensibly to benefit fish, namely the pumping of water from the Columbia River into the Umatilla Basin to be shared equally, "bucket for bucket" to benefit irrigators and fish. We find no proposal in the Umatilla collection that addresses the evaluation of benefits to fish of this measure. Yet, the results of all the other measures being undertaken in the Umatilla Basin certainly are affected by the amount and timing of water made available by the pumping strategy.

This project (Power Repay # 198902700) and other in the Umatilla Basin like it are individual parts of the "Umatilla Initiative". As such, none of them is a stand alone proposal that is susceptible to scientific peer review. This proposal, for example, includes no information on the amount of water pumped from the Columbia or on possible effects on fish.…… information being gathered is not adequate to evaluate the effectiveness of the pumping measure in terms of providing benefits to fish.….This suggests that proponents might benefit from reorganizing their efforts under a single head. That would provide a unified perspective, leading clarification of the fact that the success of all the individual efforts is affected by the pumping of water from the Columbia River. Monitoring and evaluation should then focus upon documenting flow manipulations and measuring the effects on fish passage and survival.

"It remains unclear why the total cost of the Power Repay Project #198902700 ($1.5 million) is charged to the Council's Fish and Wildlife Budget, when the pumped water is shared "bucket for bucket' with irrigators... What is the appropriate charge to Council's Fish and Wildlife Program of the cost of pumping water from the Columbia River into the Umatilla Basin ? Are there more cost-effective measures that could restore water for fish into the Umatilla River; e.g., what might be the relative cost/benefits of purchase of lands and their associated water rights versus the present cost of electricity to pump water from the Columbia River?"

"Is there a cap to the volume of water that might be requested to be pumped, and if so, what is the cap?"

BPA incurs the cost of pumping the amount of water equal to live flow left in the river for fish migration as well as that pumped in exchange for storage water in McKay Reservoir. It serves as off-site mitigation for mortality caused by the lower dams. Any amount of water pumped to irrigators above that amount is billed to the appropriate Irrigation District. There is no "cap" for the pumping. Fish managers desire to maintain 250 cfs to the Umatilla River mouth for fish migration and 300 cfs for homing and migration in the fall thru the combination of live flow exchange pumping and release of water stored in McKay Reservoir. Annual pumping costs to BPA have potential to vary considerably depending on the duration, and timing of low flows. Oregon Department of Water Resources does the accounting and annually reports how much water is pumped where and for what purpose, along with live river flows to the NPCC.

Prior to the initiation of the pumping project the Umatilla ran dry for significant portions of the year. The impacts on outmigrating juveniles and returning adults were obvious based on first principles: fish need water. Without the Basin Project in place the Umatilla would run dry again. Adults and juveniles would need to be trapped and hauled in both directions during portions of their runs, and straying from the Umatilla would increase. This is costly and can stress the fish. The co-managers have been unable to identify a clear, justifiable, high-priority monitoring exercise to quantify the benefits of a running river, or

the risks of desiccating it. The co-managers fully support alternative flow restoration strategies. One potential alternative for increasing instream flows is the Columbia Basin Water Transactions Program. This program is uniquely positioned to acquire water rights, however due to the small amount of anticipated water purchase, it would have little or no effect on Umatilla Basin Project pumping costs.

2. Fish Passage O&M

Justification for this project (Passage O&M #198343600) should be specifically provided in the group of individual projects that use the facilities maintained and operated by this one.

Each proposal to BPA included a list of links to other proposals. The Fish Passage Facilities Operations and Maintenance project maintains the ladder and screen sites that provide passage for Umatilla fish. All projects in the Umatilla that deal with anadromous fishes therefore rely upon the services of this project to ensure that facilities are operated and maintained according to accepted fish passage criteria to provide adequate passage conditions for upstream and downstream migrants.

The response to #19802200" also notes "Currently, there is no M&E specific to the passage program being conducted although an updated passage conditions assessment has been proposed for 07-09 under project #19000501. However, this passage assessment component is not identified for funding at this time." The ISRP has previously called attention to the need for a monitoring and evaluation plan to be described in each proposal. Without inclusion of M&E information, the ISRP is unable to discover to what degree or whether anadromous fish actually benefit from actions proposed. Nor have we been able to identify a proposal that would monitor and/or evaluate the effects on fish of the passage facilities in the Umatilla River"

Passage conditions in the Umatilla were studied during the formative years of the Umatilla Natural Production Monitoring and Evaluation Project. As passage changes have been made in the system they are coordinated with in-basin interests along with NMFS. There have been numerous passage changes since the last major passage evaluation was conducted. A comprehensive passage study covering both juvenile and adult migration would certainly be informative, although it is unclear at this time if there are sufficient fiscal resources to support this work.

The "updated passage condition assessment" wording above was made by the project sponsor as a specific reference to evaluation of the effectiveness of passage facilities. Section 2: Migration Survival and Homing briefly describes these evaluations, significant findings, and remaining RM&E needs. M&E related to this topic (Figure B, Appendix C, RM&E Objective 12b) was included in the Juvenile Salmonid Outmigration & Survival Project proposal (#198902401), but should have been described in more detail in the proposal. This objective attempts to associate river conditions and facility operations to smolt passage route preferences at TMD (juvenile fish bypass, spill, or fish ladder) and relative subsequent survival associated with the three routes. The current Comprehensive RM&E plan also includes plans to re-evaluate adult passage to assess emerging and continuing passage concerns identified by Fish Passage Operations biologists.

An alternative, and perhaps more informative, administrative structure would mesh all of the Umatilla projects into one proposal. The proposal would have headings for each of the permitting, operations, maintenance, and M&E components. The elements of the M&E projects which address operations directly could therefore be more easily elucidated. However, this idea of a single proposal for all activities in the Subbasin has never been supported by BPA or NPCC. Instead the funding entities have requested that M&E elements be contained in separate projects. Therefore the M&E proposals are simply cross-referenced in the O&M proposals. The frustration caused by this structure is understandable. However, this conversation and these criticisms should be between ISRP, BPA, and NPCC – they do not involve project sponsors, as these are not decisions that the project sponsors have control over.

3. Fish Passage Operations:

The figures presented in this response (Fish Passage Operations #198802200) suggested that a substantial reduction in the numbers of fish hauled has resulted in recent years. Still the relationship with flow is not clear. There remain sections of the river, between Birch Creek and Three Mile Dam, which continue to dewater – if our interpretation is correct. Are we to assume that no fish mortality occurs in the trap and haul operation? One assumes that volition migration versus truck and haul is to fish's benefit, but we find no attempt to document the extent to which the assumption holds or does not.

Some of the river can still dewater during some of the year: though not typically during peak migration times. Although the precise shape of the relationship between flow and volitional migration is uncertain, its general form is quite clear. Trap and haul is needed when the river is dewatered, and not needed under natural flow regimes.

Mortality observed during the actual activity of trap and haul is typically low and reported in Fish Passage Operations annual reports. Delayed mortality remains a concern. Over the last 16 years there have been three studies to monitor delayed mortality associated with trap and haul of juveniles. Results varied widely ranging from significantly lower survival for transported fish to better survival for transported fish than for controls. An assessment of delayed mortality for adults can be determined from the transport and holding of broodstock. Over the last six years, prespawning mortality of transported fish has ranged from 3.3% for spring Chinook held for outplanting to 5.2% for summer steelhead. The managers would prefer volitional migration when possible and the primary mechanism for eliminating the need for trap and haul is the Umatilla Basin Project.

C. ISRP's Concerns about the Habitat Projects

"Until data are presented to show it to be otherwise, it is faith rather than science that permits a conclusion that changes in habitat have caused increased run-strength. The data presented in response Figure 1 provided no meaningful answer to questions regarding the habitat work. To gain some scientific credibility, sponsors could at least try to provide comparative data from an untreated system to help account for out-of-basin affects. Pointing to modeled results from EDT is not enough. EDT permits formulation of a hypothesis regarding habitat quality, a hypothesis that then needs to be tested.... There remains the need to develop an adaptive management experiment to evaluate the effectiveness of habitat improvement techniques, ultimately to the smolt yield stage. ISRP has recommended to Council that some assistance to subbasins may be required to standardize and establish this process within the basin, and we remain hopeful that Umatilla projects will form part of that exercise. Success should be measured in terms of increased smolt production in the system.....Presentation of results in terms of fish response has gone unheeded in both responses. There remains the need to fully develop the effectiveness evaluation of habitat improvement work.... There is no evidence that an increase in salmonid carrying capacity or productivity is a result of this work... the limiting factors appear to primarily relate to out of basin factors and fish passage within the basin and to flows."

The co-managers have never ascertained that changes in habitat have "caused" increased run strength. Co-managers have concluded that a combination of management actions have resulted in stable or increasing run strength. The specific level of contribution of types of actions varies considerable between species. The primary management actions that have improved returns to the Umatilla have been:

1) hatchery fish reintroduction and supplementation
2) juvenile and adult passage improvement and restoration
3) flow improvements

These actions have undoubtedly increased natural smolt production from the Umatilla Basin. Tributary habitat restoration is principally focused at improving productivity and capacity between the spawning and parr phases. Conversely, smolt production, or the smolt-per-spawner ratio, are impacted in the spawning and rearing areas, as well as in the migratory corridors where flow and passage conditions continue to improve. Therefore, the benefits of habitat restoration cannot be measured based solely on smolt-per-spawner ratios to-and-from TMD. To *quantify* the *direct* impacts it would be necessary to engage in the "adaptive management" or experimental approach referenced above in the ISRP's comments. Both BPA and NPCC have made clear they are unwilling to fund these activities in many systems in the Columbia Basin including the Umatilla – a fact that the ISRP has not clearly acknowledge in past reviews. Without funding it is impossible to partition the specific benefits and responses associated with the tributary habitat actions. Our approach allows us to only assess the combined effects of all the management actions in combination..

The next best thing to *directly measuring and quantifying* the response of spawner-to-parr performance in and around habitat restoration areas is to model the response. The co-managers have used EDT to carefully formulate and present the hypothetical response of Umatilla populations to changes in limiting factors in the habitat restoration areas. Until funding is made available to *directly quantify* spawner-to-parr performance in the habitat restoration areas the EDT analytical framework will have to suffice. When funding for these activities becomes available it would be greatly beneficial to engage the ISRP, as well as CSMEP and PNAMP, in the design of an experimental habitat treatment regime and M&E program.

