Umatilla Basin Natural Production Monitoring andEvaluation

Summary Report
1998 - 2002

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THE UMATILLA BASIN NATURAL PRODUCTION MONITORING AND EVALUATION PROJECT

SUMMARY REPORT
1999-2002

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Editor

Fisheries Program
Department of Natural Resources
Confederated Tribes of the
Umatilla Indian Reservation

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Contract Period
September 30, 1998 to December 31, 2002
Project Number 1990-005-01

Prepared for:

U.S. Department of Energy
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THE UMATILLA BASIN NATURAL PRODUCTION MONITORING AND EVALUATION PROJECT

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INTRODUCTION

The Umatilla Basin Natural Production Monitoring and Evaluation Project (WWNPME) was funded by Bonneville Power Administration (BPA) as directed by section 4(h) of the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (P. L. 96-501). This project is in accordance with and pursuant to measures 4.2A, 4.3C.1, 7.1A.2, 7.1C.3, 7.1C.4 and 7.1D.2 of the Northwest Power Planning Council's (NPPC) Columbia River Basin Fish and Wildlife Program (NPPC 1994). Work was conducted by the Fisheries Program of the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) under the Umatilla Basin Natural Production Monitoring and Evaluation Project (UBNPME). Chapter One provides an overview of the entire report and shows how the objectives of each statement of work from 1999, 2000, 2001, and 2002 contract years are organized and reported. This chapter also provides background information relevant to the aquatic resources of the Umatilla River Basin. (Figure 1-1, Tables 1-1 and 1-2). Data and reports from this and previous efforts are available on the CTUIR website http://www.umatilla.nsn.us.

This project was one of several subprojects of the Umatilla River Basin Fisheries Restoration Master Plan (CTUIR 1984, ODFW 1986) orchestrated to rehabilitate salmon and steelhead runs in the Umatilla River Basin. Subprojects in additions to this project include:

- Watershed Enhancement and Rehabilitation;
- Hatchery Construction and Operation;
- Hatchery Monitoring and Evaluation;
- Satellite Facility Construction and Operations for Juvenile Acclimation and Adult Holding and Spawning;
- Fish Passage Construction and Operation;
- Juvenile and Adult Passage Facility Evaluations;
- Evaluation of Juvenile Salmonid Outmigration and Survival in the Lower Umatilla River Basin, and
- Flow Augmentation to Increase Stream Flows below Irrigation Diversions

PROJECT OBJECTIVES BY YEAR AND CHAPTER

Objectives are outlined below for the statements of work for the 1999, 2000, 2001 and 2002 contract years. The same objectives were sometimes given different numbers in different years. Because this document is a synthesis of four years of reporting, we gave objectives letter designations and listed the objective number associated with the statement of work for each year. Some objectives were in all four work statements, while other objectives were in only one or two work statements. Each objective is discussed in a chapter. Chapters reporting activities and findings are listed with the specific objective below. Because data is often interrelated, aspects of some findings may be reported or discussed in more than one chapter. Approaches, methods, results and discussion are addressed in the individual chapters.

Objective A, Chapter 2. Estimate abundance and densities of juvenile spring Chinook[1] salmon, summer steelhead, bull trout and mountain whitefish in index sites and selected stream reaches in the Umatilla River Basin.
1999 and 2000, Objective 1
2001 and 2002, Objective 3

Objective B, Chapter 3. Collect and tag natural juvenile Chinook and steelhead with passive integrated transponder (PIT) tags in the Umatilla River for detection at John Day Dam. Estimate minimum survival and timing of outmigrants from the Umatilla River to John Day Dam.
1999-2002, Objective 2

Objective C, Chapter 4. Determine natural spawning success, spawning habitat utilization, prespawning mortality, and redds per adult spring Chinook salmon passed above Three Mile Falls Dam. Determine, spawning distribution, success and timing of steelhead, fall Chinook salmon and coho salmon.
1999-2000, Objective 3
2001-2002, Objective 1

Objective D, Chapter 4. Estimate tribal harvest of adult salmon and steelhead returning to the Umatilla River.
1999-2002, Objective 4

Objective E, Chapter 4. Determine age and growth characteristics of natural anadromous salmonids in the Umatilla River Basin.
1999-2002, Objective 6

Objective F, Chapter 5. Monitor stream temperatures in coordination with other projects in the Umatilla River Basin.
1999-2002 Objective 5

Objective G, Chapter 6. Coordinate with other agencies and comply with the required administrative processes, reports, applications, proposals and coordination for watershed assessments, master plans, sub-basin plans, Total Maximum Daily Load (TMDL) allocation process, Umatilla Management Monitoring Oversight Committee (UMMEOC), Endangered Species Act (ESA) and Umatilla Fisheries Annual Operations Plan (AOP).
2001 and 2002, Objective 7

[1] In this report Chinook is capitalized in recognition of the Chinook Tribe. While the American Fisheries Society does not capitalize Chinook, they do capitalize Apache trout, Gila trout, Paiute sculpin and Umatilla dace. These fish all bear the names of tribes and are capitalized. We also capitalize Chinook salmon to be consistent with English language dictionaries and standard conventions.

Objective H, Chapter 6. Collect baseline genetic data from Umatilla River endemic summer steelhead.
1999 Objective 7

Objective I, Chapter 6. Develop a Research, Monitoring and Evaluation Plan for the salmonids of the Umatilla River Basin.
2002 Objective 8

Objective J, Chapter 6. Summarize and report data and findings and post data and reports on a website.
2002 Objective 9

UMATILLA BASIN GENERAL INFORMATION AND BACKGROUND

Geographic and Vegetative Features
The Umatilla River Basin in Northeast Oregon comprises 1,465,600 acres of the 6,400,000 acres of ceded CTUIR land (Figure 1-1). The Umatilla River originates on the west slope of the Blue Mountains, east of Pendleton, and flows 115 miles in a northwesterly direction to the Columbia River at RM 289. The Umatilla River Basin, hydrologic unit number 17070103 (US Geological Survey, USGS, 1989), has a drainage area of 2,290 square miles. The mouth of the Umatilla River near the town of Umatilla is at approximately 270 feet elevation (above mean sea level). The headwaters are as high as 4,950 feet. Mean annual precipitation ranges from ten inches/year at Umatilla to 50 inches/year in the headwaters (Taylor 1993).

The basin can be roughly divided into two physiographic regions. The lower river, west of Pendleton, has cut a low valley into a broad upland plain called the Deschutes-Umatilla Plateau. Parent geologic materials of the plain are dominated by multiple layers of middle Miocene basalt flows, specifically, the Wanapum and Grand Ronde Basalts, originating 14 to 17 million years ago. Basalt bedrock outcroppings are common in the river channel and act as hydraulic controls that delay the deepening of the river channel and valley floor. On top of the Miocene basalts are Pleistocene and Holocene loess, alluvial and glaciofluvial deposits (NPPC 1990, Walker and MacLeod 1991). Currently, vegetation on the broad Deschutes-Umatilla Plateau includes dry-land crops and sagebrush-grass communities. Historically, deciduous trees were abundant in riparian areas on the valley floor. However, land-use practices during the last hundred years have cleared most of these areas for irrigated agricultural and urban uses. ODFW (1987) estimated 70 percent of riparian areas in the Umatilla River Basin needed improving.

Foothills and the Blue Mountains dominate the region east of Pendleton. Faulting, lifting and folding of volcanic, sedimentary and metamorphic rock created the Blue Mountains. The middle Miocene basalts of the lower river are also the dominant parent materials in the headwaters. The river and streams have cut steep sided canyons into the layers of rock that form the higher elevations of the Blue Mountains. Exposed basalts have fractured into blocks and plates while unexposed layers remained fairly impervious to water (Walker and MacLeod 1991). The combination of steep canyon walls and impervious bedrock leads to poor ground water recharge (NPPC 1990). U.S. Geological Survey data from 1933 through 2001 show stream hydrographs that reflect the various features of the basin as described above (Figure 1-2). High flows regularly occur during rainstorms and snow melt conditions. Extreme low flows are common during summer and dry conditions. This effect is less pronounced in the North Fork Umatilla Wilderness Area. The North Fork subbasin has less human development, more large woody debris and more climax plant communities, and headwater areas with higher elevations with more persistent snow packs. Vegetation distribution patterns upstream from Pendleton are typical for the Blue Mountains. Grasses and small shrubs dominate the drier, south facing slopes. Conifers dominate the north facing slopes, higher elevations and moderately wet areas.

Historical Background

Summer steelhead, Chinook and coho salmon were abundant in the Umatilla River prior to the 1900's. Irrigation and agricultural development throughout the basin in the early 1900's was believed to be the primary cause of the decline of steelhead and the extinction of salmon (Bureau of Reclamation, BOR, 1988). Since 1855, aquatic and riparian habitats have been degraded through irrigation diversions, water extractions, channelization, livestock grazing, logging as well as other agricultural and urban developments (Nielsen 1950, NPPC 1987). Irrigation is still and important influence in the basin. Recently CTUIR observed 84 separate locations where water was diverted or pumped from the mainstem of the Umatilla River (Contor et al. 1995, 1996 and 1997). Additional water was also extracted from spring areas near RM 72-78 for municipal water supplies; however the City of Pendleton has initiated actions that will move the point of diversion downstream to RM 55.5.

Low flows, high water temperatures, suspended sediments, sewage and agricultural chemicals are primary factors associated with poor water quality in the basin for the last 100 years. Water quantity and quality limit salmonid production in much of the Umatilla River Basin. During extensive habitat surveys throughout the Umatilla Basin, CTUIR and ODFW staff frequently observed channelized streams, excess sediment from croplands, eroded banks, an absence of suitable riparian vegetation, and chemical, industrial and municipal pollutants (CTUIR 1994, Contor et al. 1995, 1996 and 1997). All of these anthropogenic factors are known to be deleterious to salmonids and their habitat (Stroud 1992, Waters 1995, Stouder et al. 1997). Much of the Umatilla River from the Highway 11 Bridge in Pendleton (RM 55.3) down stream to Echo (RM 26.3) has been channelized and straightened. As a result there are few meanders, lateral scour pools or oxbows. In addition, large woody debris have been removed from the river. Woody debris are important for salmonids and the creation of stream habitat complexity (Heifetz et al. 1986, Murphy et al. 1984). Large woody debris sources have also been reduced so the potential to replace debris currently limited. CTUIR and ODFW have been active in habitat restoration efforts beginning in the 1990s including flow augmentation, stream restoration projects, and the removal of passage barriers (Volkman 1994, Shaw 1996).

Table 1-1 Approximate river miles of land marks on the mainstem of the Umatilla River (from the Oregon Department of Water Resources Umatilla Basin Map).

Location	River Mile
Three Mile Falls Dam	4.1
Hermiston North Drain	5.6
Steelhead Park	8.8
Boyd's Dam	10.2
Minnehaha Springs	10.3
Maxwell Dam	15.2
Stanfield Bridge	23.0
I-84 Bridge	24.2
Dillon Dam	24.6
Echo Bridge	26.3
Westland Diversion	27.2
Colds Springs Diversion	28.2
Stanfield Diversion	32.4
Yoakum Bridge	37.0
Horseshoe Curve	39.8
Barnhart	42.2
Coombs Canyon	46.5
Birch Creek Confluence	48.3
Reith Bridge	48.5
McKay Creek	50.5
Pendleton 10th Street Bridge	53.0
Wildhorse Creek	55.0
Highway 11 Bridge	55.3
Mission Bridge	59.5
Minthorn Springs	63.8
Cayuse Highway Bridge	67.5
Thorn Hollow Bridge	73.5
Squaw Creek Confluence	76.7
Meacham Creek Confluence	79.0
Imeques Acclimation Facility	79.5
Ryan Creek	81.8
Bobsled Creek	84.6
Bar M Ranch Driveway	86.1
Bear Creek	87.1
Corporation Guard Station	88.5
Confluence of North and South Fork	89.5