D. ISRP's Concerns about the Natural Production Project

> *For a project (Natural Production M&E) that began six years ago, with the goal of monitoring natural production of salmonids in the basin in detail, very little data to that effect is presented. In the response, indicate how information from this work will be used to evaluate achievement of the visions, goals, and objectives of the subbasin plan.*

The M&E efforts for the Umatilla Subbasin are focused on:

1) Before-After analysis
2) Limiting Factors analysis
3) Status and Trends in abundance, productivity, diversity and distribution

There is no experimental design targeted explicitly on understanding the relative impacts of alternative hatchery treatments or flow operations. Instead the focus is to assess how population status and trends respond through time to the combined array of actions that are implemented across all the H's, characterize undesirable outcomes, and make adaptive changes based on new information M&E efforts began more than six years ago in the early years of the Umatilla Program during the "Before" baseline period stage. Since that time the Natural Production M&E effort has:

1) documented and described improved spawning performance
2) documented the distribution and a snap-shot of the density of fry and parr
3) closely monitored the relationship between water temperature and spawner performance in the mainstem Umatilla
4) surveyed in-stream and riparian habitat in the entire subbasin
5) analyzed habitat, flow, temperature and passage information using the EDT framework
6) documented ongoing and increased tribal harvest
7) assessed abundance and productivity of steelhead and spring Chinook salmon

An internal addition to the Umatilla Natural Production M&E Project has been the development of an experimental analysis of the impacts of Meacham Creek on salmonid productivity. The design includes

one treatment and two controls, at the watershed scale. Meacham will receive significant habitat treatments, whereas neither the North Fork nor the South Fork of the Umatilla River will receive habitat actions in the coming decade or so. However, as with many components of the Umatilla RM&E Program, investigations of the impacts of habitat on salmon productivity have not been funded by BPA. Without funding, the experimental analyses proposed by ISRP cannot be implemented.

> *The presentation of this proposal (Natural Production M&E) is lengthy, with rather confusing objective(s) that may include 25 of 44 loosely related objectives of several projects. The connection is not well defined, and a clear design is lacking. The purpose, to "support adaptive management of Umatilla salmonid natural production through pro-active monitoring and evaluation of those resources" is vague……...A clear definition of the experiment at hand and the evaluation of key response variable(s), of which there only should be a few (e.g., smolts per spawner as a function of spawner density), is required. What is the experiment? What feature of "salmonid performance" is to be monitored, and why?*
>
> *There are several management actions outlined in Table 3 (Natural Production M&E proposal), but one is unconvinced that the design will sort these actions, nor control for many other confounding factors.*
>
> *Table 4 (Natural Production M&E proposal) lists many monitoring actions, but the purpose is not clear, nor coordinated. There are multiple objectives but a clearer explanation of purpose and linkages is necessary.*
>
> *What if only 198902401 (Juvenile Salmonid Outmigration and Survival M&E and not Natural Production M&E) were supported (or vice versa), would the (natural production) monitoring be adequate?*

There is no singular "experiment at hand" in the Umatilla. It is a system where management actions have been implemented under an adaptive management philosophy to achieve the goals and objectives of management.. These are pursued through the application of best management practices obtained locally and abroad.

A better perspective might be that of the USDA experimental system versus a farm that implements USDA BMPs. In the experimental system academics and practitioners work together to design growth experiments, to implement treatments and controls with great care (often at the expense of production), and carefully measure responses. This might be akin to the Intensively Monitored Watersheds in the Columbia Basin. A farm that implements BMPs is different. Goals and objectives come first. Still, learning and adaptation are critical. How much did you reap? What did you sow? What were the expenses and income? Which pests and other *limiting factors* predominate? What new organic fertilizers are available? Etc. The Umatilla M&E program is structured more like an institution that implements BMPs than an institution of higher learning.

Smolts-per-spawner is an excellent metric of performance for the system at hand. In the Umatilla this metric is responding to numerous cross-correlated activities. The Natural Production M&E project supports adaptive management through some data collection, and extensive use of an analytical framework to help sort out the relative contributions of each activity to smolt productivity and capacity.

The specific data collection activities that CTUIR and ODFW engages in were developed as part of the Hatchery Master Planning process and a long-standing MOA between the co-managers. These determine the features of "salmonid performance" monitored by this project, versus those of ODFW's Hatchery M&E and Outmigration and Survival M&E projects. Project 198902401 was not funded due in part to ISRP reviews, and in part to limitations in funding. Umatilla smolt production will therefore not be monitored in the NPCC program. A more coherent integrated design might be to maintain one single

M&E contract and project with comprehensive analytical and reporting exercises. The co-managers could than focus on the handful of metrics (environmental conditions, harvest, spawners, parr, and smolt performance) needed to conduct before-and-after, status and trends and limiting factors analysis. Recommendations for this design to BPA and NPCC would be welcomed.

> *"Nonetheless, the key recruitment analyses and required basic evaluations of life-stage limiting factors remain unreported, at least in the response (Natural Production M&E #199000501). Such analyses would point to the key elements of fisheries science and management, where actions may be derived based on stock status and trends. For example, Chilcote (2003) suggested wild steelhead in the Umatilla had recruits per spawner values that were lowered in the presence of hatchery steelhead. Do results of this project refute or agree with his relationship?"*

The spawner-recruit curve has been developed for all focal species, and has been presented in numerous forums including project reports. Reviewers were referred to project reports and the Comprehensive Report to review results and conclusions from the M&E program. Unfortunately, the final draft of the Comprehensive Report was not posted to the BPA website until after the project solicitation was finished In the previous project report we presented the updated recruit-per-spawner curve and described some hypotheses regarding its shape and high level of variance. Given the lack of funding for smolt and parr monitoring, the Natural Production M&E Project used the EDT analytical framework to connect limiting factors to specific life stages.

The Umatilla M&E program uses a before-and-after, status and trend, and limiting factors analysis design. Due to the large number of variables at play, it is not possible to determine if recruitment has been "*lowered in the presence of hatchery steelhead*". Nonetheless the specific question is an interesting one. Umatilla recruitment overall has been similar to other middle Columbia steelhead populations. Therefore it would be difficult to determine if percent hatchery spawners has "*lowered*" the recruit-per-spawner ratio of steelhead, or if the response is due simply to density dependant factors which should also be at play as production increases. Therefore, CTUIR is sponsoring a direct investigation of Umatilla steelhead productivity and reproductive success through project 200203000: Salmonid Progeny Markers. The results of that study will be used to further analyze the relationship between hatchery steelhead and recruitment.

> *"There is a need for a Umatilla program review, and within that, a need to define clearly the role of this project (#199000501) in directing management activities within the subbasin. Funding should be qualified on the ability to make that tie. This work is central to the whole effort of fisheries and habitat management in the subbasin. It needs to provide data and inform when to release water, when to truck, etc."*

The Natural Production M&E project role in "***directing*** *management activities within the subbasin*"is strictly to provide information to inform management decisions. The legal responsibility for providing direction falls upon the Umatilla Management, Monitoring, and Evaluation Oversight Committee, of which the Natural Production M&E staff are members and participate. In the Umatilla management decisions are made based on science, logistical, management, and policy criteria. The role of the Natural Production M&E project is to provide data, information, and analysis to the managers to help inform decision making. These products include raw data of habitat, population and harvest performance, as well as analytical products including run-reconstruction, limiting factors analyses, and the impacts of operations on productivity and capacity.

> *This project (Juvenile Salmonid Outmigration and Survival #198902401) should provide data on egg-smolt survival and/or smolts-per-spawner as a function of spawner density to augment the information provided in table 4 (p 33). This is the key response variable in monitoring population dynamics and toward evaluation of management actions. There may also be a*

possibility….to explore alternative methods for estimation of adults to relate smolt yields to spawner abundance more effectively (POST).

These performance metrics referenced above are the building blocks of the before-and-after, status and trend, and limiting factors analyses being conducted in the Umatilla. They are presented in project reports annually, and are also posted to numerous web-sites. Recommendations for alternative methods would be welcomed. We should note that no smolt abundance data available in the future because project however the funding scenario for the subbasin makes implementation of additional remote-sensing equipment difficult or unlikely.

E. ISRP's Concerns about the Hatchery Program

1. Management Concerns:

"In general, the Program seems to be well organized but is not reaching its overall adult fish production goals. Release numbers are presented in a table but few data (text only) on adult returns and harvest are provided. Adult return goals have not been met for any of the species, a result of low smolt-to-adult survival. Some adaptive management is indicated in the spring Chinook program (reductions). There is insufficient communication of program results and impacts, even if there is a separate M&E project."

"The supplementation program remains a concern to the ISRP. There is concern that the whole system will be comprised of fish derived from supplementation, as more and more hatchery fish spawn in the wild. The practice continues in spite of the fact that supplementation, as an ecosystem experiment, remains untested and unproven."

As an ecosystem experiment supplementation has been tested in a general way for hundreds of years. Many of the Columbia Basin stocks have experienced some impacts from supplementation that was implemented more than a hundred years ago. The practice of supplementation continues in the Umatilla because it produces results that are consistent with the reintroduction, harvest, and ecosystem function goals of the program: enhance abundance of natural spawners, enhance the role of carcasses and fish in the food chain of the Umatilla, support harvest, and keep unintended negative impacts within acceptable limits.

Nonetheless there are several conservation and evolutionary concerns that have been raised regarding Umatilla hatchery programs. These concerns continue to be studied in numerous forums. CTUIR co-manages several conservation-based artificial programs in other basins such as the Touchet and Grande Ronde, as well as the hands-off approach in the John Day. The Umatilla subbasin supports a more aggressive harvest-oriented program for Chinook and coho salmon, although adaptation and learning are part of that program. As new information has been derived, concerning fall Chinook for example, the program has been tuned to help support the goals of the co-managers through BMPs. Information supporting those changes has been collected, aggregated, and presented by the Umatilla Hatchery M&E project, suggesting that the communication pathways have been successful.

Although return goals have not been met for natural fish, hatchery steelhead return goals have been approached or met the revised Subbasin Plan goal in three years and the 1995 and 1998 broods of spring Chinook have exceeded the smolt-to-adult survival goal. Spring Chinook returns have provided all Umatilla broodstock needs since 2000 and Indian and non-Indian fisheries have occurred in 14 of the last 18 years. In addition, outplanted Umatilla spring Chinook returns have contibuted to reviving natural production in the neighboring Walla Walla Basin. Harvest is a primary management goal for the spring Chinook hatchery program. This suggests increasing hatchery smolt production, or changes in hatchery smolt release strategies or run allocation would be more effective for meeting management goals.

2. M&E Concerns:

"Research continues on release strategies, but more work may be required on the issue of acclimation sites and steelhead residualism, as well as evidence of collaboration on supplementation studies in the basin."

Past juvenile fish surveys by CTUIR and snorkel surveys by ODFW did not indicate that substantial numbers of residuals are remaining in tributary rearing areas after release. We suspect substantial numbers may residualize some years in the mid-Umatilla mainstem below McKay Creek based on angler reports. We would conduct EMAP juvenile sampling in this area to determine the magnitude and distribution of residuals in the future if funded (Figure C, Appendix C, RM&E Objective 1d). In lieu of that, recruiting catch and release anglers for mark-recapture sampling and recording might be explored, however the evidence to date suggests this is a low-priority issue.

ODFW and CTUIR do collaborate during the experimental design stage of supplementation studies. We worked jointly and with managers on the experimental design of the Iskuulpa Creek progeny-marker study during development of the RM&E Plan (Figure C, Objectives 3e and 3f). In addition, project proposals are distributed to all key program staff for review and also discussed face-to-face in our monthly UMMEOC meeting forum. Additional opportunities for collaboration will depend on sustainable funding for collaborative projects.

"The reported results seem to indicate that the hatchery is not contributing to natural fish populations (see Figures 1 and 2). Are there other actions that need to occur besides hatchery releases and their habitat restoration activities to increase abundance?"

It is unclear if the reviewers are asking how to increase the abundance of naturally spawned fish, or to increase abundance of both the natural and hatchery fractions. The question is generally unclear, given the general nature of the All-H equation. There are numerous actions that could increase the abundance of Chinook and steelhead returns to the Umatilla. These include both in-basin and out-of-basin effects, such as improved passage at the dams, decreased harvest, and a moratorium on additional Columbia River water exports. To improve the production of naturally spawned fish in the Umatilla, in-basin passage conditions could continue to be approved and mainstem flows could be improved through the water trust programs.

"The methods and procedures for collecting data on recovery of marked fish will be done by related projects that are specified. The goal is to obtain full accounting of all artificial production strategies. A missing ingredient seems to be designation of responsibility for combining description of both steps, the marking and recovery methods. Since we assume the present project (Hatchery M&E) has the ultimate responsibility for analysis of the objectives specified, are we to assume that the progress report of this project will include both?"

Yes – both the data sets will be provided in all progress reports. The co-managers share data on a near-real time basis. Analysis that require data from multiple agencies are typically reported based on the standing MOA for M&E responsibilities. A more comprehensive solution might be to change the contractual, project, and reporting structures, and to fully fund a comprehensive collaborative M&E program in the Umatilla Subbasin.

F. ISRP's Concerns about the Lamprey Restoration Project

"Watershed-specific issues, such as identification of specific obstacles to passage, are no doubt important but a concerted, well-coordinated, and cooperative effort would provide better scientific results with respect to identification of physical and biological characteristics of impediments to passage."

CTUIR is seeking to restore Pacific lamprey in the Umatilla Basin by comprehensively addressing all lamprey limiting factors within the watershed and by providing research and cooperation that will improve lamprey monitoring and survival outside the Umatilla Basin. This unique project in the Columbia Basin has been very well coordinated, from initial multi-agency planning to extensive publication of results. This project developed a widely coordinated Umatilla Lamprey Restoration Plan that was initially required by the NPCC prior to implementing this project. In addition, this project initially developed the Columbia Basin Lamprey Technical Workgroup which for the first time, provided a multi-agency forum to identify lamprey limiting factors and coordinate actions to address them. The group continues to meet and in 2005 produced a paper on Critical Uncertainties for Lamprey in the Columbia River Basin. The report was coordinated and approved through all Columbia Basin Fish and Wildlife Authority (CBFWA) members and was submitted to the NPCC to assist them in making Columbia Basin lamprey project funding decisions. The report placed an important value on implementing and monitoring specific restoration actions using means such as transplantation. The report also placed an imminent value on addressing lamprey passage obstacles, both in the Columbia River mainstem and tributaries. Through subcontract, our project utilizes Mary Moser, NOAA, a foremost leader in identification of physical and biological characteristics of impediments to in passage in the Columbia Basin. These efforts demonstrate a very well coordinated, cooperative and scientific effort that has called upon numerous Columbia Basin lamprey "experts", particularly for addressing lamprey passage issues in the Umatilla Basin.

The specific Umatilla watershed was chosen for a comprehensive lamprey restoration program due to the significant habitat improvement progress resulting from salmon and steelhead projects, ongoing projects (outmigration monitoring and adult enumeration/counting window) that could provide assistance in monitoring lamprey and the deep cultural significance of restoring lamprey to the homelands of CTUIR. Although flow and passage measures implemented for salmon and steelhead have also helped lamprey, we have found that additional actions are necessary for lamprey due to their swimming and migration behavior and timing. This is why findings form this project have lead to additional water being provided for summer migration and the proposed work to make existing salmon passage facilities more "lamprey-friendly".

> *The basic question is "Does the region need a lamprey project with similar goals, objectives and tasks in every subbasin?" If this criterion is applied to the Umatilla Basin, the question becomes "What is the innovative work that is being done that is expected to be applicable basinwide, or that requires tasks specific to the Umatilla?"... provide a revision of the Project History section, organized by objectives."*

The Pacific Lamprey Research and Restoration Project was developed with a two pronged approach. First, we realized along with the rest of the researchers and managers, that not much was known about the biology of Pacific lamprey. Therefore the project was developed to answer critical knowledge gaps to help restore lamprey in the Columbia River Basin. This included status of lamprey in the Columbia Basin, Basic biology research to help restoration, and a project in the Umatilla River to restore Pacific lamprey numbers by out-planting spawning lampreys. The Umatilla River pilot study objective was to examine the effects of out-planting adult lampreys. In essence, the study was a before and after case study.

The goal of the lamprey research and restoration out-planting project was to restore natural production of Pacific lampreys in the Umatilla River to self-sustaining and harvestable levels. The project has not reached the mentioned goal. However, not enough time has been given to properly evaluate the Umatilla out-planting study. Studies to evaluate the effects of restoration efforts are not being funded long enough for proper evaluation (ISRP 2002). We started collecting data on the status of Pacific lamprey in the

Umatilla River in 1997. After development of a restoration plan, we began out-planting lampreys in 2000. We expected to see increases in larvae immediately, which we did. However, we did not expect to see increases in young out-migrants until 2006, due to their long larval life history phase from 4-6 years.

From this study, we have evidence that habitat for spawning and rearing is not limiting natural production of lamprey in the Umatilla River. We have found that out-planting adult spawning phase Pacific lamprey into the upper reaches of the Umatilla is a viable method to increase the numbers of larvae. Through time, larval distribution began to extend down stream. In 2005/2006, we captured large numbers of metamorphosed young adults with a screw trap located on the lower Umatilla River. However, we would like to see a few more few more years to determine whether the out-migrant numbers are increasing and making it out of the Umatilla River.

Continued monitoring should occur before this type of out-planting project is transferred to other basins. It is important to properly assess the existing project in the Umatilla River. In addition, the knowledge that we are gaining through our basic research will have broad application for lamprey restoration in the Columbia Basin.

The CTUIR's Lamprey project has produced 8 peer reviewed scientific articles that directly relate to knowledge needs in the Columbia River Basin. We recently submitted a population genetics manuscript to the Journal of North American Fisheries Management (in review). Our findings show that there are genetic differences among adult lampreys sampled from the Pacific Northwest (including Columbia River tributaries), Alaska, and Japan. This research will have broad application to the Columbia River Basin.

During 2006, we were able to identify possible larval migratory pheromones from washings. Washings were collected from Umatilla River larvae. We have identified 4 possible compounds and are currently testing the ability of adults to detect these compounds. In addition, we have identified 2 possible sex pheromones from spermiating lamprey washings. We are working very hard to determine the ability of Pacific lamprey to smell these compounds. This summer we are studying the effects of the compounds on migratory behavior in the Umatilla River. This research may have broad application to the basin for restoration. If we know that larvae release compounds that will attract migrating adult Pacific lamprey, we might use this knowledge to assist in restoration of Columbia River tributaries or even attracting migrants into traps below the dams. If we could trap lampreys below major dams, we could transport them to the forebay for release. Using pheromones to trap organisms has already been shown to be effective with insects and sea lamprey in the Great lakes tributaries.

In addition to the above research, we have the first evidence of ancestral (lamprey) stress hormone structure and function. We are compiling the data into a manuscript to be submitted in the Proceedings of the National Academy of Sciences (PNAS) this year. This research has broad application to the Columbia River Basin. Understanding the effects of stress on salmonids has had broad management implications in the basin. We think understanding stress in lamprey will have management implications as well.

A revision of the CTUIR lamprey project history by general objective is presented in Section II.D.10.

> *"To what degree might factors within the Umatilla Basin still limit abundance even if mainstem passage is improved."*

We think that several factors may limit abundance in the Umatilla Basin. 1) Low head diversion dams, 2) irrigation withdrawals, and 3) lack of migratory pheromones in water exiting the mouth of the Umatilla River. Our recent research shows that lamprey migration can be impeded by low head diversion dams in the Umatilla River. There are hundreds of low head diversion dams in the tributaries of the Columbia and Snake Rivers. All of these dams have the potential to block

or impede the migration of adult lamprey. Irrigation withdrawals could be impacting rearing conditions for lamprey larvae. In addition, outmigrants could be diverted into canals or impinged on screens. Further, lack of water to carry possible migratory pheromones could be an issue for attracting adults.

IV. LITERATURE CITED

BOR (Bureau of Reclamation). 1988. Umatilla Basin Project, Oregon. Planning report, Final environmental impact statement. Boise, Idaho.

Boyce, R.R. 1986. A comprehensive plan for rehabilitation of anadromous fish stocks in the Umatilla river basin. Final report to the Bonneville Power Administration, Portland, Oregon. Report DOE/BP 18008-1.

Brim-Box, J., D. Wolf, J. Howard, C. O'Brien, D. Nez, D. Close. 2004. Distribution and Status of Freshwater Mussels in the Umatilla River System, 2002-2003. Annual Report to BPA, Project No. 200203700. 74 electronic pages.

Cameron, W.A. and S.M. Knapp. 1993. Evaluate the juvenile fish bypass facility in the West Extension Irrigation District Canal at Three Mile Falls Dam and document passage of juvenile salmonids through the juvenile fish bypass facility and east-bank adult fish ladder. Pages 1-48 in S.M. Knapp, editor. Evaluation of juvenile fish bypass and adult fish passage facilities at water diversions in the Umatilla River. Bonneville Power Administration, Report DOE/BP-01385-3.

Cameron, W.A., S.M. Knapp, and B.P. Schrank. 1994. Evaluation of juvenile salmonid bypass facilities, passage, and trapping and loading procedures at various water diversions in the lower Umatilla River and development of trap designs. Pages 1-76 in S.M. Knapp, editor. Evaluation of juvenile fish bypass and adult fish passage facilities at water diversions in the Umatilla River. Bonneville Power Administration, Report DOE/BP-01385-4.

Cameron, W.A., S.M. Knapp, and B.P. Schrank. 1995. Evaluation of Feed and Furnish canal bypass facilities, of juvenile salmonid passage through fish ladders, and of trap and load procedures at Westland Canal on the Umatilla River. Pages 1-98 in S.M. Knapp, editor. Evaluation of juvenile fish bypass and adult fish passage facilities at water diversions on the Umatilla River. Bonneville Power Administration, Report DOE/BP-01385-5.

Cameron, W. A., S. M. Knapp, and R. W. Carmichael. 1997. Evaluation of juvenile salmonid bypass facilities and passage at water diversions on the lower Umatilla River. Final report to Bonneville Power Administration, Portland, Oregon. Report DOE/BP-01385-7.

Carpenter, S. R., and J. F. Kitchell, editors. 1993. The trophic cascade in lakes. Cambridge

Close, D.A. M. Fitzpatrick, H. Li, B. Parker, D. Hatch, and G. James. 1995. Status report of the Pacific Lamprey (*Lampetra tridentata*) in the Columbia River Basin. BPA, Portland Oregon.

Contor, C. R., E. Hoverson, P. Kissner, and J. Volkman. 1996. Umatilla Basin natural production monitoring and evaluation. Annual report 1994-1995 to Bonneville Power Administration, Portland, Oregon. Report DOE/BP-75349-2.

Contor, C. R., E. Hoverson, P. Kissner, and J. Volkman. 1997. Umatilla Basin natural production monitoring and evaluation. Annual report 1995-1996 to Bonneville Power Administration, Portland, Oregon. Report DOE/BP-75349-3.