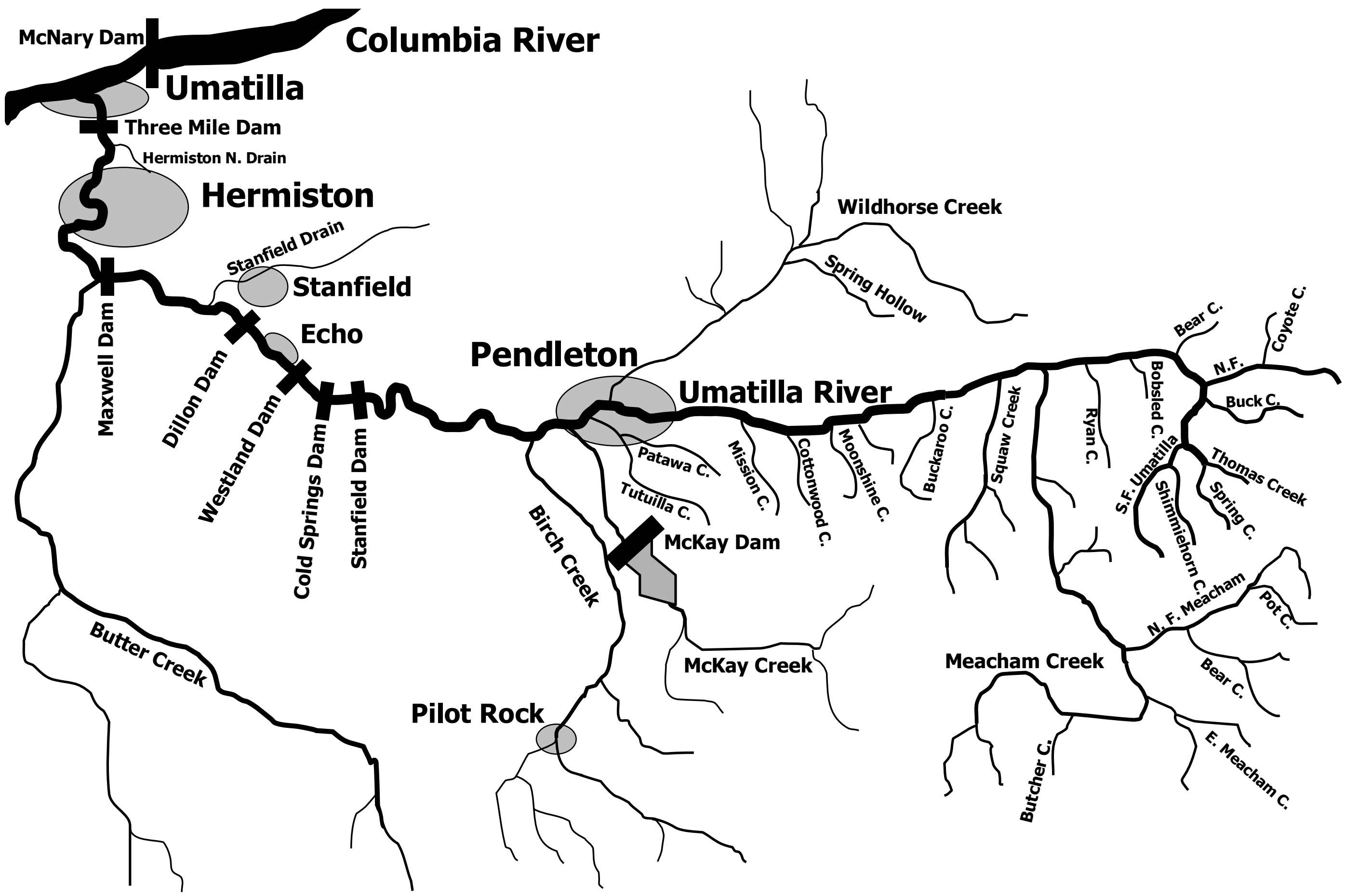

Figure 1-1 Umatilla River Basin

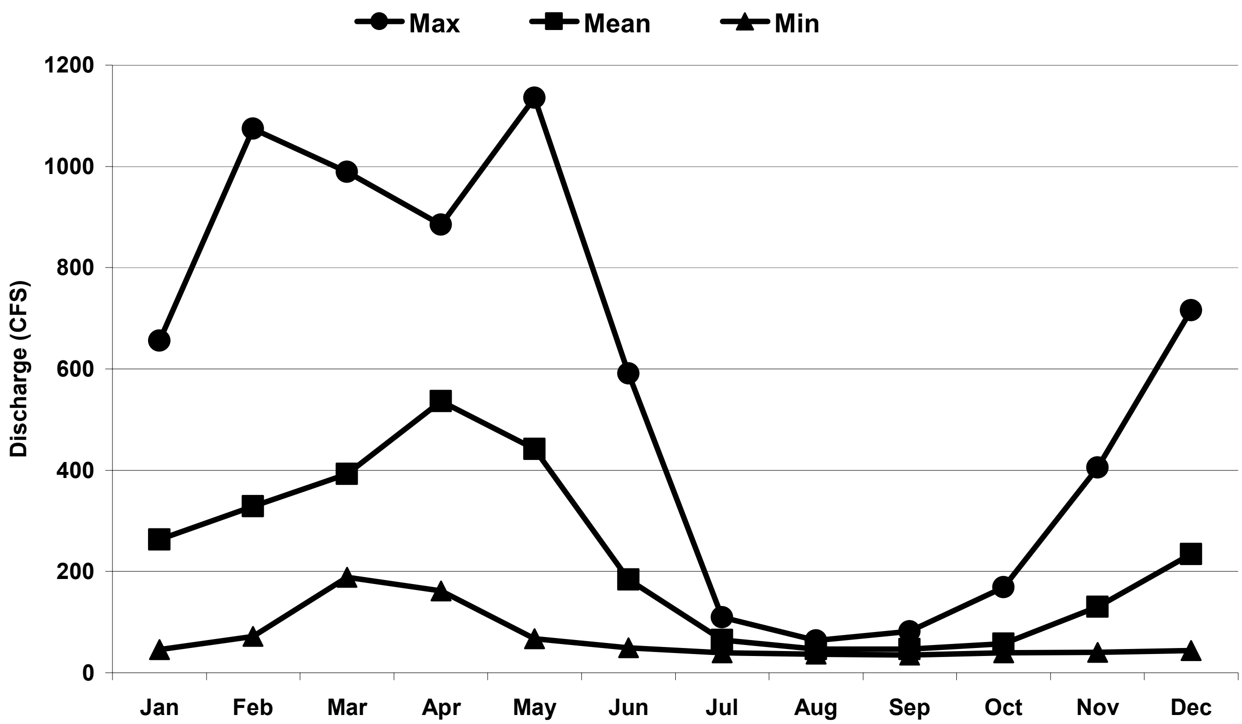

Figure 1-2 Maximum, mean and minimum average monthly flow data from USGS flow gage in the Umatilla River at river mile 1.7 from 1933 to 2001 (USGS website, gage number 14020000, http://waterdata.usgs.gov/or/nwis/monthly).

Fishes of the Umatilla River Basin

Since the 1980s, CTUIR and ODFW have supplemented summer steelhead (ESA listed) and reintroduced spring Chinook salmon, fall Chinook salmon and coho salmon to the basin by releasing hatchery reared juveniles. The records related to stocking salmonids into the Umatilla Basin are summarized below. Adult returns of hatchery fish have fluctuated through the years and have provided adults for hatchery broodstock, harvest opportunities and natural production (see Chapter 4).

Currently, bull trout, resident redband trout and mountain whitefish are present in the basin in low numbers. Bull trout are listed as threatened under the Federal Endangered Species Act and are moderately abundant in the North Fork of the Umatilla. However, they are absent or in very low abundance in other tributaries such as Meacham Creek, Birch Creek, Squaw Creek and the South Fork Umatilla River and tributaries.

The salmonid habitat in the headwaters is in good to excellent condition. Observed densities of juvenile salmonids in the headwater reaches have been fairly high (50-200 salmonids/100 m^2). Salmonid densities have been up to 300 times higher in areas with suitable water quality (Umatilla RM 81-89.6) than in the reaches where water quality was poor (Umatilla RM 0-27). The ratio of non-salmonids to salmonids was 2:1 in quality habitat (RM 82-89.8) and 455:1 in the lower river (Contor et al. 1998). A little more than half of the 32 fish species observed in the Umatilla River Basin are native to the basin (Table 1-2). Fifteen exotic species were either introduced directly into the river during the last 130 years or they colonized the basin from introductions elsewhere in the region.

Table 1-2 Fish species observed in the Umatilla River Basin (Origin codes are: N= Native, E=exotic H=hatchery reintroduction with a naturalized sub-population. Location codes are: R= mainstem rivers, P=ponds and T= tributaries. Abundance codes are: A=abundant, C= Common, F=Few, R=Rare and U=Unknown; adapted from James et al. 2001)

Species	**Origin**	**Location**	**Abundance**
Bull Trout (*Salvelinus confluentus*)	N	R, T	F
Brook Trout (*Salvelinus fontinalis*)	E	P	R
Spring Chinook (*Oncorhynchus tshawytscha*)	H	R, T	C
Fall Chinook (*Oncorhynchus tshawytscha*)	H	R, T	F
Coho Salmon (*Oncorhynchus kisutch*)	H	R, T	F
Summer Steelhead (*Oncorhynchus mykiss*)	N	R, T	A
Mountain Whitefish (*Prosopium williamsoni*)	N	R, T	F
Pacific Lamprey (*Lampetra tridentata*)	N	R, T	R
Western Brook Lamprey (*Lampetra richardsoni*)	N	R, T	F
Longnose Dace (*Rhinichthys cataractae*)	N	R, T	U
Speckled Dace (*Rhinichthys osculus*)	N	R, T	A
Umatilla Dace (*Rhinichthys umatilla*)	N	R, T	U
Leopard Dace (*Rhinichthys falcatus*)	N	R, T	U
Chiselmouth (*Acrocheilus alutaceus*)	N	R, T	C
Peamouth (*Mylocheilus caurinus*)	N	R, T	F
Redside shiner (*Richardsonius balteatus*)	N	R, T	A
Northern pikeminnow (*Ptychocheilus oregonensis*)	N	R, T	C
Bridgelip and Largescale Sucker (Catostomidae)	N	R, T	C
Carp (*Cyprinus carpio*)	E	R, T	F
Pumpkinseed (*Lepomis gibbosus*)	E	R, T	R
Bluegill (*Lepomis macrochirus*)	E	R, T	R
White crappie (*Pomoxis annularis*)	E	R, T	F
Black crappie (*Pomoxis nigromaculatus*)	E	R, T	F
Yellow Perch (*Perca flavescens*)	E	R, T	R
Large Mouth Bass (*Micropterus salmoides*)	E	R	R
Small Mouth Bass (*Micropterus dolomieu*)	E	R	C
Brown Bullhead (*Ameiurus nebulosus*)	E	R	R
Channel Catfish (*Ictalurus punctatus*)	E	R	F
Mosquitofish (*Gambusia*)	E	R	R
Paiute sculpin (*Cottus beldingi*)	N	R, T	C
Margin sculpin (*Cottus marginatus*)	N	R, T	C
Torrent sculpin (*Cottus rhotheus*)	N	R, T	R

Stocking History of Hatchery Rainbow Trout, Summer Steelhead and Salmon

Trout Stocking History:

Tim Bailey (ODFW District Fisheries Biologist in Pendleton) provided hatchery trout stocking data that are summarized in Table 1-3. The rainbow trout planted as catchables (legal size) and/or fingerlings were either “Shasta” which are spring spawners and/or “Cape Cod” stock which are fall spawners (Tim Bailey, ODFW, personal communication). It is possible that other rainbow trout stocks were used as well.

Table 1-3 Summary of non-endemic stocks of catchable (legal size) and fingerling rainbow trout planted throughout the Umatilla Basin from 1945-1995.

Location	Years	Numbers/Year	Type
Umatilla River	1945-1995	3,000-58,000	Legal
Umatilla River	1945-1995	35,000-648,000	Fingerling
Pearson Creek	1947	3,000	Fingerling
Meacham Creek	1951-1958	1,000-2,000	Legal
Meacham Creek	1967	7,000	Legal
Meacham Creek	1968	6,800	Fingerling
McKay Res.	1946	40,000	unknown
McKay Res.	1948-1950	6,000-9,000	Legal
McKay Res.	1953-1958	95,000-310,000	Fingerling
McKay Res.	1960-1966	150,000-696,000	Fingerling
McKay Res.	1970	25,000	Fingerling
McKay Creek	1946	3,000	Legal
McKay Creek	1947-1948	8,500-16,000	Fingerling
McKay Creek	1949-1950	1,800-4,800	Legal
McKay Creek	1953 and 1955	5,600 and 2,000	Legal
Birch Creek	1952 and 1953	900 and 1,500	Legal
Birch Creek	1955 and 1957	1,200 and 1,000	Legal
Birch Creek	1958 and 1961	1,000 and 200	Legal
East Birch Creek	1945-1948	7,800-11,000	Fingerling
East Birch Creek	1949-1953	1,000-1,600	Legal
East Birch Creek	1955-1963	1,000-4,000	Legal
West Birch Creek	1945-1947	5,800-11,000	Fingerling
West Birch Creek	1948-1952	1,800-2,000	Legal
West Birch Creek	1955-1963	1,000-3,000	Legal

Steelhead Stocking History:

The early stocking history of the steelhead into the Umatilla River included Skamania and Idaho stocks in the 1960s. Since 1975 hatchery supplementation of steelhead in the Umatilla basin has been limited to steelhead broodstock collected from the Umatilla, and may have included a few out of basin strays that returned to Three Mile Dam (Table 1-4).