Contor, C. 2003. Umatilla Basin natural production monitoring and evaluation, 1998-2002 Summary Report, Project No. 199000501, 294 electronic pages, BPA Report DOE/BP-00004115-1.

CRITFC (Columbia River Inter-tribal Fish Commission). 1996. The Columbia River anadromous fish restoration plan (CRFMP)of the Nez Pierce, Umatilla, Warm Springs and Yakima Tribes: Part II Subbasin Plans. Available online at: http://www.critfc.org/tech/subbasin.pdf

Crabtree, D., 1996. Upper Umatilla River and Meacham Creek Watersheds Ecosystem Analysis, Fish and Aquatic Habitat. United States Forest Service, Umatilla National Forest.

CTUIR and ODFW. 1990. Umatilla Hatchery Master Plan. Submitted to the Northwest Power Planning Council.

CTUIR. 1996. The Comprehensive Plan. Pendleton, OR.

CTUIR and ODFW. 2004. Umatilla/Willow Subbasin plan. Prepared for the Northwest Power and Conservation Council. Available online at: http://www.nwcouncil.org/fw/subbasinplanning/umatilla/plan/

Gowan, R. 1986. Use of supplemental oxygen to rear Chinook in saltwater. Pages 35-38 in Papers on the use of supplementatal oxygen to increase hatchery rearing capacity in the Pacific Northwest, Pacific Northwest Fish Culture Conference, December 2-4, 1986, Springfield, Oregon.

Grant J., J.D.M. Schwadrtz, D, W. Cameron, R. Stonecypher, Jr., and R. Carmichael. 2007. Comprehensive assessment of salmonids restoration and enhancement efforts in the Umatilla River Basin. CTUIR, Pendleton, OR and ODFW Portland, OR

Howard, J.K. and D. Close. 2003. Pacific Lamprey Research and Restoration Project, 2003 Annual Report, Project No. 199402600, 134 electronic pages, (BPA Report DOE/BP-00005455-7).

Howard, J.K., D. Close, and A. Jackson. 2004. Pacific Lamprey Research and Restoration Project, 2004 Annual Report, Project No. 199402600, 66 electronic pages, (BPA Report DOE/BP-00005455-8).

IHOT (Integrated Hatchery Operations Team). 1994. Policies and procedures for Columbia River anadromous salmonid hatcheries. Report to the Bonneville Power Administration DOE/EP-2432, Portland, Oregon.

ISRP (Independent Science Review Panel). 2002. Review of council staff's research plan for fish and wildlife in the Columbia River Basin. Prepared for the Northwest Power Planning Council. ISRP 2002-4.

Jackson, A. D., P.D. Kissner, D.R. Hatch, B.L. Parker, D.A. Close, M.S. Fitzpatrick, and H. Li. 1996. Pacific lamprey research and restoration. BPA, Portland Oregon.

Jackson, A. D., D.R. Hatch, B.L. Parker, D.A. Close, M.S. Fitzpatrick, and H. Li. 1997. Pacific lamprey research and restoration. BPA, Portland Oregon.

Kissner, P.D. 1992. Examine the passage of adult salmonids at Three Mile Falls Dam. Pages 104-140 in S.M. Knapp, editor. Evaluation of juvenile fish passage facilities at Three Mile Falls Dam, Umatilla River. Interim annual report to Bonneville Power Administration, Report DOE/BP-01385-2.

Kissner, P.D. 1993. Examine the passage of adult salmonids at Three Mile Falls Dam. Pages 49-97 in S.M. Knapp, editor. Evaluation of juvenile fish bypass and adult fish passage facilities at water diversions in the Umatilla River. Bonneville Power Administration, Report DOE/BP-01385-3.

Knapp, S.M., and D.L. Ward. 1990. Operation and evaluation of the juvenile fish bypass system in the West Extension Irrigation District canal at Three Mile Falls Dam. Pages 4-32 in A.A. Nigro, editor. Evaluation of juvenile fish bypass and adult fish passage facilities at Three Mile Falls Dam, Umatilla River. Annual report to Bonneville Power Administration, Report DOE/BP-01385-1.

Knapp, S.M. 1992. Operation and evaluation of the juvenile fish bypass system in the West Extension Irrigation District canal at Three Mile Falls Dam and documentation of juvenile salmonid passage through the bypass facility and east-bank adult fish ladder. Pages 1-52 in S.M. Knapp, editor. Evaluation of juvenile fish passage facilities at Three Mile Falls Dam, Umatilla River. Interim annual report to Bonneville Power Administration, Report DOE/BP-01385-2.

Kutchins, K. 1990. Examine the passage of adult salmonids at Three Mile Falls Dam. Pages 33-61 in A.A. Nigro, editor. Evaluation of juvenile fish bypass and adult fish passage facilities at Three Mile Falls Dam, Umatilla River. Annual report to Bonneville Power Administration, Report DOE/BP-01385-1.

Lichatowich, J.A. 1992. Umatilla River Basin natural production monitoring and evaluation plan. Confederated Tribes of the Umatilla Indian Reservation prepared by Alder Creek Consulting, Sequim, WA 98382

Moore, K., K. Jones & J. Dambacher. 2002. Methods for stream habitat surveys. pp. 54, Version 12.1, Oregon Department of Fish and Wildlife, Aquatic Inventories Project, Natural Production Program, Corvallis, OR.

Moser, M.L., R.W. Zabel, B.J. Burke, L.C. Stuehrenberg, and T.C. Bjornn. 2005. Factors affecting adult Pacific lamprey passage rates at hydropower dams: using "time to event" analysis of radiotelemetry Data, Pages 61-70. *In*: M.T. Spedicato, G. Marmulla, and G.Lembo, editors, Aquatic Telemetry: Advances and Applications, FAO-COISPA, Rome.

Nigro, A.A. and D.L. Ward. 1986. Evaluation of lower Umatilla River channel modification below Three Mile Falls Dam. Report to Bonneville Power Administration, Report DOE/BP-19130-1.

NPPC (Northwest Power and Conservation Council). 2004. Guide to subbasin planning. Northwest Power and Conservation Council document 2004-07. Available online at: http://www.nwcouncil.org/fw/subbasinplanning/admin/guides/brochure2004_06.pdf ……

Schwartz, J.D.M. and W. Cameron. 2006. Comprehensive research, monitoring and evaluation plan for the Umatilla Basin summer steelhead and Chinook salmon. CTUIR and ODFW U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife, P.O. Box 3621, Portland, Oregon 97208-3621

Severson, R.F., J.L. Stark, and L.M. Poole. 1986. Use of oxygen to commercially rear coho salmon. Pages 25-34 in Papers on the use of supplemental oxygen to increase hatchery rearing capacity in the Pacific Northwest, Pacific Northwest Fish Culture Conference, December 2-4, 1986, Springfield, Oregon.

Shaw R. T. and A. D. Sexton. 2000. Umatilla River Basin anadromous fish habitat enhancement project, 1999 Annual Report. BPA Portland, Oregon.

USFS (U.S. Forest Service). 2001. Umatilla-Meacham Ecosystem Analysis. United States Forest Service, Umatilla National Forest. Available online at: http://www.fs.fed.us/r6/uma/projects/ecosystem/umamea.pdf

Van Cleve, R. and R. Ting. 1960. The condition of salmon stocks in the John Day, Umaitlla, Walla Walla, Grande Ronde, and Imnaha Rivers as Reported by various fisheries agencies.

Volkman, J. 1994. Evaluation of adult passage facilities at water diversions in the Umatilla River. Pages 99-143 in S.M. Knapp, editor. Evaluation of juvenile fish bypass and adult fish passage facilities at water diversions in the Umatilla River. Bonneville Power Administration, Report DOE/BP-01385-4.

Volkman, J. 1995. Evaluation of adult passage facilities at water diversions in the Umatilla River and their movement following upriver transport and assessment of factors for homing into the Umatilla River. Pages 77-116 in S.M. Knapp, editor. Evaluation of juvenile fish bypass and adult fish passage facilities at water diversions on the Umatilla River. Bonneville Power Administration, Report DOE/BP-01385-5.

Walters, T.R., R.D. Ewing, M.A. Lewis, R.W. Carmichael, and M.L. Keefe. 1994. Evaluation of effects of transporting juvenile salmonids on the Umatilla River at high water temperatures. Pages 117-130 in S.M. Knapp, editor. Evaluation of juvenile fish bypass and adult fish passage facilities at water diversions in the Umatilla River. Bonneville Power Administration, Report DOE/BP-01385-3.

Westers, H., V. Bennett, and J. Copeland. 1986. Michigan's experience with supplemental oxygen in salmonid rearing. Pages 12-16 in Papers on the use of supplemental oxygen to increase hatchery rearing capacity in the Pacific Northwest, Pacific Northwest Fish Culture Conference, December 2-4, 1986, Springfield, Oregon.

V. APPENDIXES

Appendix A: Selected Portions of the Subbasin Plan, Management Section
(pages 5-3 through 5-7 CTUIR and ODFW 2004)

5.2 Vision for the Subbasin
The vision for the Umatilla/Willow subbasin is a healthy ecosystem with abundant, productive, viable, and diverse populations of aquatic and terrestrial species, which will support sustainable resource-based activities that contribute to the social, cultural, and economic well-being of the communities within the subbasin and the Pacific Northwest.

This vision entails several broad goals for the subbasin that can be categorized as human use; habitat; population; and research, monitoring, and evaluation goals.

Human Use
- Provide for non-consumptive recreational, educational, aesthetic, scientific, economic, cultural, and religious uses of the subbasin's diverse fish and wildlife resources.
- Provide for sustainable consumptive, ceremonial, subsistence, and recreational uses of the subbasin's diverse fish and wildlife resources.
- Provide for sustainable resource-based activities to support the economies and cultures of the communities within the subbasin.

Habitat
- Protect existing high quality fish and wildlife habitat and strongholds.
- Restore and enhance degraded and diminished fish and wildlife habitats to support population restoration goals and to mitigate impacts from the construction and operation of the Columbia basin hydropower system and other anthropogenic impacts.
- Restore the health and function of ecosystems in the Umatilla/Willow subbasin to ensure continued viability of their natural resources.

Population
- Maintain and enhance the diversity, abundance and productivity of existing fish and wildlife populations within the subbasin.
- Strive for de-listing and avoidance of future listings of native fish and wildlife species in the subbasin under state and federal Endangered Species Acts.
- Restore and maintain self-sustaining populations of extirpated species consistent with habitat availability, public acceptance, and other uses of the lands and waters of the state.

Research, Monitoring, and Evaluation
- Develop a research, monitoring, and evaluation plan for the ecosystems of the subbasin that is consistent with and complements the larger regional efforts to track the status of fish and wildlife populations and their habitats as needed for appraising management actions, the results of these actions, and for evaluating other environmental changes.

5.3 Aquatic Biological Objectives and Strategies

5.3.1 Aquatic Approach and Methods

As described in Section 5.1, the development of objectives and strategies for the aquatic management plan was driven by the vision for the subbasin (Section 5.1), the current biological and ecological conditions, and the economic and social realities described in the assessment (Section 3.0). Two types of objectives were developed by the aquatic working group, numerical objectives for the number of the number of returning adults of steelhead and salmon and habitat objectives designed to improve limiting factors identified by EDT. EDT was the major methodology used to develop objectives for natural returns and to identify limiting factors from which habitat objectives and strategies were derived. In addition, objectives were developed to address passage barriers in the subbasin, which have received little attention in some areas and the impact of which is most likely underestimated by the current EDT outputs. Strategies were also developed by the aquatic working group to improve habitat and to enhance the artificial production programs in the subbasin.

5.3.2 Aquatic Objectives and Strategies

The aquatic working group developed a set of 16 qualitative management objectives that are used to guide more specific, quantitative objectives and strategies. These qualitative management objectives are:

Population and Environmental Status
1: Monitor the status and trends of fish and mussel populations, their habitats and ecosystems throughout the Umatilla Basin.

Natural Production
2: Maintain and enhance natural production, productivity, abundance, life history characteristics and genetic diversity of fish and mussels throughout the Umatilla Basin using habitat protection and improvement.

3: Maintain, augment, and enhance natural production, productivity, abundance, life history characteristics and genetic diversity of steelhead, Chinook, coho, and lamprey throughout the Umatilla Basin using hatchery supplementation and out-planting

4: Maintain the Birch Creek sub-population as a natural steelhead sanctuary (not supplemented).

5: Restore and maintain diverse and productive natural populations of Chinook and coho in the Umatilla Subbasin using hatchery reintroductions.

Hatchery Program
6: Develop and maintain a local brood source for steelhead and Chinook from returns to the Umatilla River.

7: Operate hatchery program to achieve subbasin smolt production, smolt to adult return, and hatchery adult return goals from the subbasin plan.

8: Achieve optimal effectiveness in the operation of the Umatilla Basin steelhead and Chinook hatchery programs while meeting production, population, and conservation objectives for natural- and hatchery-reared fishes.

9: Minimize any negative impacts of the Umatilla Basin hatchery program on natural steelhead and Chinook, and non-target populations.

Flow and Passage

10: Maintain and enhance flow for homing and passage of steelhead and Chinook through the lower Umatilla River using flow restoration and enhancement.

11: Maintain and enhance steelhead and Chinook rearing and spawning habitat in the mainstem Umatilla River with flow enhancement and protection.

12: Maintain and enhance passage of adult and juvenile steelhead and Chinook throughout the Umatilla Subbasin with passage protection and restoration.

Fisheries

13: Maintain and enhance tribal and non-tribal steelhead, Chinook, coho and lamprey fisheries compatible with production, population, and conservation objectives.

Collaboration and Communication

14: Maximize effectiveness of Umatilla Subbasin RM&E projects with collaborative study planning and implementation, synthesis of results, and results dissemination.

15: Maximize management effectiveness of Umatilla Basin fish programs using local and regional protocols in RM&E methodologies that allow exchange of compatible information among local and regional databases and fisheries management entities.

16: Maximize our understanding of the impacts of out-of-basin factors on Umatilla smolt-to-adult survival with collaborative assessments, surveys, tagging, data analysis, modeling, and results dissemination.

In addition to these qualitative management objectives, the aquatic working group also developed numeric population goals for returning adults of steelhead and salmon. These numeric goals include natural returns, hatchery returns, and harvest goals (Table 11). The potential natural production of each species (except coho) expected from the implementation of the management plan is listed as natural return objectives. The current EDT model predicts no sustainable natural production of coho based on the implementation of the habitat restoration plan so a value of ½ PFC was used instead. These expected natural production objectives assume the implementation of all habitat restoration actions including the Phase III flow enhancement project, and the maintenance of Phase I and II flow enhancement projects. Although many habitat actions are included in the management plan, it is the implementation of these flow restoration activities that provide the greatest fish benefits within a 15-year time period (the work projection period of this plan).

Other adult return objectives from past planning efforts are also included in Table 11 Since this plan is a culmination of numerous planning efforts, it is important to recognize anadromous fish objectives from previous planning documents.

Table 11. Comparison of anadromous fish objectives from various plans & processes

Species	Source Plan[1/]	Tot. Return Objective	Natural Returns	Hatchery Returns	Harvest Component
Spring Chinook	1987 USvOR	2,030	870	1,160	-
	1990 SBP	11,000	1,000	10,000	8,800
	1996 TRP	11,000	1,000	10,000	8,800
	2001 SBS	8,000	3,000	6,000	4,000
	2004 EDT[2/]	-	1,702	-	-
Fall Chinook	1990 SBP	21,000	11,000	10,000	5,400
	1996 TRP	21,000	11,000	10,000	5,400
	2001 SBS	12,000	6,000	6,000	5,000
	2004 EDT[2/]	-	4,192	-	-
Coho	1990 SBP	6,000	-	6,000	-
	1996 TRP	6,000	-	6,000	-
	2001 SBS	6,000	-	6,000	-
	2004 EDT[2/]	-	1,568	-	-
Steelhead	1987 USvOR	7,958	4,300	3,658	-
	1990 SBP	9,670	4,000	5,670	5,460
	1996 TRP	9,670	4,000	5,670	5,460
	2001 SBS	5,500	4,000	1,500	1,384
	2004 EDT[2/]	-	3,610	-	-

1/ Sources of spring chinook and steelhead return objectives are as follows:
USvOR = 1987 United States vs Oregon Subbasin Production Reports; SBP = 1990 NPPC Subbasin Plan; TRP = 1996 CRITFC Spirit of the Salmon (Tribal Restoration Plan); SBS = 2001 NPPC Subbasin Summary.

2/ EDT natural production estimates are not objectives but were derived from the PFC analysis in this plan in Section 3.6.1.2.

Appendix B: Umatilla Basin Spring Chinook Management Guidelines

In the mid-1980s, spring Chinook salmon had been absent from the Umatilla River Basin for over 70 years. Losses were generally attributed to water diversions and stream habitat degradation within the basin and impacts related to the Federal hydropower system in the mainstem Columbia River. A comprehensive Umatilla Restoration Plan was developed (Boyce 1986) that identified habitat restoration, tributary passage improvement and artificial propagation measures to restore salmonid populations to the Umatilla River. As part of this basin restoration

effort, spring Chinook juveniles produced at several different hatchery facilities were released into the Umatilla River beginning in 1986 with the intent of providing for fisheries and restoring natural production.

In 1989, a Umatilla Hatchery Program Master Plan was developed. The Master Plan identified facility construction needs (Umatilla Hatchery and satellite facilities) and outlined spring Chinook production objectives as well as establishing goals for adult returns, natural production and harvest. Many changes have been made to the artificial production program through the years, however the overall goals for the spring Chinook program as outlined in the Master Plan have guided operation of the program until recently. In 2001, the Umatilla Subbasin Summary was developed which reassessed the Master Plan goals for spring Chinook and established new goals for the program.

The Subbasin Summary identified an adult return goal of 8,000 spring Chinook returning to the mouth of the Umatilla River. Of the 8,000, 6,000 were anticipated to be hatchery fish and 2,000 were expected to be natural origin adults. Disposition of these 8,000 adults was outlined in the Subbasin Summary as follows; 3,000 for natural spawning escapement (producing 2,000 actual spawners), 1,000 for broodstock, and 4,000 for harvest. Since the Subbasin Summary was produced, the proposed expansion of the artificial production program identified in that document has been dropped from consideration lowering the broodstock need to 560 adults. In addition, further assessment of the quality and quantity of available habitat has determined that under current habitat conditions fewer spawners can be supported than identified under the long term goals. Also, prespawning mortality losses are much higher than previously estimated. Lastly, a new objective, providing adults to the Walla Walla River for natural spawning enhancement monitoring and evaluation has been identified. In response to these new goals and objectives, a management guidelines table (attached) has been developed that designates the number of adults for each purpose at varying return levels.

In order to avoid annual negotiations regarding management decisions for spring Chinook, Umatilla Basin co-managers have agreed to use these management guidelines for setting the annual disposition of adult spring Chinook returning to the Umatilla River for the next two years, or until an agreement is reached that supersedes these guidelines. This will allow harvest levels, broodstock collection rates, and transfer numbers to be determined based on the annual run projection and incorporated into the Umatilla Basin and Hatchery Annual Operating Plan (AOP). There are two general attributes in common to all the disposition categories; 1) the total number of fish includes both natural and hatchery origin adults and no differentiation is placed on origin for any disposition category (with exception of Walla Walla Outplanting) and 2) includes only true adults and not jacks. Following are the details for each disposition category in the table.

Total Run Size

- This is the preseason estimate forecasted in the AOP for number of adults returning to the mouth of the Umatilla River.

- In-season adjustments may be made to follow the management guidelines if significant differences between forecasted and actual adult return numbers are observed.

Broodstock

- The broodstock collection goal for the current 810,000 yearling smolt production program is 560 adults.

- Broodstock will be collected at 50:50 male to female ratio.

- Adults will be collected from a cross section of the run returning to TMD based on a five year running historical average of return timing.

- A minimum program size of 270,000 yearling smolts will be maintained (200 brood).

- At run sizes less than 750 adults, attempts will be made to fulfill the Umatilla program broodstock need from other Carson stock sources in the following priority: 1) Little White Salmon NFH; 2) Carson NFH; and 3) other mid Columbia stations.

Spawning Escapement

- The number of fish identified in the spawning escapement total is the sum of actual spawning fish and those lost to prespawning mortality.

- Percent prespawning loss is estimated to be approximately 54% (Range 40 – 68%) under current habitat conditions.

- Under current habitat conditions, an estimated escapement of 1,875 adults would fully seed the available habitat capacity (600 spawners) under the poorest pre-spawner survival conditions.

- Spawning escapement will be managed for a maximum of 1,875 adults over the next two years. At the end of that period, habitat conditions will be reassessed to determine whether the spawning escapement goal should be changed.

- The long term escapement goal remains at 3,000 adults. This will be contingent on additional habitat enhancement occurring in the upper mainstem Umatilla River and Meacham Creek.

Walla Walla Outplants

- Outplants into the South Fork Walla Walla River will continue for reintroduction and monitoring and evaluation efforts.

- No coded-wire-tagged or unmarked adults will be hauled to the Walla Walla River.

- Adults will be collected from a cross section of the run returning to TMD.

In-River Harvest

- The in-river harvest total includes both Indian and non-Indian fisheries.
- Total harvest is to be proportioned at 50% each for Indian and non-Indian fisheries.
- The harvest goal of 4,000 adults would be achieved at run sizes of 7,000 to 8,000 fish.