Table 1-4. Summary of hatchery steelhead stocked into the Umatilla River. Fish were released directly in to the river or from acclimation ponds at Minthorn (Umatilla RM 63.8) and Bonifer Ponds (Meacham Creek RM 2.1; Rowan, 2002)

Years of Release	**Number (Thousands/Year)**	**Stock**
1967	110	Skamania
1967	380	Idaho (Oxbow)
1968-1970	40-175	Skamania
1975	11	Umatilla Origin
1981	27	Umatilla Origin
1982-1986	54-127	Umatilla Origin
1987	1.5	Umatilla Origin
1989-1991	75-130	Umatilla Origin
1992	200	Umatilla Origin
1993-2002	120-158	Umatilla Origin

Salmon Stocking Histories:
The early stocking history of the salmon into the Umatilla River included Tule stocks of fall Chinook salmon in 1982. From 1983 on, Bonneville and Priest Rapids up-river-bright stock were released. Spring Chinook salmon of Carson stock have been released since 1986. Coho of Little White Salmon stock were released from 1966 to 1969. Coho of Tanner Creek stock have been releases into the Umatilla River since 1987 (Table 1-5; Rowan, 2002).

Table 1-5. Salmon stocking history for the Umatilla River (1981-2002; Rowan 2002).

	Fall Chinook		**Spring Chinook**		**Coho**	
Release Year	**Direct Releases**	**Acclimation Facilities**	**Direct Releases**	**Acclimation Facilities**	**Direct Releases**	**Acclimation Facilities**
1981	0	0	0	0	0	0
1982	3,807,171	0	0	0	0	0
1983	80,564	20,000	0	0	0	0
1984	1,141,354	53,308	0	0	0	0
1985	3,283,679	188,655	0	0	0	0
1986	2,029,602	242,389	300,438	174,970	0	0
1987	1,476,830	213,506	169,100	99,897	786,660	161,889
1988	3,395,688	214,749	366,808	107,427	996,433	0
1989	2,689,285	78,825	164,786	160,734	829,607	157,299
1990	3,387,741	71,864	295,200	194,783	856,524	132,404
1991	3,371,388	79,672	271,365	181,649	802,655	152,974
1992	3,410,989	0	1,679,737	109,101	961,386	0
1993	2,794,435	0	1,619,992	0	892,678	0
1994	3,148,839	0	619,135	1,217,602	884,105	0
1995	0	2,693,386	0	673,331	1,514,266	0
1996	0	3,524,816	0	378,561	1,477,383	0
1997	0	3,100,754	0	225,883	1,400,939	0
1998	0	3,213,452	0	941,982	1,606,786	0
1999	0	2,292,234	0	659,607	1,475,911	0
2000	0	3,490,275	0	816,184	0	1,561,290
2001	322,283	725,474	0	782,733	0	1,474,559
2002	312,869	827,757	0	876,121	0	1,621,857
Total	**34,652,717**	**21,031,116**	**5,486,561**	**7,600,565**	**14,485,333**	**5,262,272**

Abbreviations Used in this Report
Most abbreviations used in this report are defined the first time they are used in each chapter and listed below to eliminate the need to search for the imbedded definitions (Table 1-6).

Table 1-6 Primary abbreviations used in this report in all chapters

AOP	Annual Operations Plan
BON	Bonneville Dam
BOR	U.S. Bureau of Reclamation, U.S. Department of Interior
BPA	Bonneville Power Administration
^{o}C	Centigrade (Temperature)
CRITFC	Columbia River Intertribal Fisheries Commission
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
ESA	Endangered Species Act
Hwy	Highway
JDD	John Day Dam
M&E	Monitoring and Evaluation
Mt.	Mountain
NMFS	National Marine Fisheries Service, U.S. Department of Commerce
NPPC	Northwest Power Planning Council
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
O.	*Oncorhynchus*
OWEB	Oregon Watershed Enhancement Board
PIT	Passive Integrated Transponder
PSMFC	Pacific States Marine Fisheries Commission (also PMFC)
RM	River Mile
RM&E	Research, Monitoring and Evaluation
SOW	Statement of Work
U of I	University of Idaho
US	United States
USACE	Army Corpse of Engineers
USDA	US Department of Agriculture
USGS	US Geologic Survey
USFS	US Forest Service
USFWS	US Fish and Wildlife Service
TMDL	Total Maximum Daily Load

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CHAPTER TWO: JUVENILE SALMONID ABUNDANCE

THE UMATILLA BASIN NATURAL PRODUCTION MONITORING AND EVALUATION PROJECT

PROGRESS REPORT
1999-2002

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INTRODUCTION

This chapter summarizes juvenile salmonid abundance monitoring efforts completed during the contract years September 30, 1998 through December 31, 2002. The Umatilla Basin Natural Production Monitoring and Evaluation Project (UBNPME) was funded by Bonneville Power Administration (BPA) as directed by section 4(h) of the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (P. L. 96-501). This project is in accordance with and pursuant to measures 4.2A, 4.3C.1, 7.1A.2, 7.1C.3, 7.1C.4 and 7.1D.2 of the Northwest Power Planning Council's (NPPC) Columbia River Basin Fish and Wildlife Program (NPPC 1994). Work was conducted by the Fisheries Program of the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) under the Umatilla Basin Natural Production Monitoring and Evaluation Project. Data and reports are available at http://www.umatilla.nsn.us.

Objective and Tasks

Objective A; Objective 1 of the 1999-2000 project statements of work and Objective 3 of the 2001 and 2002 project statements of work. Estimate abundance and densities of juvenile spring Chinook[2] salmon, summer steelhead, bull trout and mountain whitefish in index sites and selected stream reaches in the Umatilla River Basin.

Task A.1

Sample established index sites during August when conditions are the most consistent from year to year. Electrofish with multiple pass depletion methods and estimate abundance and densities of salmonid species captured.

Task A.2

Digitize and summarize capture data, estimate densities and abundance, examine trends, compare methods, report findings and discuss management implications.

This objective addresses uncertainties identified in the Umatilla Basin Salmonid Restoration Project regarding how the progeny of reintroduced salmon and native steelhead utilize natural rearing habitat and how distribution and abundance of salmonids might change through time. This objective provides data necessary to examine species distributions, trends, relationships between spawner densities and resultant rearing densities, age structure, growth rates, and species composition.

[2] In this report Chinook is capitalized in recognition of the Chinook Tribe. While the American Fisheries Society does not capitalize Chinook, they do capitalize Apache trout, Gila trout, Paiute sculpin and Umatilla dace. These fish all bear the names of tribes and are capitalized. We also capitalize Chinook salmon to be consistent with English language dictionaries and standard conventions.

MATERIALS AND METHODS

Index Sites

Methods for monitoring trends in salmonid abundance in the Umatilla Basin were established early in the 1990s but were modified in 2002 as a result of a number of regional processes and input from ISRP and subsequent direction from BPA. For the juvenile salmonid monitoring efforts during the summers of 1999-2001, the selection of most of the existing juvenile rearing index sites occurred in the early 1990s. Index sites were a minimum of 100 m in length and occasionally more than 300 m depending on stream size and habitat complexity. Each site was usually broken into two reaches to provide some measure of within site variability. The lower and upper boundary of each site was marked with numbered tags to assist consistent sampling from year to year. Most tags were placed on living trees or on wooden posts outside of the active channel to reduce the chances of loss during high flows. Each index site was marked on a Umatilla River Basin map. Measured habitat features included habitat unit type (pool, riffle etc.), unit length, width and maximum depth (mean depth for fast water habitat types), and woody debris. For the habitat measurements, we utilized a subset of the methods used for the basin wide habitat inventories conducted by CTUIR and ODFW in the 1990s (Contor et al. 1995, 1996, 1997, 1998) which followed methods described by Moore et al. (1993).

Early in the development of the UBNPME project, CTUIR examined stratified random sampling and dismissed it because of a host of problems. For example, landowner access prevented large areas from being sampled so obtaining a true unbiased sample design was impossible. We knew that collecting information from different sites each year from only part of the basin would reduce the strengths of a stratified random design. Furthermore, we knew that each sampling technique had its own biases and effectiveness in different habitat types. We estimated smaller bias and smaller uncertainty could be achieved by using sampling protocols that held both the methods and locations constant. This seemed reasonable because we were more interested in year to year variation associated with adult spawners and climatic conditions than we were in annual estimates of juvenile production basin-wide. We knew this concept and design would not provide annual basin-wide salmonid estimates but it would provide more consistent data for trend and population status information at selected sites. Because fish abundance can change dramatically in association with changes in site specific habitat features, CTUIR selected permanent sites at more stable areas. We used additional presence-absence surveys throughout the basin to documented fish distributions.

CTUIR did not give up on estimating total abundance and production potential of the basin. We used ODFW habitat survey methods to stratify reaches into individual habitat features. We then used a modified Hankin and Reeves (1988) approach and estimated salmonid densities in 5-20 % of each habitat type. We then expanded the estimate based on the quantity of each habitat type. This was done for 160 miles of mainstem and tributary habitat. Population estimates were calculated for each reach (CTUIR 1994, Contor et al. 1995, 1996, 1997, 1998, 2000).

The number of index sites was reduced to 25 in 1996 to accommodate a reduction of the monitoring program funding and as originally outlined by Lichatowich (1992) in the original Umatilla Basin Monitoring and Evaluation Plan. During 1999-2002, crews sampled most of the established index sites in the Umatilla Basin during July and August when the flows and conditions are the most consistent from year to year.

Electrofishing

For electrofishing at density sites, we used a variety of methods depending on stream width. We used one or two Smith-Root electrofishing backpack units (Model 12A or 12B) with pulsed direct current (DC) to generate the lowest effective electric field to collect fish (range: 300-1000 volts, 40-60 Hertz, 0.5-4µs). Settings were reduced if crews observed injured fish. Electrofishing techniques employed since 2000 should be considered less aggressive in relation to techniques used historically. These less aggressive techniques were employed to reduce the potential for injury to bull trout, steelhead and spring Chinook. The new techniques provided lower depletion rates between passes, especially in deeper areas and areas with abundant cover and habitat complexity. In fact, in 2002, we avoided electrofishing in large woody debris piles and other areas known to hold adult bull trout; electrofishing was also not permitted after August 15th in areas identified by Buchanan et al. (1997) as bull trout spawning habitat.

Block nets were set across the stream channel roughly fifty meters apart to prevent fish from entering or escaping the site. Operators began each pass at the downstream net and worked upstream across the entire stream until reaching the upstream net. Most sites received at least two passes with similar effort. Additional passes (up to three) were conducted until a reasonable depletion pattern was achieved between successive passes. Salmonids were collected by dip netters, identified (genus and species), measured (fork length in mm), checked for marks or injury, and scales were collected from a subset that included some bull trout. Juvenile resident rainbow trout were not differentiated from juvenile steelhead. Juvenile spring Chinook were not differentiated from juvenile fall Chinook. Numbers of common non-salmonids were estimated by broad approximation.

Crews collected scale samples from a sub-sample of fish of varying sizes for age and growth information. We remove approximately 6-12 scales from an area two scale rows above the lateral line, posterior to the dorsal fin, and anterior to the adipose fin. Scales were mounted in the field directly onto clear Mylar envelopes. Stream name, site, date, species and fork length were recorded on the Mylar. No additional handling or mounting was required before reading.

To estimate total abundance of salmonids, we used a removal-depletion software program developed by the U.S. Forest Service (Van Deventer and Platts, 1989). These numbers were used in conjunction with area estimates to calculate fish per 100 m^2. We also calculated catch per unit effort (CPUE) by dividing the number of fish collected by the number of minutes of electroshocker on-time. We did not use block nets on the larger stream and river sections so density estimates at these larger sites should be considered minimal density estimates.

Area sampled was determined by multiplying the site length by the mean stream width (mean width weighted by habitat unit length). Measured habitat features followed methods described by Moore et al.(1993) and included habitat unit type (pool, riffle etc.), unit length, unit mean width, maximum depth for pools, and mean depth for fast water habitat types. The number of large woody debris and large boulders were recorded for each site.

Snorkeling

In 2002, we snorkeled the entire area of 20 sties in the Umatilla River Basin prior to electrofishing. Densities were estimated based on observed numbers. We did not correct for possible double counting or for unobserved fish do to concealment or other factors. Sites ranged from 45 to100 meters in length (Table 2-18). One or two snorkelers counted the number of salmonids at each survey location by habitat unit type. Habitat features were measured after both snorkeling and electrofishing efforts were completed. Snorkelers moved upstream, counting all salmonids in a single upstream pass at a rate of about 100 m/hour. Snorkelers relayed fish-counts either verbally or with hand signals to streamside personnel. Observed salmonids were ranked as either fry, juvenile, or adult based on total length (i.e. ≤ 50mm 51- 200 mm, and ≥ 201 mm). Precise counts were made whenever possible but estimates were made during three basic conditions:

1) Occasionally, too may juvenile Chinook were present to allow for accurate counts;
2) General estimates were made for non-salmonid species, and
3) Crews sometimes estimated juvenile steelhead numbers if precise counting interfered with the juvenile Chinook counts.

When numbers were high, we concentrated on juvenile Chinook abundance. The rational used to concentrate on Chinook stems from our perception that visual counts for rainbow trout by snorkeling techniques can be unreliable (Rodgers 2000, Nickelson 1998).

Presence/Absence and Fry Surveys
These abbreviated surveys provided a quick assessment and documentation of salmonid presence at specific locations. Fish occurring at low densities could easily have been missed with this type of sampling so the absence of fish in a sample may only indicate low abundance or seasonal use. Documenting complete absence requires more intensive and repeated sampling. CTUIR used electrofishing methods during P/A surveys. These surveys were usually less intensive and normally extended to only a portion of the entire wetted area of the stream. Fry surveys were only conducted along the margin of the streams.

Salvage Operations
There are several different types of salvage operations conducted by CTUIR each year. These salvage efforts collectively provide some useful information about the distribution of salmonids in the basin. For example we salvaged salmonids from McKay Creek during December of 1999 when flows from McKay Reservoir were stopped. We removed fish from Mission Creek on October 16, 2001 at St. Andrews Road to allow for a more fish friendly culvert to be installed without injuring fish in the construction area. CTUIR staff also assisted ODFW and a CTUIR habitat project in salvage operations in McCoy Creek when a stream was relocated from a straight artificial channel back into the original meandering channel.

RESULTS AND DISCUSSION

Index Sites
Data collected from index surveys from 1999-2002 are summarized in the tables and figures below (Tables 2-1 through 2-18 and Figures 2-1 through 2-21). Figure 2-1 is a map showing the location of the index sites. We included considerable detail in the tables and figures to: 1) maintain some consistency with earlier reports, and 2) meet the variety of data requests were receive on a regular basis. The details allow individuals to examine the data from a variety of perspectives depending on their needs.

Findings from index sites surveyed from 1998 through 2002 were generally consistent with earlier findings (CTUIR 1994, Contor et al. 1995, 1995, 1997, 1998, 2000). Primary juvenile spring Chinook distribution remained limited to the upper mainstem Umatilla River and the North Fork. Chinook densities were much lower than juvenile steelhead densities (Figures 2-7 through 2-9). A few juvenile Chinook were observed at very low densities on the margins of their core area (Tables 2-3, 2-7, 2-11, 2-15, and 2-17, Figure 2-18). Since 1993, there does not appear to be any successful expansion of Chinook outside of the core area even with increases spawners and redds (Figure 2-18). Juvenile spring Chinook densities (and CPUE, in their core rearing areas) follows the previous years redd abundance unless high flow events scour and destroy redds as likely occurred in 1997 and to some extent in 2002 (Figures 2-10, 2-11).

Coho salmon, bull trout and mountain whitefish have been found in only a few index sites at low to moderate numbers (Figures 2-19 through 2-21). Most coho observations have been collected during salvage or presence/absence surveys in the lower river outside of the core spring Chinook and steelhead rearing areas (see the salvage and presence/absence sections below).

Juvenile summer steelhead were abundant in headwater reaches with adequate water and suitable water temperatures including the upper foothill streams such as Moonshine Creek as well as the larger systems and their tributaries such as Birch Creek, Meacham Creek, the North Fork of the Umatilla River (Figure 2-17). The sizes of parr have been similar through the years. Steelhead parr tend to be smaller in the headwaters and larger in the lower reaches (Tables 2-4, 2-8, 2-12, and 2-14; Figures 2-2 through 2-6). Findings from the migrant traps and index sites also suggest that larger fish move lower in the basin even if they don't migrate to the ocean for another year.

There has been considerable variation in observed densities between years and among sites (Figure 2-7 through 2-9). There have also been clear expansions and contractions of salmonid distribution and abundance associated with fluctuations in flows and climatic conditions since the M&E project began in 1992. These fluctuations continued during the 1997-2002 time period with decreased stream flow and observed abundance despite the fact that the number of spawners and redds increased. For steelhead, it appears that most of the suitable rearing habitat is fully seeded. The juvenile steelhead populations appear to be driven by flow and other habitat related factors rather than by adult spawners (Figure 2-12). CTUIR biologists suggest that significant habitat improvement will be necessary to increase natural production beyond current levels. Adult to adult return data presented in Chapter Four (Figure 4-7) shows that Umatilla River steelhead are near or below replacement as would be expected of a population that is over-seeding rearing habitat (and artificially maintained through supplementation). Fully seeding suitable rearing habitat was one goal of the supplementation program that appears to have been reached.

There are uncertainties about the benefits and costs to over-seeding salmonid rearing habitat. Over-seeding is common in abundant salmonid populations. There does not appear to be any question that the changes to the mainstem Columbia, land-use practices, and climate over the last 150 years have contributed to the decline of steelhead in the basin. A population can sometimes adapt to new selective pressures given that changes occur at a slow pace and random genetic mutations and drift provide successful adaptations. Most mutations are deleterious and are selected against through natural mortality prior to reproduction. Beneficial mutations and combinations are less common. Therefore, larger populations and over-seeding the habitat should provide three important benefits: 1) increase selective pressure on individuals with marginally deleterious traits so they are removed from the population; 2) increase the overall number of fish in the top 2-5% of the fitness scale, and 3) fully seed the habitat on favorable years with expanded suitable habitat.

In addition to nutrient enrichment, over-seeding may also provide benefits for spring Chinook for the same reasons discussed above for steelhead. Managed harvest of hatchery fish and protection of naturally produced fish appears to be an equally valid strategy for Chinook as for steelhead. In the Umatilla River Basin, sport and Tribal fishers are restricted from sanctuary areas that protect fish in quality spawning habitat. Further protection could be provided by having rod and reel fishermen release unmarked Chinook. Catch and release is clearly not appropriate for the traditional Tribal gaff fisheries. Gaff fishing also occurs later in the season after fish begin to hold in pools and is limited to marginal spawning areas through regulations. Fish in these marginal areas appear maladapted as they select poor holding habitat with warm water temperatures. Harvesting fish that choose to hold in poor habitat should have little affect on natural reproduction because prespawning mortality rates are high (even during years with no fishing, see Chapter 4).

Assuming out-of-basin spring Chinook are maladapted to the Umatilla River Basin to some degree, then we should expect lower survival than endemic stocks in adjacent basins (i.e. John Day River). However, progeny of hatchery adults that do survive are likely to have better traits for the current conditions than the general source population. As discussed above, while over-seeding causes density dependent mortality it would also increase the number of rare but better adapted, individuals. It would also make it more difficult for less adapted individuals to survive because of density dependant factors. For a number of generations, we should expect adult to adult return rates to be lower than replacement, but the average fitness of the population should increase over time if some protection of naturally produced fish is provided.

A primary management objective of the Umatilla program is to provide a consistent fishery for the region. This includes fairly aggressive harvest quotas aimed at utilizing hatchery returns. The management strategy for the Umatilla Basin must be put into a regional perspective. CTUIR (and ODFW) support the "*protect endemic stocks, no hatchery intervention and restore habitat*" approach used for the John Day River Basin for both spring Chinook and summer steelhead. CTUIR also supports the proactive genetic conservation approach used for Grande Ronde River Basin spring Chinook salmon. The goals for the Umatilla Basin are different from surrounding areas and recognize the social, cultural and political need to have significant harvest opportunities somewhere in the region. Management understands that some naturally produced Chinook with unique traits may be removed from the spawning population through more aggressive harvest goals. In fact, surplus fish on the spawning grounds may be considered a waste for this program. Increases in harvest rates may be desired even if harvest opportunities increase mortality and stress to naturally produced fish. To balance this, managers are aware that past attempts to manage for optimum harvest and optimum sustained yield (mixed with politics) have not always been successful (Strouder et al.). Overall, even when considering aggressive harvest management goals, it may be a good idea to allow some surplus spawning to protect against unplanned over-harvest, as well as for unforeseen changes in ocean conditions, migration corridors and rearing habitat. In the long run, limited over-seeding may have both management and ecological benefits and may more closely mimic healthy wild populations.

CTUIR management understands potential risks of supplementation projects identified and discussed regionally (Chilcote et al. 1986, Nickelson et al. 1986, Steward and Bjornn 1990, Leider et al. 1990, Flemming and Gross 1991, Campton et al. 1991, Meffe 1992, Byrne et al. 1992, Waples 2001, Reisenbichler et al. 2003). Questions about benefits and risks of progressive supplementation programs using endemic stocks and modern breeding and brood collection strategies remain. Progeny mark development and pedigree analysis projects in process and planning will examine reproductive success and management implications for the Umatilla River summer steelhead management strategy. However, it will require a number of years and careful completion of those studies before a better understand the reproductive success of hatchery reared steelhead spawning naturally when modern breeding and brood collection practices are used in conjunction with endemic stocks.

The current Tribal strategy for supplementing Umatilla River steelhead primarily uses naturally produced adults for broodstock. Hatchery reared fish of endemic origin are used in limited numbers. The concept is based on the idea that deleterious alleles and poor genetic combinations will be weeded out through natural selection just as in all-wild populations. To do this, adults used for hatchery spawning must have survived the harsh environment of a natural system. Hatchery reared adults that spawn in the wild may pass deleterious traits into redds but those deleterious traits should be eliminated through natural selection in the wild. In the hatchery, matrix breeding practices and the elimination of domestication factors are incorporated wherever possible (within the realms cost effectiveness and existing technology). By routinely cycling each genetic line through the natural environment, negative traits will only survive in recessive forms as in natural populations.

The other side of the supplementation issue that is frequently ignored is the potential for some hatchery reared steelhead (from endemic stock that were reared in the wild) and strays (a natural process) to have unique and beneficial traits that are better suited to the altered environment than ancestral traits. This concept is frequently used successfully in wildlife management and conservation animal husbandry by introducing new breeding stock to smaller isolated populations. Fear of out-breeding depression with little concern of inbreeding depression, lack of diversity, and the natural plasticity of larger salmonid populations tends to dominate current fisheries genetics management. Unique beneficial combinations and mutations are not limited to small local populations and are more likely to occur in large diverse populations.

In summary, CTUIR suggests that moderately over-seeded natural spawning and natural rearing of salmonids in natural environments will eliminate negative traits and perpetuate beneficial traits much more effectively than humans making uniformed judgments about genetic fitness of individual fish returning to weirs.

Comparisons of Monitoring Techniques

CTUIR sampling protocol for monitoring juvenile salmonid abundance changed significantly in 2002. During the project review process in 2001, ISRP proposed that an “E-map” sample design be used in the Umatilla River Basin to assess juvenile salmonid abundance. CTUIR responded by working with ODFW (Bruce McIntosh of the Corvallis Research Station) to develop a basin-wide sampling design and protocol modeled after the work of Don Stevens, Tony Olsen, Phil Larsen and Tom Kincaid of the U.S. Environmental Protection Agency, Corvallis, Oregon (Jacobs et al. 1998, Firman and Jacobs 2001). In 2002, our plan was to implement a more statistically robust evaluation of juvenile salmonid distribution and abundance (ignoring inaccessible private lands) to meet local and regional fisheries managers information needs (as recommended by the ISRP). However, BPA was not yet willing to proceed with implementation of this new plan until a basin wide, comprehensive RM&E plan was developed with formal reviews and subsequent revisions. In response to ISRP recommendations and BPA’s position, CTUIR conducted cursory evaluations of the proposed snorkeling method suggested by ODFW (Rodgers 2000) and compared it to observations using the traditional electrofishing techniques.

A preliminary comparison of the old and new methods during 2002 provided insight about both methods in a variety of habitat types and stream sizes. The sampling methods proposed by ODFW (Rodgers 2000) involved snorkeling only pool habitat greater than or equal to 40 cm in maximum depth. It appears to CTUIR that both methods have problems and biases. The old strategy was not suitable for basin-wide abundance estimates of rearing juvenile salmonids because it was designed to look at trends at stable index sites. Snorkeling selected pools as described by Rodgers (2000) did not appear to be an effective technique for *O. mykiss* in the Umatilla River Basin. Juvenile steelhead and rainbow trout can be very abundant in fast water habitats, (Contor et al. 1995, 1996, 1997) they conceal themselves during the day (Mullen et al 1992) and they may also move into and out of pools to feed. Furthermore, may of the stream reaches in this area lack pools greater than 40 cm deep. Often we see a few larger rainbows dominating pools. Many of the younger age classes are found outside of the deeper pool habitat types.

The new sampling design would work ideally in systems where most of the salmonid habitat was accessible to sampling. However, in the Umatilla River Basin we are sometimes excluded from large tracks of private land. When extended parts of the basin are not available, the randomized sample design represents less and less of the entire basin and develops similar weaknesses as our original design, but without its strengths.