Umatilla River Adult Spring Chinook Management Guidelines

Total Run Size	Broodstock	Spawning Escapement	Walla Walla Outplanting	In-River Harvest (% of run)
250	200	50	0	0 (0%)
500	400	100	0	0 (0%)
750	560	150	0	0 (0%)
1000	560	400	0	0 (0%)
1500	560	600	0	300 (20%)
2000	560	800	200	440 (22%)
2500	560	1000	250	690 (28%)
3000	560	1200	300	940 (31%)
3500	560	1400	350	1190 (34%)
4000	560	1600	400	1440 (36%)
4500	560	1800	450	1690 (38%)
5000	560	1875	500	2065 (41%)
5500	560	1875	600	2465 (.45%)
6000	560	1875	700	2865 (.48%)
6500	560	1875	800	3265 (.50%)
7000	560	1875	900	3665 (.52%)
8000	560	1875	1000	4565 (.57%)

Appendix C: Supplemental Tables and Figures

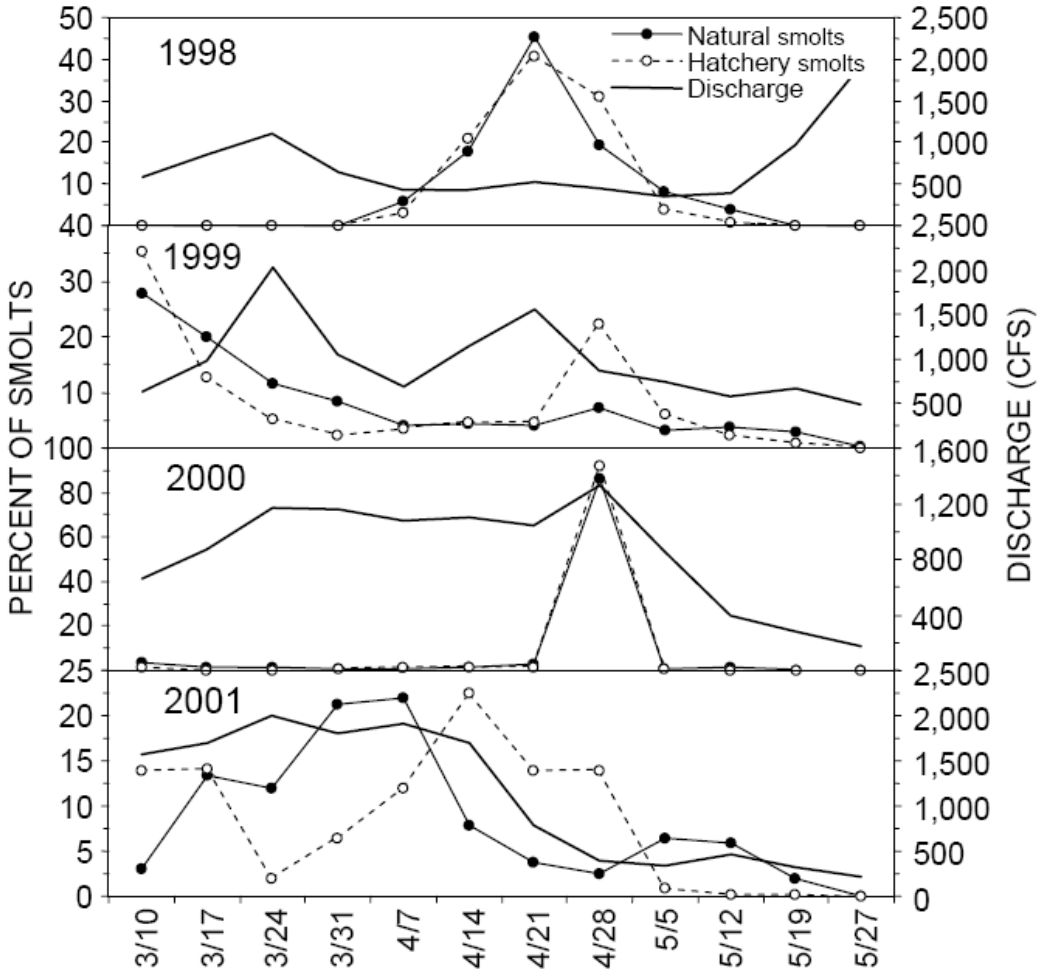


Figure 16. Timing of smolt outmigration for natural and hatchery spring Chinook salmon smolts in the Umatilla River, 1998-2001. Smolt monitoring was conducted with a rotary screw trap in March (RM 1.2) and a fish bypass trap at the West Extension Irrigation District canal in April and May (RM 3.7).

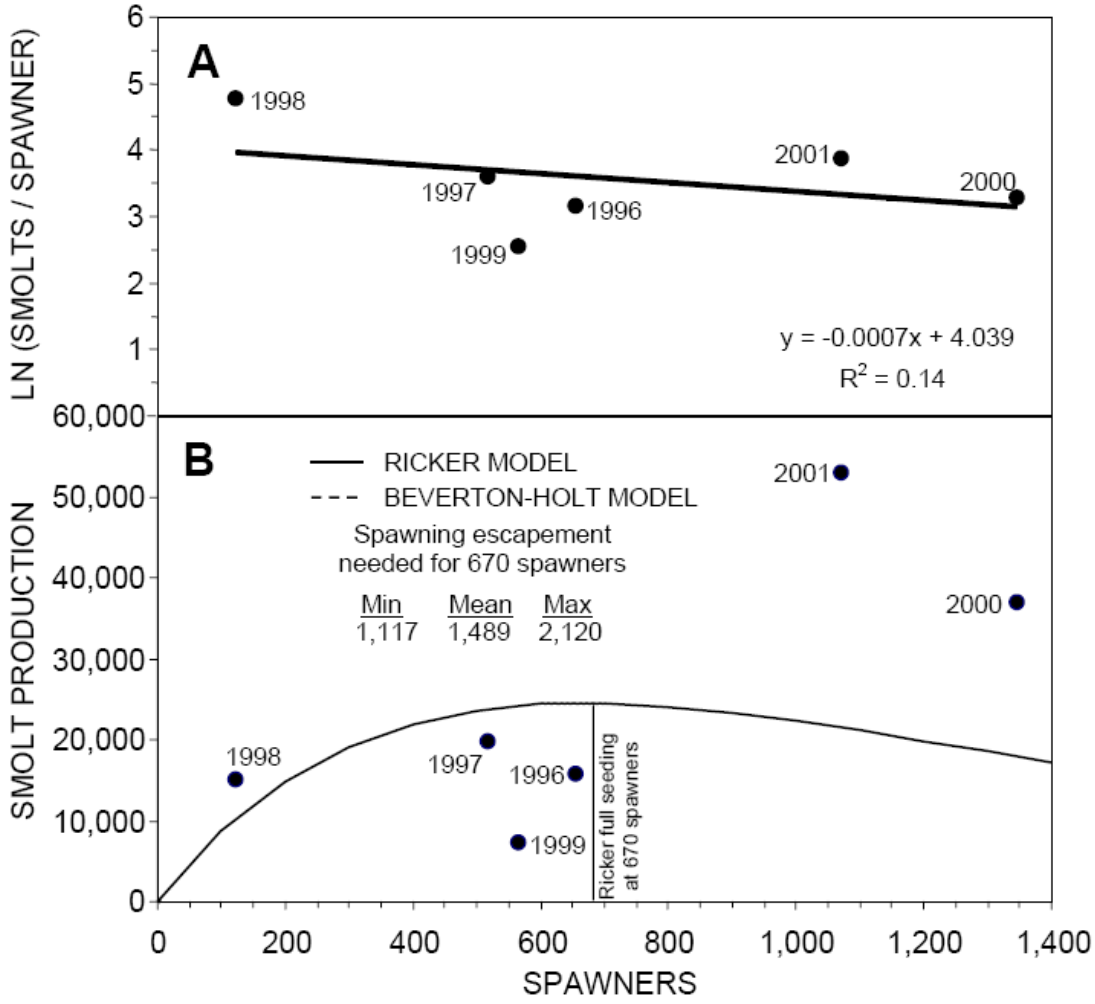
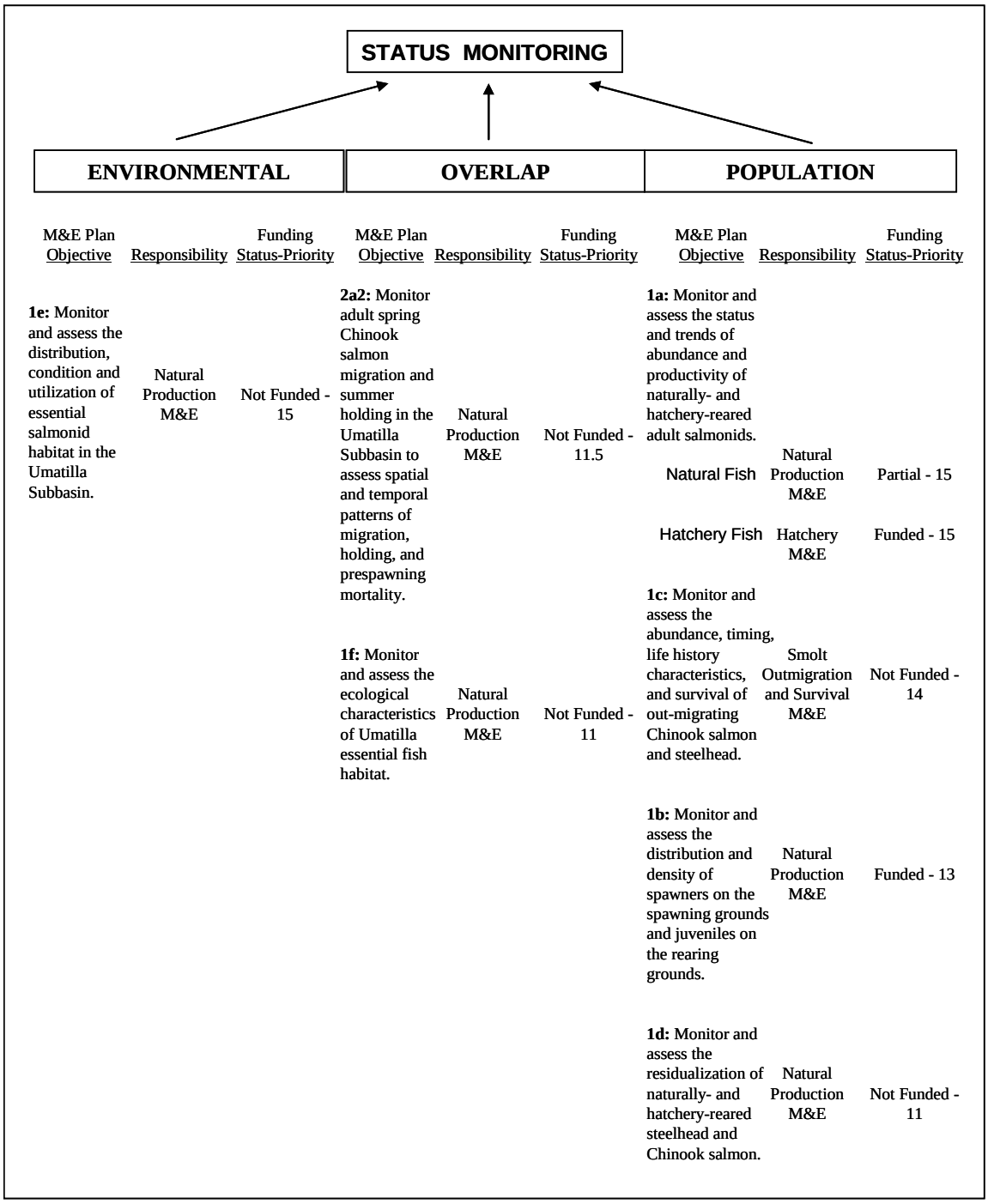


Figure 29. In-basin productivity of natural spring Chinook salmon in the Umatilla River characterized by A) a regression model of smolts produced per spawner at varying spawner abundances, and B) Ricker and Beverton-Holt stock-recruitment models, brood years 1996-2001. Estimates of spawner abundance and smolt production were based on redd counts and lower river smolt monitoring, respectively. The Ricker model estimated full seeding is at 670 spawners. Spawning escapement needed to result in 670 spawners ranges from 1,117 - 2,120 (mean 1,489) depending on annual prespawn losses noted in Table 19.