CTUIR has conducted most surveys with electrofishing and depletion estimators to avoid snorkeling related problems such as fish hiding behavior, double counting, poor water clarity, and large shallow reaches that are difficult to snorkel. Electrofishing techniques have the disadvantage of crew safety issues and occasionally injuring and killing fish. Concerns with various methods and the ongoing development of a comprehensive RM&E plan naturally led to a side by side comparison of both snorkeling and electrofishing techniques at 20 of the 25 established index sites. Given the extra snorkeling efforts required for the comparison crews did not have time to sample all 25 sites in 2002. Results of both methods are summarized in Tables 2-13 through 2-17 and in Figures 2-13-through 2-16. The estimates between snorkel counts, electrofishing CPUE and density estimates from the same locations were variable and inconsistent. Generally, more Chinook were observed through snorkeling than collected during electrofishing. The opposite was often true with juvenile steelhead. Electrofishing was a poor technique in larger pools. Snorkeling was a poor technique in small shallow streams. Stream size, habitat types, and habitat complexity were different at each site. The differences between methods were variable depending on habitat features.

It remains unclear which methods should be incorporated into the new Umatilla Basin Comprehensive Research, Monitoring and Evaluation Plan. Other monitoring projects in the region have tried different approaches. For example; Glen Mendel (2002) of WDFW conducted juvenile abundance monitoring in the Washington portion of the Walla Walla Basin. Mendel used snorkeling and electrofishing depending on habitat features. Pheadra Budy et al. of the USFWS utilized body tags and visual recapture techniques during snorkeling surveys (personal communication about ongoing work). We suggest that valuable components of several approaches could be synthesized into a standardized methodology that would be effective in a broad range of habitat types.

Early in the development of the UBNPME project, CTUIR examined stratified random sampling and dismissed it because of a host of problems that would bias the samples (landowner access problems for examples). We knew that collecting information from only part of the basin each year would prevent the development of reliable estimates of salmonid abundance basin-wide. Furthermore, we knew that each sampling technique had its own biases and effectiveness in different habitat types. We estimated smaller bias and smaller uncertainty in sampling would result from sampling protocols that held both the methods and locations constant. This seemed reasonable because we were more interested in year to year variation associated with adult spawners and climatic conditions of a stream reach and reaches than we were in annual estimates of juvenile production basin-wide. We knew this concept and design would preclude the annual basin-wide salmonid estimates but it would provide more consistent data for population dynamics at selected sites. Because fish abundance can change dramatically with habitat features on both large and small scales, CTUIR selected permanent sites at more stable areas for the fixed index sites. Presence-absence surveys conducted throughout the basin documented fish distributions seasonally and the smolt monitoring project at TMD estimated annual smolt production (multiple technique strategy to examine trends, distribution and production.

ISRP recommends the development of a single design to examine trends, abundance, distribution and productivity basin-wide on an annual basis. This will require a number of key components including an unbiased sample design. Theoretically, there will always be some bias in every sample design in the real world; however certain designs are more effective at minimizing or at least randomizing bias. This is likely why ISRP recommended the stratified-random design and methods described by Rodgers (2000). A second primary requirement is that each site is sampled in an equal manner and results reflect true abundance or at least have consistent biases in estimates for all sites. Unfortunately, 2002 data indicates that sampling effectiveness and bias between methods is variable at different locations (Tables 2-14 and 2-15, and Figures 2-15 and 2-16). Rodgers (2000) solved the problem of assessing abundance in various habitats by ignoring all but one class of habitat. His methods only samples pools greater than 40 cm deep. Hankin (1984, 1986) solved the problem another way by stratifying by individual habitat type. CTUIR used Hankin's method when estimating population abundance in large stream reaches associated with physical habitat surveys (Contor et al. 1994, 1995, 1996, 1997, 1998, 2000). However, this method was too labor intensive to conduct across the basin every year.

The problem with multiple techniques lies in the original problem of differences in effectiveness and biases of each method. However, as single method may be most effective with a certain set or class of habitat types. Mendel's concept (2002) of using separate methods where they are most effective expands Rodgers design of a single method for a single habitat type (Rodgers 2000). Taking Mendel's concept a bit further and melding it with the traditional Hankin and Reeves concept would provide a number of standardized sampling methods that would be utilized based on habitat criteria. Site selection would be developed using a stratified-random design in a rotating panel schedule as described by Firman and Jacobs (2001). After an initial habitat survey, crews would sample salmonids from several habitat types found in each 1000 m site depending on habitat features. Sampling would be conducted using the appropriate methods based on per-determined criteria. This approach would require additional testing, development and standardization. Fortunately, there are several ongoing regional processes examining these very issues. Until further progress is made with regional sampling protocols, CTUIR plans to use snorkeling as the primary method (to reduce the risk of injuring salmonids) with electrofishing used only fast-water habitat types, turbid streams and very low flow conditions.

Fry Surveys and Presence/Absence Surveys

CTUIR began seasonal presence/absence surveys and fry surveys in 1992 to better understand salmonids seasonal distributions, life history characteristics and age and growth data. Over the years salmonids have been found in ephemeral streams and seasonally dewatered reaches and channels. Compiling information gathered from index sites and these other sampling efforts has provided managers with detailed utilization maps and life-history charts for each species. Data collected from 1999-2002 is summarized in Tables 2-19 through 2-27 and in Figures 2-17 through 2-21.

Significant numbers of fall Chinook and coho salmon have spawned in the mid and lower reaches of the Umatilla River. Estimated egg deposition has run into the millions at times (see Chapter Four). CTUIR has never sampled in the lower river with gear suitable for density estimates, but fall Chinook, coho and steelhead fry and par have been observed. Our techniques could easily miss fish. Lack of fish collected at a presence/absence site suggests that abundance is probably low but does not necessarily indicate absence. Collecting fish at a site confirms their presence but does not indicate abundance or the suitability and productivity of the habitat beyond a general indication.

Salvage Operations
During December of 1999, CTUIR salvaged about 4000 salmonids from McKay Creek including 2 bull trout (Table 2-28).

Table 2-28. Summary of salmonids salvaged from McKay Creek, RM 0-6, December, 1999.

	7-Dec	**8-Dec**	**9-Dec**	**13-Dec**	**14-Dec**	**21-Dec**	**22-Dec**	**Total**
Site Location RM	5.8-6.1	5.8-6.1	5.5-5.7	4.0-4.2	1.9-2.1 & 3.1	0.1-0.3	2.4-2.6	
Natural Coho	250	300	250	250	450	425	375	**2300**
Natural Steelhead	75	75	125	75	150	350	250	**1100**
Bull Trout	0	0	1	1	0	0	0	**2**
Mountain Whitefish	5	20	25	15	160	175	200	**600**
Adult Salmon	0	0	0	0	8	1	1	**10**
Total	**330**	**395**	**401**	**341**	**768**	**951**	**826**	**4012**

During the fall of 2000, CTUIR conducted salvage operations in McKay Creek but did not record the date, time, or locations. Staff reported collecting "approximately 500 juvenile coho, approximately 10 mountain whitefish, three juvenile Chinook salmon, one adult steelhead, and one brown bullhead. Crews also observed two adult coho carcasses.

During July 15-17, 2002, project staff assisted CTUIR's habitat project and ODFW in salvaging salmonids from 4500 feet of McCoy Creek. Fish were salvaged from a channelized section of stream that was subsequently reestablished into its original channel. Crews salvaged two juvenile spring chook, 159 juvenile summer steelhead and 2301 non-salmonids.

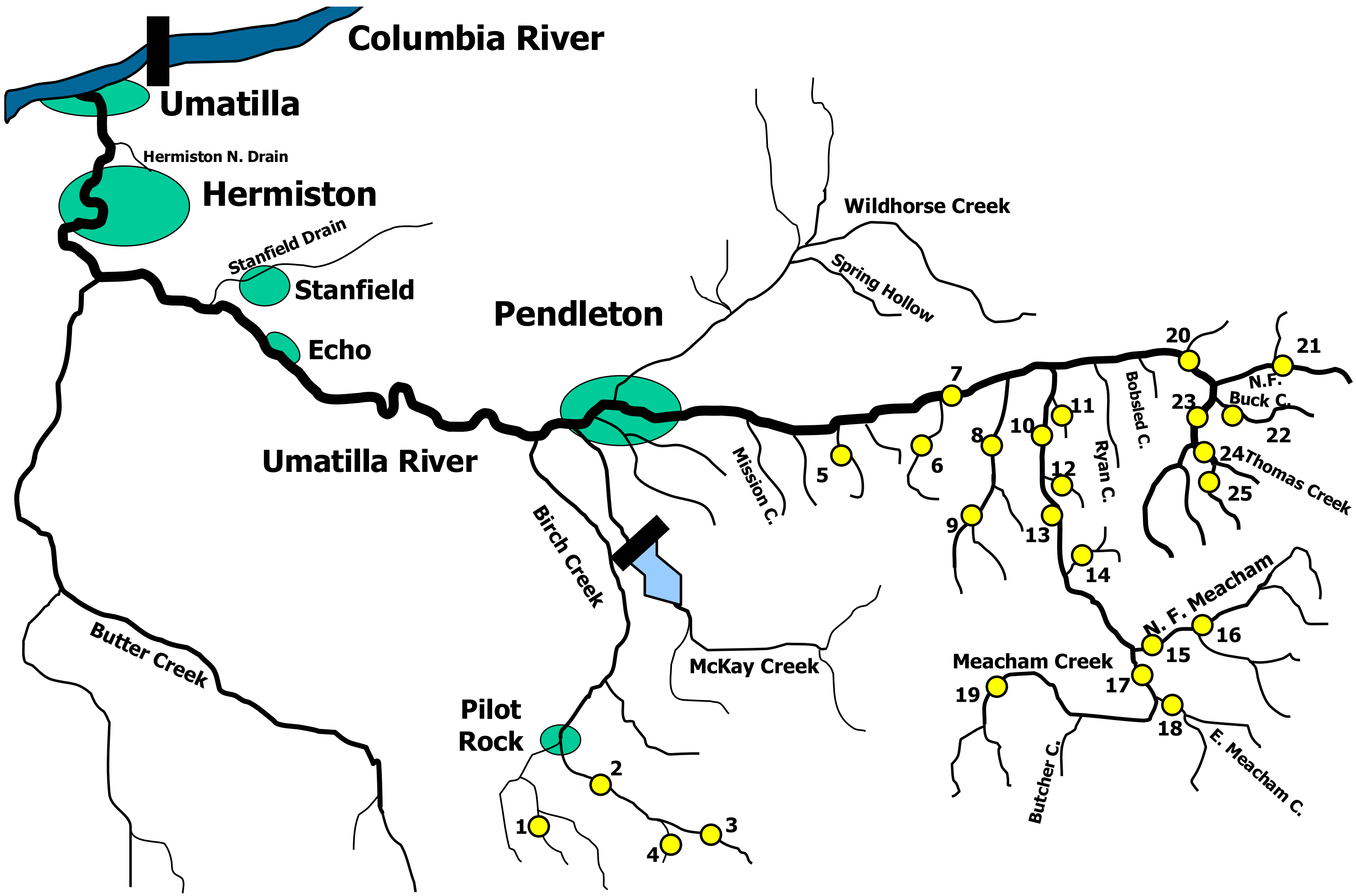

Figure 2-1. Location of fish survey index sites in the Umatilla River Basin, 1999-2002.

Table 2-1. Summary of juvenile salmonid index sites surveyed during the summer of 1999.