M&E Plan Objective	Responsibility	Funding Status-Priority
1e: Monitor and assess the distribution, condition and utilization of essential salmonid habitat in the Umatilla Subbasin.	Natural Production M&E	Not Funded - 15

M&E Plan Objective	Responsibility	Funding Status-Priority
2a2: Monitor adult spring Chinook salmon migration and summer holding in the Umatilla Subbasin to assess spatial and temporal patterns of migration, holding, and prespawning mortality.	Natural Production M&E	Not Funded - 11.5
1f: Monitor and assess the ecological characteristics of Umatilla essential fish habitat.	Natural Production M&E	Not Funded - 11

M&E Plan Objective	Responsibility	Funding Status-Priority
1a: Monitor and assess the status and trends of abundance and productivity of naturally- and hatchery-reared adult salmonids.		
Natural Fish	Natural Production M&E	Partial - 15
Hatchery Fish	Hatchery M&E	Funded - 15
1c: Monitor and assess the abundance, timing, life history characteristics, and survival of out-migrating Chinook salmon and steelhead.	Smolt Outmigration and Survival M&E	Not Funded - 14
1b: Monitor and assess the distribution and density of spawners on the spawning grounds and juveniles on the rearing grounds.	Natural Production M&E	Funded - 13
1d: Monitor and assess the residualization of naturally- and hatchery-reared steelhead and Chinook salmon.	Natural Production M&E	Not Funded - 11

Figure A. Monitoring and evaluation objectives listed in the Comprehensive Research, Monitoring, and Evaluation Plan for Umatilla Subbasin Summer Steelhead and Chinook Salmon (Schwartz and Cameron 2006) associated with environmental and population status monitoring, project responsible for implementing the objective, current funding status, and a points score level of importance of the objective to the Umatilla River Fisheries Program developed by CTUIR and ODFW subbasin managers and M&E staff. Point scores for all M&E objectives ranged from 7-15, with 15 the most important and 7 the least important.

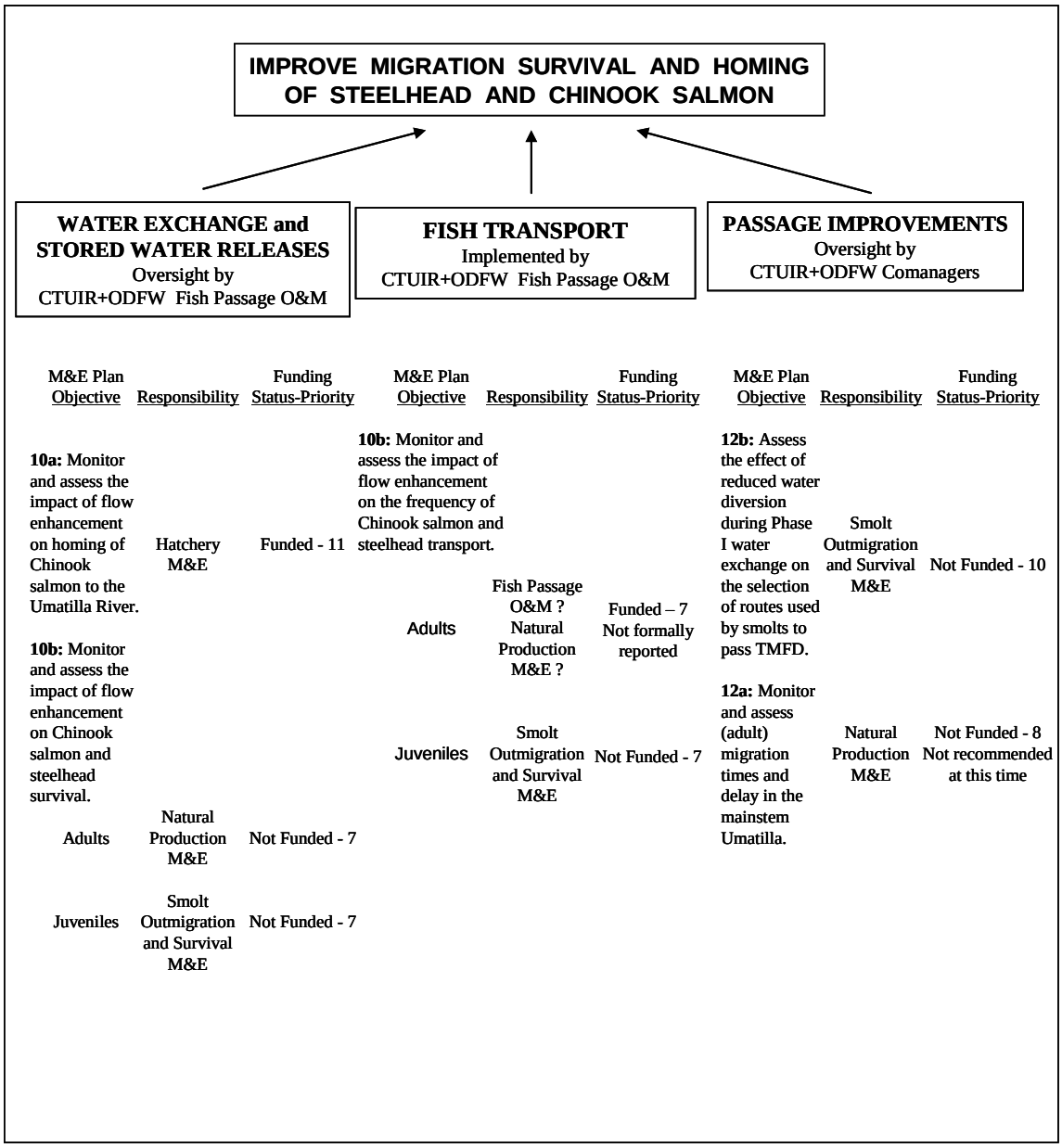


Figure B. Monitoring and evaluation objectives listed in the Comprehensive Research, Monitoring, and Evaluation Plan for Umatilla Subbasin Summer Steelhead and Chinook Salmon (Schwartz and Cameron 2006) associated with improving migration survival and homing of Chinook salmon and summer steelhead in and to the Umatilla River, project responsible for implementing the objective, current funding status, and a points score level of importance of the objective to the Umatilla River Fisheries Program developed by CTUIR and ODFW subbasin managers and M&E staff. Point scores for all M&E objectives ranged from 7-15, with 15 the most important and 7 the least important.

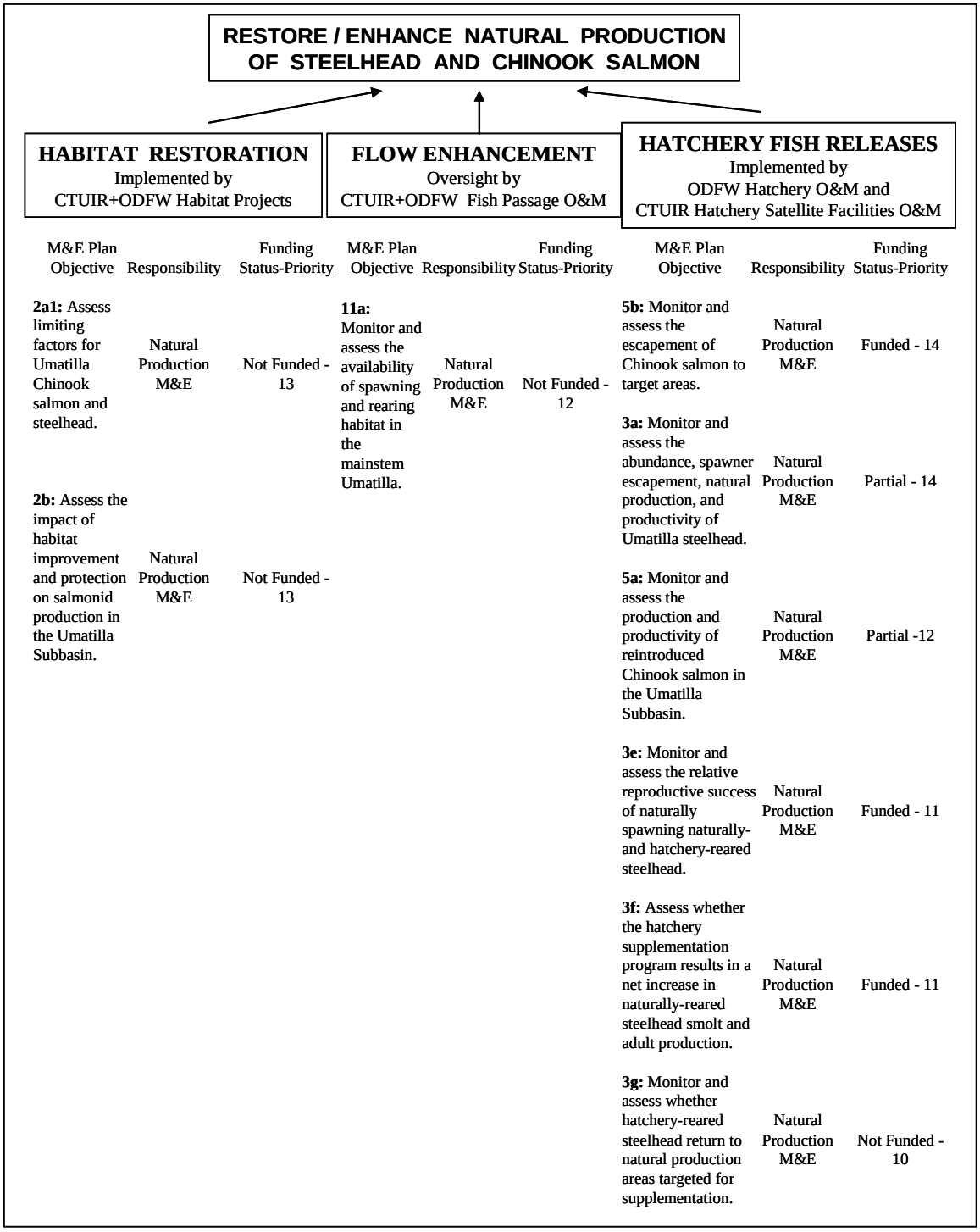
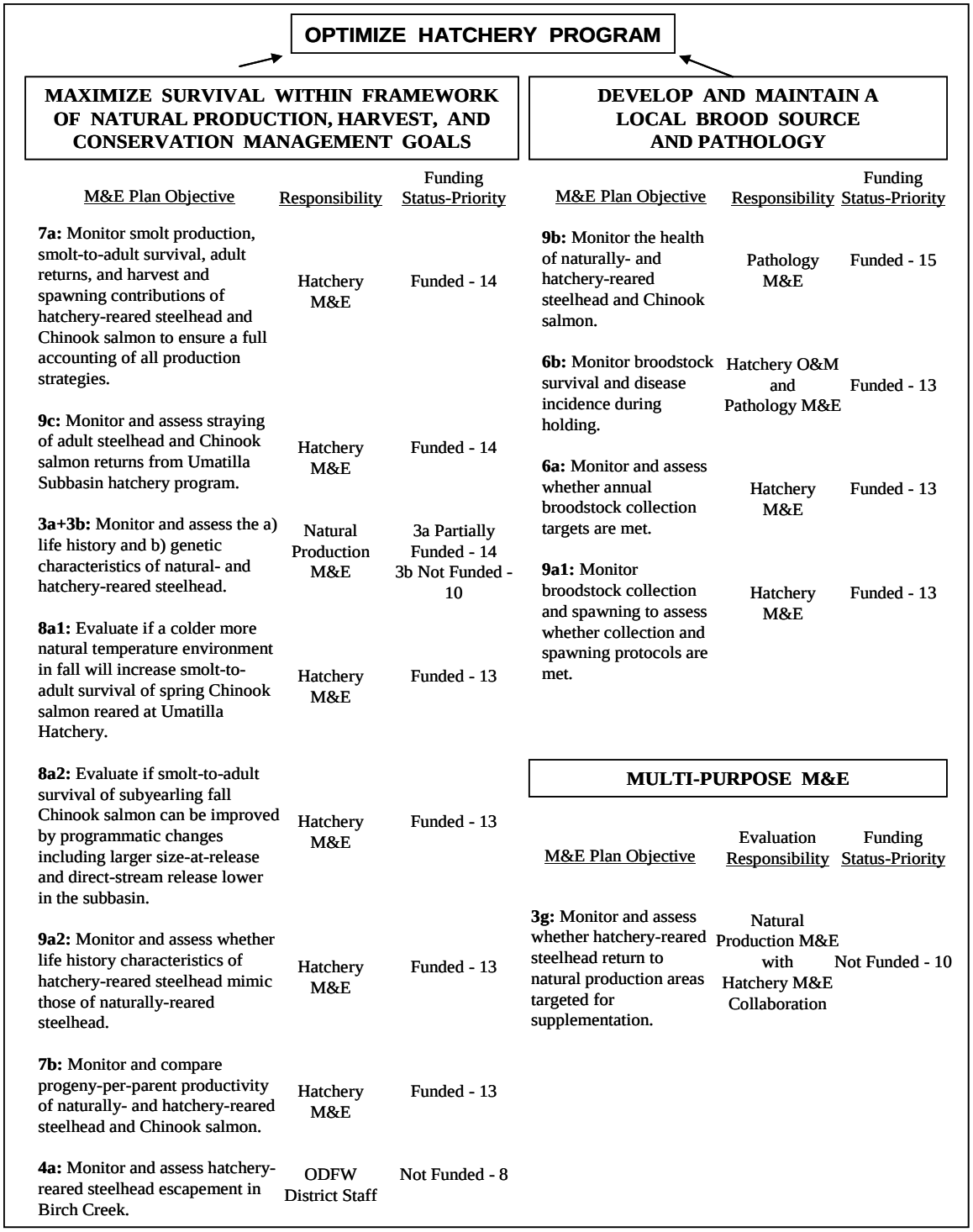


Figure C. Monitoring and evaluation objectives listed in the Comprehensive Research, Monitoring, and Evaluation Plan for Umatilla Subbasin Summer Steelhead and Chinook Salmon (Schwartz and Cameron 2006) associated with restoration and enhancement of Chinook salmon and summer steelhead natural production, project responsible for implementing the objective, current funding status, and a points score level of importance of the objective to the Umatilla River Fisheries Program developed by CTUIR and ODFW subbasin managers and M&E staff. Point scores for all M&E objectives ranged from 7-15, with 15 the most important and 7 the least important.



M&E Plan Objective	Responsibility	Funding Status-Priority
7a: Monitor smolt production, smolt-to-adult survival, adult returns, and harvest and spawning contributions of hatchery-reared steelhead and Chinook salmon to ensure a full accounting of all production strategies.	Hatchery M&E	Funded - 14
9c: Monitor and assess straying of adult steelhead and Chinook salmon returns from Umatilla Subbasin hatchery program.	Hatchery M&E	Funded - 14
3a+3b: Monitor and assess the a) life history and b) genetic characteristics of natural- and hatchery-reared steelhead.	Natural Production M&E	3a Partially Funded - 14 3b Not Funded - 10
8a1: Evaluate if a colder more natural temperature environment in fall will increase smolt-to-adult survival of spring Chinook salmon reared at Umatilla Hatchery.	Hatchery M&E	Funded - 13
8a2: Evaluate if smolt-to-adult survival of subyearling fall Chinook salmon can be improved by programmatic changes including larger size-at-release and direct-stream release lower in the subbasin.	Hatchery M&E	Funded - 13
9a2: Monitor and assess whether life history characteristics of hatchery-reared steelhead mimic those of naturally-reared steelhead.	Hatchery M&E	Funded - 13
7b: Monitor and compare progeny-per-parent productivity of naturally- and hatchery-reared steelhead and Chinook salmon.	Hatchery M&E	Funded - 13
4a: Monitor and assess hatchery-reared steelhead escapement in Birch Creek.	ODFW District Staff	Not Funded - 8

M&E Plan Objective	Responsibility	Funding Status-Priority
9b: Monitor the health of naturally- and hatchery-reared steelhead and Chinook salmon.	Pathology M&E	Funded - 15
6b: Monitor broodstock survival and disease incidence during holding.	Hatchery O&M and Pathology M&E	Funded - 13
6a: Monitor and assess whether annual broodstock collection targets are met.	Hatchery M&E	Funded - 13
9a1: Monitor broodstock collection and spawning to assess whether collection and spawning protocols are met.	Hatchery M&E	Funded - 13

M&E Plan Objective	Evaluation Responsibility	Funding Status-Priority
3g: Monitor and assess whether hatchery-reared steelhead return to natural production areas targeted for supplementation.	Natural Production M&E with Hatchery M&E Collaboration	Not Funded - 10

Figure D. Monitoring and evaluation objectives listed in the Comprehensive Research, Monitoring, and Evaluation Plan for Umatilla Subbasin Summer Steelhead and Chinook Salmon (Schwartz and Cameron 2006) associated with optimizing the Umatilla River Hatchery Program, project responsible for implementing each objective, current funding status, and a points score level of importance of the objective to the Umatilla River Fisheries Program developed by CTUIR and ODFW subbasin managers and M&E staff. Point scores for all M&E objectives ranged from 7-15, with 15 the most important and 7 the least important.

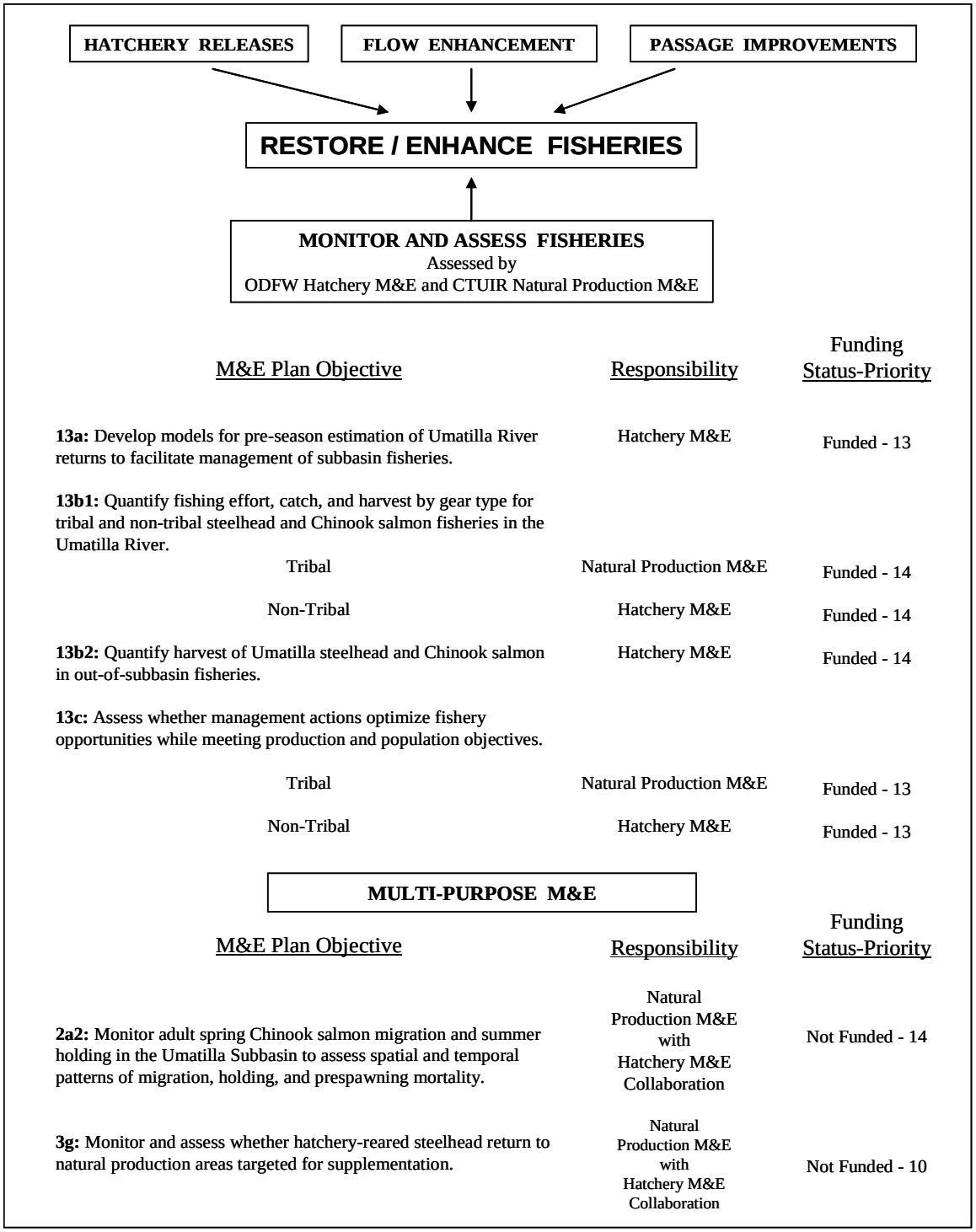


Figure E. Monitoring and evaluation objectives listed in the Comprehensive Research, Monitoring, and Evaluation Plan for Umatilla Subbasin Summer Steelhead and Chinook Salmon (Schwartz and Cameron 2006) associated with restoration and enhancement of Chinook salmon and summer steelhead fisheries, project responsible for implementing the objective, current funding status, and a points score level of importance of the objective to the Umatilla River Fisheries Program developed by CTUIR and ODFW subbasin managers and M&E staff. Point scores for all M&E objectives ranged from 7-15, with 15 the most important and 7 the least important.