Umatilla River Basin Salmonid Surveys, 1999						**Site Length (m)**	**Site Width (m)**	**Site Area (m^2)**	**No. of Passes**	**First Pass (Sec)**	**Second Pass (Sec)**	**Volts**	**Sal. Cap. Pass 1**	**Sal. Cap. Pass 2**	**Total Est. Sal.**	**Density (Sal/m^2)**	**1st Pass CPUE (Sal/Min)**
Site Summary Location	**Site No.**	**River Mile**	**Date**	**Time**	**Water Temp**												
West Birch Cr.	D1-1	10.5	08/26/99	8:20	16	50.5	1.8	92	2	399	399	300	27	12	46	0.498	4.06
West Birch Cr.	D1-2	10.5	08/26/99	8:45	16	51	1.8	90	2	282	282	300	41	16	65	0.726	8.72
East Birch Cr.	D2-1	4.5	08/19/99			50	2.8	138	2	710	778	200-300	76	29	120	0.869	6.42
East Birch Cr.	D2-2	4.5	08/19/99			50	3.5	175	2	355	355	200	15	6	23	0.131	2.54
East Birch Cr.	D3-1	13	08/19/99			50.1	3.0	149	2	426	426	300-400	53	11	66	0.444	7.46
East Birch Cr.	D3-2	13	08/19/99			50	1.6	79	2	412	412	300-400	59	24	97	1.222	8.59
Pearson Cr.	D4-1	2	08/23/99			50	2.7	137	2	525	525	200-400	66	29	115	0.841	7.54
Pearson Cr.	D4-2	2	08/23/99			50	3.1	154	2	483	485	400	62	20	90	0.583	7.70
Moonshine Cr.	D5-1	1	08/25/99	8:30	16	50	1.1	55	2	508	508	200	54	27	104	1.903	6.38
Moonshine Cr.	D5-2	1	08/25/99	9:30	16	50.1	1.3	64	2	551	551	300	101	21	126	1.969	11.00
Buckaroo Cr.	D6-1	1	08/23/99			50	1.6	81	2	459	459	200-400	54	17	77	0.946	7.06
Buckaroo Cr.	D6-2	1	08/23/99			50	1.4	68	2	242	248	200	30	2	32	0.473	7.44
Umatilla R.	D7-1	74	07/28/99			100	4.0	400	2	1188	1188	600	23	9	35	0.088	1.16
Squaw Cr.	D8-1	2.5	08/27/99	9:30	17	51.4	5.8	296	2	575	575	400	80	41	160	0.540	8.35
Squaw Cr.	D8-2	2.5	08/27/99		18	48.6	4.2	206	2	494	494	400	74	30	122	0.591	8.99
Squaw Cr.	D9-1	7	08/27/99		24				2	580	580	400	62	20	90		6.41
Meacham Cr.	D10-1	3	08/24/99	8:30	16	50	0.0	0	2	386	n one	400	39	0	39		6.06
Meacham Cr.	D10-2	3	08/24/99	8:50	16	50	6.2	309	2	474	474	400	60	30	116	0.376	7.59
Boston Can. Cr.	D11-1	0.6	08/02/99	11:15	16	50	8.2	410	2	554	554	200	36	19	72	0.176	3.90
Boston Can. Cr.	D11-2	0.6	08/02/99	12:20	18	50	1.6	78	2	646	649	200-300	39	17	66	0.850	3.62
Line Creek	D12-1	0.3	08/02/99	2:15	17	50	1.2	61	2	406	406	200	15	0	15	0.245	2.22
Line Cr.	D12-2	0.3	08/02/99	2:45	17	54.5	0.7	39	2	702	702	200-400	105	22	132	3.429	8.97
Meacham Cr.	D13-1	9	08/05/99	10:16	17	68.9	0.7	49	2	524	523	400	30	14	53		3.44
Meacham Cr.	D13-2	9	08/05/99	10:53	17				2	454	454	400-500	25	15	56		3.30
Camp Cr.	D14-1	0.6	08/05/99		17				2	617	617	400	63	17	85		6.13
NF Meacham	D15-1	0.5	08/24/99	11:30	19	50	3.4	172	2	653	654	400	79	34	136		7.26
NF Meacham	D15-2	0.5	08/24/99	12:50	19	50	4.0	198	2	443	453	400	48	22	85	0.495	6.50
NF Meacham	D15-3	0.5	08/24/99	1:00	19	50	3.6	179	2	450	450	300-400	37	19	72	0.364	4.93
NF Meacham	D16-1	3	08/04/99	11:00	20				2	787	790	400-500	125	50	206		9.53
Meacham Cr.	D17-1	17	08/03/99			100	3.1	306	2	1069	1069	200-500	74	45	181	1.009	4.15
Meacham Cr.	D17-2	17	08/03/99	1:10	21	50	2.8	141	2	714	714	200-500	50	24	92	0.301	4.20
East Meacham	D18-1	0.3	08/26/99	12:20	16	50	2.1	106	2	395	395	300-400	47	23	88	0.622	7.14
East Meacham	D18-2	0.3	08/26/99	12:55	18	50	4.0	199	2	360	360	300	54	25	97	0.918	9.00
Meacham Cr.	D19-1	28.5	08/09/99	2:20	18	50	5.0	250	2	521	521	300-600	79	44	172	0.863	9.10
Meacham Cr.	D19-2	28.5	08/09/99			50	1.3	65	2	423	423	300	27	7	35	0.140	3.83
Umatilla R.	D20-1	88	07/28/99			90	10.2	920	2	614	614	600	53	32	126	1.938	5.18
NF Umatilla	D21-1	2.7	07/30/99			50	2.8	138	2	499	499	600	41	11	55	0.060	4.93
NF Umatilla	D21-2	2.7	07/30/99			50	3.2	158	2	314	314	400	19	10	36	0.261	3.63
Buck Cr.	D22-1	1	07/27/99			46	2.1	98	2	431	431	400	38	6	44	0.279	5.29
Buck Cr.	D22-2	1	07/27/99			50	2.6	129	2	331	331	400	29	4	33	0.336	5.26
SF Umatilla	D23-1	4	07/27/99			50	5.1	257	2	411	411	600	40	15	62	0.480	5.84
SF Umatilla	D23-1	4	07/27/99			50	4.2	209	2	442	442	400	45	17	70	0.272	6.11
Thomas Cr.	D24-1	0.7	08/25/99	12:00	14	54.5	4.0	218	2	398	398	300-600	48	19	77	0.369	7.24
Thomas Cr.	D24-2	0.7	08/25/99	12:50	14	45.5	4.7	213	2	439	439	300-600	30	8	40	0.183	4.10
Spring Cr.	D25-1	0.2	07/29/99	14:00		47.5	1.3	62	2	543	543	400	31	7	39	0.183	3.43
Spring Cr.	D25-2	0.2	07/29/99	14:35		50	2.3	116	2	544	544	400	37	9	48	0.774	4.08
Total						**2259**	**3.2**	**7265**		**23733**	**23439**		**2320**	**879**	**3796**	**0.431**	**5.87**

Table 2-2. Summary of stream habitat features of index sites surveyed in the Umatilla River Basin during the summer of 1999.

Umatilla River Basin Salmonid Surveys, 1999				Site	Mean	Site	Habitat Units												
Habitat Summary	Site No.	River Mile	Date	Length (M)	Wetted Width	Total Area	1 Type	Area (m2)	2 Type	Area (m2)	3 Type	Area (m2)	4 Type	Area (m2)	5 Type	Area (m2)	6 Type	Area (m2)	Total Area
West Birch	D1-1	10.5	26-Aug-99	50.5	1.8	92.4	RI	64	LP	20	RI	8.5		0		0		0	92.4
West Birch	D1-2	10.5	26-Aug-9	51.0	1.8	89.5	LP	9.8	RI	4.8	LP	3.6	RI	25.9	LP	4.3	RI	41.1	89.53
East Birch	D2-1	4.5	19-Aug-99	50.0	2.8	138.1	RI	130	SP	7.92		0		0		0		0	138.12
East Birch	D2-2	4.5	19-Aug-99	50.0	3.5	175.0	RI	175		0		0		0		0		0	175
East Birch	D3-1	13	19-Aug-99	50.1	3.0	148.5	SP	12.7	LP	8.4	RI	75.6	LP	30.1	RI	17.5	LP	4.2	148.52
East Birch	D3-2	13	19-Aug-99	50.0	1.6	79.4	SP	6.6	RI	32.5	LP	31.3	RI	9		0		0	79.41
Pearson	D4-1	2	23-Aug-99	50.0	2.7	136.7	RI	79.67	LP	26.2	RI	12.6	LP	12.6	RI	5.6		0	136.7
Pearson	D4-2	2	23-Aug-99	50.0	3.1	154.4	RI	70.4	RP	84		0		0		0		0	154.4
Moonshine	D5-1	1	25-Aug-99	50.0	1.1	54.7	RI	4.98	LP	4.3	RI	4.62	LP	2.9	RI	20.3	SP	17.6	54.66
Moonshine	D5-2	1	25-Aug-99	50.1	1.3	64.0	RI	17.2	SP	5.28	RI	4.62	SP	5.94	RI	27.4	GL	3.5	64
Buckaroo	D6-1	1	23-Aug-99	50.0	1.6	81.4	PD	40	DU	0	LP	26.1	RI	15.3		0		0	81.41
Buckaroo	D6-2	1	23-Aug-99	50.0	1.4	67.6	PD	8.2	DU	0	LP	37	PD	22.4		0		0	67.6
Umatilla	D7-1	74	28-Jul-99	100.0	4.0	400.0	RI	96	GL	304		0		0		0		0	400
Squaw	D8-1	2.5	27-Aug-99	51.4	5.8	296.2	LP	189	RI	76.5	LP	30.7		0		0		0	296.22
Squaw	D8-2	2.5	27-Aug-99	48.6	4.2	206.4	RI	65.3	LP	51.7	RI	89.4		0		0		0	206.44
Squaw	D9-1	7	27-Aug-99							0		0		0		0		0	0
Squaw	D9-2	3	27-Aug-99	50.0	0.0	0.0	DU	0		0		0		0		0		0	0
Meacham	D10-1	3	24-Aug-99	50.0	6.2	308.8	GL	218	LP	91.2		0		0		0		0	308.8
Meacham	D10-2	0.6	24-Aug-99	50.0	8.2	410.0	RI	410		0		0		0		0		0	410
Boston Can.	D11-1	0.6	2-Aug-99	50.0	1.6	77.7	SP	6.1	RP	22.8	SP	13.8	RP	35		0		0	77.69
Boston Can.	D11-2	0.3	2-Aug-99	50.0	1.2	61.3	RB	10.4	LP	7.95	RB	10.6	RI	21.4	LP	4.8	RI	6.2	61.31
Line	D12-1	0.3	2-Aug-99	54.5	0.7	38.5	RB	6.6	PP	4	RB	5.39	SP	0.9	RB	19.8	PP	1.8	38.5
Line	D12-2	9	2-Aug-99	68.9	0.7	49.3	RB	10.6	PP	4.8	RB	12.1	SP	3.4	RI	15.9	SP	2.4	49.27
Meacham	D13-1	9	5-Aug-99					0		0		0		0		0		0	0
Meacham	D13-2	0.6	5-Aug-99					0		0		0		0		0		0	0
Camp	D14-1	0.5	5-Aug-99					0		0		0		0		0		0	0
NF Meacham	D15-1	0.5	24-Aug-99	50.0	3.4	171.8	RI	33.8	LP	22.4	RI	116		0		0		0	171.75
NF Meacham	D15-2	0.5	24-Aug-99	50.0	4.0	197.9	SP	25.5	RI	172		0		0		0		0	197.93
NF Meacham	D15-3	3	24-Aug-99	50.0	3.6	179.4	RI	70.7	SP	40.8	RP	67.8		0		0		0	179.36
NF Meacham	D16-1	3	4-Aug-99					0		0		0		0		0		0	0
Meacham	D17-1	17	3-Aug-99	100.0	3.1	306.0	RI	42	LP	94	IP	170		0		0		0	306
Meacham	D17-2	17	3-Aug-99	50.0	2.8	141.4	LP	21	RI	120		0		0		0		0	141.4
E Meacham	D18-1	0.3	26-Aug-99	50.0	2.1	105.7	RI	12.2	LP	19.8	RI	35.7	LP	12	RI	26		0	105.66
E Meacham	D18-2	0.3	26-Aug-99	50.0	4.0	199.4	LP	14.9	RI	184.5		0		0		0		0	199.38
Meacham	D19-1	28.5	9-Aug-99	50.0	5.0	250.4	PP	219	RP	13.6	RI	17.4		0		0		0	250.42
Meacham	D19-2	28.5	9-Aug-99	50.0	1.3	65.0	PD	65		0		0		0		0		0	65
Umatilla	D20-1	88	9-Aug-99	90.0	10.2	920.4	LP	676	RI	244.1		0		0		0		0	920.37
NF Umatilla	D21-1	2.7	30-Jul-99	50.0	2.8	138.2	LP	35.5	RB	44.2	RI	12.3	SP	46.2		0		0	138.18
NF Umatilla	D21-2	2.7	7-Jul-99	50.0	3.2	157.7	LP	14.8	RB	6.9	LP	54.4	RI	43.2	LP	24.3	RI	14	157.65
Buck	D22-1	1	27-Jul-99	46.0	2.1	98.1	RI	32.5	LP	6.7	RI	45.8	SP	0.3	RI	12.9		0	98.13
Buck	D22-2	1	27-Jul-99	50.0	2.6	129.2	RI	76.7	LP	10.4	RI	22.4	LP	19.7		0		0	129.21
SF Umatilla	D23-1	4	27-Jul-99	50.0	5.1	257.0	LP	92	RP	165		0		0		0		0	257
SF Umatilla	D23-2	4	27-Jul-99	50.0	4.2	208.5	RP	71.5	LP	16	RP	66	GL	55		0		0	208.5
Thomas	D24-1	0.7	25-Aug-99	54.5	4.0	218.1	RP	57.0	PP	14.3	RI	77.7	SP	69		0		0	218.08
Thomas	D24-2	0.7	25-Aug-99	45.5	4.7	213.1	RI	74.1	LP	104	RI	35		0		0		0	213.05
Spring	D25-1	0.2	29-Jul-99	47.5	1.3	62.0	RI	4.4	SP	0.75	RP	56.9		0		0		0	62.025
Spring	D25-2	0.2	29-Jul-99	50.0	2.3	115.8	SP	31.5	RP	59	LP	25.3		0		0		0	115.8

Table 2-3. Summary of fish captured from index sites during the summer of 1999.

Umatilla River Basin Salmonid Surveys, 1999											**General Estimates of Non-salmonids Observed**							
Catch Summary	**Site No.**	**River Mile**	**Date**	**Bull Trout**	**Nat. CH**	**Nat. STS**	**Hat. STS**	**Nat Coho**	**Mt. White Fish**	**Total Sal. Cap.**	**Dace**	**Shiner.**	**Sculpin.**	**Sucker.**	**Chisel. Mouth.**	**Oregon. Pike Min.**	**Tot. Non-Sal.**	**Sal. to non-Sal.**
West Birch	D1-1	10.5	26-Aug-99			39				39			50				50	0.780
West Birch	D1-2	10.5	26-Aug-99			57				57			75				75	0.760
East Birch	D2-1	4.5	19-Aug-99			105				105	3000		200	15			3215	0.033
East Birch	D2-2	4.5	19-Aug-99			21				21	4000		500				4500	0.005
East Birch	D3-1	13	19-Aug-99			64				64	400		100	20			520	0.123
East Birch	D3-2	13	19-Aug-99			83				83	400		150				550	0.151
Pearson Cr.	D4-1	2	23-Aug-99			95				95			100				100	0.950
Pearson Cr.	D4-2	2	23-Aug-99			82				82			75				75	1.093
Moonshine	D5-1	1	25-Aug-99			81				81							0	
Moonshine	D5-2	1	25-Aug-99			122				122							0	
Buckaroo	D6-1	1	23-Aug-99			70	1			71		5	30			2	37	1.919
Buckaroo	D6-2	1	23-Aug-99			32				32				1		2	3	10.667
Umatilla	D7-1	74	28-Jul-99			25		6	1	32	200	350	100		25		675	0.047
Squaw Cr.	D8-1	2.5	27-Aug-99			121				121	250		400				650	0.186
Squaw Cr.	D8-2	2.5	27-Aug-99			104				104	75		300				375	0.277
Squaw Cr.	D9-1	7	27-Aug-99			82				82	25		40				65	1.262
Meacham	D10-1	3	24-Aug-99			39				39	350	5	200				555	0.070
Meacham	D10-2	3	24-Aug-99			90				90	400		100				500	0.180
Boston Can.	D11-1	0.6	02-Aug-99			52	3			55			20				20	2.750
Boston Can.	D11-2	0.6	02-Aug-99			48	8			56			12				12	4.667
Line Creek	D12-1	0.3	02-Aug-99			15				15			4				4	3.750
Line Creek	D12-2	0.3	02-Aug-99			127				127							0	
Meacham	D13-1	9	05-Aug-99			44				44							0	
Meacham	D13-2	9	05-Aug-99		1	39				40	350		350				700	0.057
Camp Cr.	D14-1	0.6	05-Aug-99			80				80	40		40				80	1.000
NF Meacham	D15-1	0.5	24-Aug-99			113				113	200		100				300	0.377
NF Meacham	D15-2	0.5	24-Aug-99			69		1		70	100		300				400	0.175
NF Meacham	D15-3	0.5	24-Aug-99			56				56	150		400				550	0.102
NF Meacham	D16-1	3	04-Aug-99		1	173			1	175							0	
Meacham	D17-1	17	03-Aug-99			119				119	100	12	30	25			167	0.713
Meacham	D17-2	17	03-Aug-99			74				74	100	10	20				130	0.569
E. Meacham	D18-1	0.3	26-Aug-99			70				70			75				75	0.933
E. Meacham	D18-2	0.3	26-Aug-99			79				79			175				175	0.451
Meacham	D19-1	28.5	09-Aug-99			123				123							0	
Meacham	D19-2	28.5	09-Aug-99			34				34							0	
Umatilla	D20-1	88	28-Jul-99		4	63		1	17	85							0	
NF Umatilla	D21-1	2.7	30-Jul-99	7		44			1	52			55				55	0.945
NF Umatilla	D21-2	2.7	30-Jul-99			28			1	29			20				20	1.450
Buck Cr.	D22-1	1	27-Jul-99			44				44			35				35	1.257
Buck Cr.	D22-2	1	27-Jul-99			33				33							0	
SF Umatilla	D23-1	4	27-Jul-99			55				55			30				30	1.833
SF Umatilla	D23-1	4	27-Jul-99			62				62			35				35	1.771
Thomas Cr.	D24-1	0.7	25-Aug-99			67				67			45				45	1.489
Thomas Cr.	D24-2	0.7	25-Aug-99			38				38			35				35	1.086
Spring Cr.	D25-1	0.2	29-Jul-99			37		1		38							0	
Spring Cr.	D25-2	0.2	29-Jul-99			46				46							0	
Totals				**7**	**6**	**3144**	**12**	**9**	**21**	**3199**	**10140**	**382**	**4201**	**61**	**25**	**4**	**14813**	**0.216**

Table 2-4. Summary of salmonid length data of fish captured from index sites during the summer of 1999.

Umatilla Salmonid Surveys, 1999				**Fork Lengths (mm)**																			
Length	**Site**	**River**		**Bull Trout**				**Natural Chinook**				**Natural Steelhead**				**Hatchery Steelhead**				**Mountain Whitefish**			
Summary	**No.**	**Mile**	**Date**	**Max**	**Mean**	**Min**	**n**	**Max**	**Mean**	**Min**	**n**	**Max**	**Mean**	**Min**	**n**	**Max**	**Mean**	**Min**	**n**	**Max**	**Mean**	**Min**	**n**
W Birch Cr.	D1-1	10.5	26-Aug-99									200	94.0	53	39								
W Birch Cr.	D1-2	10.5	26-Aug-99									195	90.3	39	57								
E Birch Cr.	D2-1	4.5	19-Aug-99									165	76.7	51	105								
E Birch Cr.	D2-2	4.5	19-Aug-99									173	72.4	49	21								
E Birch Cr.	D3-1	13	19-Aug-99									209	91.6	48	64								
E Birch Cr.	D3-2	13	19-Aug-99									156	78.9	45	83								
Pearson Cr.	D4-1	2	23-Aug-99									188	103.4	45	95								
Pearson Cr.	D4-2	2	23-Aug-99									165	99.5	55	82								
Moonshine	D5-1	1	25-Aug-99									143	67.7	48	81								
Moonshine	D5-2	1	25-Aug-99									130	60.1	40	122								
Buckaroo	D6-1	1	23-Aug-99									230	81.2	41	70	197	197.0	197	1				
Buckaroo	D6-2	1	23-Aug-99									220	97.3	46	32								
Umatilla	D7-1	74	28-Jul-99									205	141.6	60	25					220	220	220	1
Squaw Cr.	D8-1	2.5	27-Aug-99									175	82.9	42	121								
Squaw Cr.	D8-2	2.5	27-Aug-99									125	68.7	35	104								
Squaw Cr.	D9-1	7	27-Aug-99									240	80.7	36	82								
Meacham	D10-1	3	24-Aug-99									350	126.3	54	39								
Meacham	D10-2	3	24-Aug-99									210	91.1	45	90								
Boston Can.	D11-1	0.6	2-Aug-99									160	61.2	30	52	215	178.0	156	3				
Boston Can.	D11-2	0.6	2-Aug-99									157	64.0	32	48	167	142.4	122	8				
Line Cr.	D12-1	0.3	2-Aug-99									153	102.6	64	15								
Line Cr.	D12-2	0.3	2-Aug-99									146	61.3	40	127								
Meacham	D13-1	9	5-Aug-99									165	121.9	34	44								
Meacham	D13-2	9	5-Aug-99					50	50.0	50	1	155	102.6	37	39								
Camp Cr.	D14-1	0.6	5-Aug-99									220	68.8	31	80								
NF Meacham	D15-1	0.5	24-Aug-99									240	94.5	43	113								
NF Meacham	D15-2	0.5	24-Aug-99									180	78.9	42	69								
NF Meacham	D15-3	0.5	24-Aug-99									270	100.9	48	56								
NF Meacham	D16-1	3	4-Aug-99					70	70.0	70	1	258	117.7	39	173					198	198	198	1
Meacham	D17-1	17	3-Aug-99									256	105.3	43	119								
Meacham	D17-2	17	3-Aug-99									123	69.3	36	74								
E Meacham	D18-1	0.3	26-Aug-99									168	81.2	43	70								
E Meacham	D18-2	0.3	26-Aug-99									150	71.3	36	79								
Meacham	D19-1	28.5	9-Aug-99									243	114.4	46	123								
Meacham	D19-2	28.5	9-Aug-99									134	68.2	46	34								
Umatilla	D20-1	88	28-Jul-99					103	86.7	73	4	210	109.9	33	63					364	227	97	17
NF Umatilla	D21-1	2.7	30-Jul-99	295	153.7	103	7					193	114.8	55	44					220	220	220	1
NF Umatilla	D21-2	2.7	30-Jul-99									183	118.0	69	28					217	217	217	1
Buck Cr.	D22-1	1	27-Jul-99									203	116.4	78	44								
Buck Cr.	D22-2	1	27-Jul-99									190	114.3	72	33								
SF Umatilla	D23-1	4	27-Jul-99									238	109.8	40	55								
SF Umatilla	D23-1	4	27-Jul-99									205	114.0	33	62								
Thomas Cr.	D24-1	0.7	25-Aug-99									184	96.3	37	67								
Thomas Cr.	D24-2	0.7	25-Aug-99									185	101.0	40	38								
Spring Cr.	D25-1	0.2	29-Jul-99									210	99.3	25	37								
Spring Cr.	D25-2	0.2	29-Jul-99									175	95.2	24	46								
Total				**295**	**154**	**103**	**7**	**103**	**69**	**50**	**6**	**350**	**93**	**24**	**3144**	**215**	**172**	**122**	**12**	**364**	**216**	**97**	**21**

Nine coho were also collected; Max 96, Mean 76 and Min fork length was 64 mm (see Table 2-3 for location details).

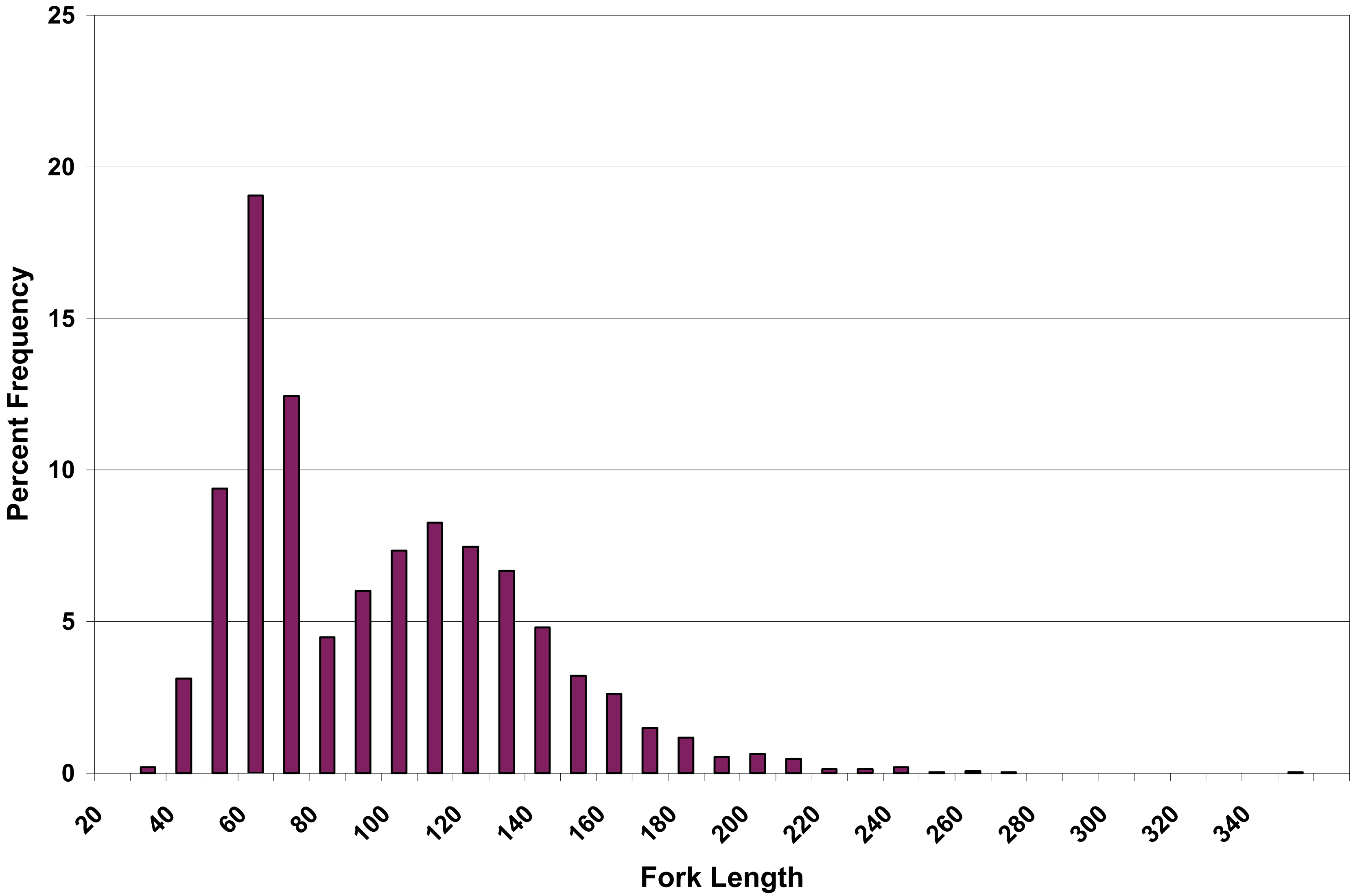

Figure 2-2. Length frequency histogram of the fork lengths (mm) of juvenile summer steelhead collected from the index sites in the Umatilla River, 1999

Table 2-5. Summary of juvenile salmonid index sites surveyed in the Umatilla River during the summer of 2000

Umatilla River Basin Salmonid Surveys, 2000						Site	Site	Site	Number	First	Second		Sal.	Sal.	Total		1st Pass
Site Summary Location	**Site Number**	**River Mile**	**Date**	**Time**	**Water Temp**	**Length (m)**	**Width (m)**	**Area (m2)**	**of Passes**	**Pass (sec)**	**Pass (sec)**	**Volts**	**Cap Pass 1**	**Cap. Pass 2**	**Est. Sal.**	**Density (Sal/m2)**	**CPUE (Sal/Min)**
West Birch Cr.	D1-1	10.5	08/16/00	9:30	16	51	2.65	135.2	2	400	400	300	48	17	72	0.533	7.20
West Birch Cr.	D1-2	10.5	08/16/00	11:05	18	53.1	1.59	84.63	2	300	300	300	40	11	54	0.638	8.00
East Birch Cr.	D2-1	4.5	08/17/00	9:30	17	50	4.00	200	2	600	600	300	66	28	112	0.560	6.60
East Birch Cr.	D2-2	4.5	08/17/00		17	50	4.40	220	2	322	322		36	18	68	0.309	6.71
East Birch Cr.	D3-1	13	08/16/00	13:37	18	53.6	1.32	70.59	2				37	7	45	0.637	-
East Birch Cr.	D3-2	13	08/16/00	9:58	18	51	1.57	79.82	2				23	2	25	0.313	-
Pearson Creek	D4-1	2	07/17/00	10:43	12	50	3.11	155.6	2	597	585	300-400	56	14	73	0.469	5.63
Pearson Creek	D4-2	2	07/17/00	11:41	12	50	1.60	80	2	522	540	300	70	20	96	1.200	8.05
Buckaroo Cr.	D6-1	1	08/22/00	10:30	15	50	1.29	64.6	1	166	-	200	57	-	-	-	20.60
Buckaroo Cr.	D6-2	1	08/22/00	11:45	16	38	1.74	66.2	1	160	-	200	9	-	-	-	3.38
Umatilla River	D7-1	74	08/30/00	9:21		100	15	1500	2				41	21	80	0.053	-
Squaw Creek	D8-1	2.5	08/22/00	12:40	21	50	2.00	100	2	524	524	300-400	48	24	92	0.920	5.50
Squaw Creek	D8-2	2.5	08/22/00		22.5	50	4.59	229.6	2	392	392	300-400	46	0	46	0.200	7.04
Squaw Creek	D9-1	7	08/25/00	10:41	17	50	3.10	155.2	2	326	326	300-400	25	12	45	0.290	4.60
Squaw Creek	D9-2	7	08/25/00	11:30	17	50	3.22	161	2	228	228	300-400	53	13	69	0.429	13.95
Meacham Creek	D10-1	3	08/21/00	10:45	18	50	5.64	282	**				1		-	-	-
Meacham Creek	D10-2	3	08/21/00		17.5	51	6.60	336.76	2	675	675	300	25	10	39	0.116	2.22
Boston Can. Cr.	D11-1	0.6	09/12/00	10:40	13	50	1.88	94.2	2	490	490	300-400	51	17	75	0.796	6.24
Boston Can. Cr.	D11-2	0.6	09/11/00	12:12	14	50	1.62	80.9	2	333	333	300-400	35	14	56	0.692	6.31
Line Creek	D12-1	0.3	09/13/00	10:00	13	51	1.48	75.6	2	380	380	200-300	39	17	66	0.873	6.16
Line Creek	D12-2	0.3	09/13/00	11:59	14	50	1.52	76.2	2	288	288		26	7	34	0.446	5.42
Meacham Creek	D13-1	9	08/28/00		17	50	13.60	680	2	977	977	400	85	25	119	0.175	5.22
Meacham Creek	D13-2	9	08/28/00	11:59	17	50	14.10	705	2	634	634		34	26	76	0.108	3.22
Camp Creek	D14-1	0.6	09/13/00	14:00	16	50	2.25	112.7	2	413	413	300-500	43	5	48	0.426	6.25
Camp Creek	D14-2	0.6	09/13/00	14:45	12	50	2.11	105.6	2	300	300	200-300	24	13	48	0.455	4.80
NF. Meacham	D15-1	0.5	09/20/00			50	3.3	166.6	2	425	425	300-400	53	26	100	0.600	7.48
NF Meacham	D15-2	0.5	09/20/00			50	2.8	140	2	318	318	300-400	59	18	83	0.593	11.13
NF. Meacham	D16-1	3	09/20/00		12	50	6.5	325.6	2	464	164	300-400	80	32	130	0.399	10.34
NF Meacham	D16-2	3	09/20/00			50	5.8	292.4	2	430	430	300-400	56	24	95	0.325	7.81
East Meacham	D18-1	0.3	09/19/00		15	50	2.85	142.5	2	319	319	300-500	27	4	31	0.218	5.08
East Meacham	D18-2	0.3	09/19/00		15	50	2.85	142.5	2	219	219	300-400	13	4	17	0.119	3.56
Meacham Creek	D19-1	28.5	08/24/00			50	3.04	152	1	524	-	200-500	63	-	-	-	7.21
Meacham Creek	D19-2	28.5	08/24/00			50	1.00	50	2	475	475	300-400	51	14	78	1.560	6.44
Umatilla River	D20-1	88	08/07/00	10:51	15	101	10.59	1069.1	1	512	-	300-400	31	-	-	-	3.63
N. F. Umatilla.	D21-1	2.7	08/08/00	9:25	12	39.1	3.70	144.67	2	387	387	300-400	28	18	70	0.484	4.34
N. F. Umatilla.	D21-2	2.7	08/08/00		13	40.5	2.30	93.15	2			300-400	19	9	33	0.354	-
Buck Creek	D22-1	1	06/19/00	11:00	12	50	3.47	173.61	2	281	283	400	12	3	15	0.086	2.56
Buck Creek	D22-2	1	06/19/00	11:50	12	50	3.79	189.6	2	331	331	400	10	5	33	0.174	1.81
Buck Creek	D22-3	1	06/20/00		10.5	50	3.13	156.49	2	462	462	400	24	6	31	0.198	3.12
Buck Creek	D22-4	1	06/20/00	11:30	12	50	3.99	199.5	2	299	299	400-500	13	2	15	0.075	2.61
Buck Creek	D22-5	1	08/09/00	11:00	14.5	50	3.26	163.2	2	455	449	300-400	23	11	41	0.251	3.03
Buck Creek	D22-6	1	08/09/00	12:00	15.5	50	3.35	167.5	2	570	570	300-400	21	8	32	0.191	2.21
SF Umatilla.	D23-1	4	08/02/00	13:45	19	50	5.92	296	2	547	547	300-500	36	17	65	0.220	3.95
SF Umatilla.	D23-2	4	08/02/00	14:50	19.5	50	4.67	233.55	2	471	471	300-400	25	12	45	0.193	3.18
Thomas Creek	D24-1	0.7	08/02/00	10:39	15	60.1	3.20	192.27	2	602	604	400-500	52	24	93	0.484	5.18
Thomas Creek	D24-2	0.7	08/02/00	12:03	16	40	3.71	148.31	2	406	406	400-600	21	10	37	0.249	3.10
Spring Creek	D25-1	0.2	08/15/00	10:00	15	50	1.66	82.8	2	470	471	300	48	11	61	0.737	6.13
Spring Creek	D25-2	0.2	08/15/00	12:00	17	50	2.50	125	2	300	301	300	41	6	48	0.384	8.20
Total						**2479.4**	**3.9**	**10698**		**18294**	**16638**		**1824**	**585**	**2591**	**0.242**	**5.98**

** Presence of adult Chinook prevented completion of survey

Table 2-6. Summary of stream habitat features of index sites surveyed during the summer of 2000.

Umatilla River Basin Salmonid Surveys, 2000						Unit 1		Unit 2		Unit 3		Unit 4		Unit 5		Unit 6		Unit 7	
Habitat Summary	**Site Number**	**Date**	**Total Length**	**Mean Width**	**Area (m^2)**	**Type***	**Area (m^2)**	**Type**	**Area (m^2)**	**Type**	**Area (m^2)**	**Type**	**Area (m^2)**	**Type**	**Area (m^2)**	**Type**	**Area (m^2)**	**Type**	**Area (m^2)**
West Birch	D1-1	8/16/00	51.0	2.7	135.2	RI	109.9	DP	6.7	GL	18.5								
West Birch	D1-2	8/16/00	53.1	1.6	84.6	LP	14.8	RI	14.6	LP	8.9	RI	25.7	LP	17.9	RI	2.9		
East Birch	D2-1	8/17/00	50.0	4.0	200.0	RI	200.0												
East Birch	D2-2	8/17/00	50.0	4.4	220.0	RI	220.0												
East Birch	D3-1	8/16/00	53.6	1.3	70.6	LP	4.0	RI	41.9	LP	10.4	RI	5.9	LP	8.5				
East Birch	D3-2	8/16/00	51.0	1.6	79.8	LP	12.5	RI	67.4										
Pearson	D4-1	7/17/00	50.0	3.1	155.6	RP	54.6	RI	58.0	RP	29.0	LP	14.0						
Pearson	D4-2	7/17/00	50.0	1.6	80.0	RP	60.0	RI	20.0										
Buckaroo	D6-1	8/22/00	50.0	1.3	64.6	RI	21.6	LP	16.0	RI	6.0	GL	21.0						
Buckaroo	D6-2	8/22/00	38.0	1.7	66.2	LP	3.9	RI	20.9	GL	18.0	RI	23.4						
Umatilla, 74	D7-1	8/30/00	100.0	15.0	1500.0	RI	1500												
Squaw	D8-1	8/22/00	50.0	2.0	100.0	LP	12.0	RI	88.0										
Squaw	D8-2	8/22/00	50.0	4.6	229.6	RI	225.6	LP	4.0										
Squaw Upper	D9-1	8/25/00	50.0	3.1	155.2	RP	76.0	RI	43.2	GL	36.0								
Squaw Upper	D9-2	8/25/00	50.0	3.2	161.0	LP	22.5	RI	9.0	GL	104.0	LP	18.0	RI	7.5				
Meacham Lower	D10-1	8/21/00	50.0	5.6	282.0	LP	260.5	RI	21.5										
Meacham Lower	D10-2	8/21/00	51.0	6.6	336.7	RP	217.0	RI	120										
Boston Canyon	D11-1	9/12/00	50.0	1.9	94.2	RI	21.0	RB	12.0	GL	12.0	RI	21.6	RP	6.0	RI	21.6		
Boston Canyon	D11-2	9/11/00	50.0	1.6	80.9	RB	22.1	SP	10.0	RB	10.8	RI	38.0						
Line	D12-1	9/13/00	51.0	1.5	75.6	RB	12.6	RI	4.8	SP	7.2	LP	3.0	RB	3.3	LP	5.6	RB	39.1
Line	D12-2	9/13/00	50.0	1.5	76.2	RB	19.2	RI	3.9	RB	19.5	LP	4.8	RB	28.8				
Meacham Creek 9	D13-1	8/28/00	50.0	13.6	680.0	RI	680.0												
Meacham Creek 9	D13-2	8/28/00	50.0	14.1	705.0	RI	705.0												
Camp	D14-1	9/13/00	50.0	2.3	112.7	BR	13.6	LP	13.0	RI	39.1	LP	9.5	RI	37.5				
Camp	D14-2	9/13/00	50.0	2.1	105.6	LP	11.2	RI	9.5	LP	4.5	RI	27.2	LP	25.2	RI	28.0		
NF Meacham	D15-1	9/20/00	50.0	3.3	166.6	RP	45.5	RI	73.1	RP	48.0								
NF Meacham	D15-2	9/20/00	50.0	2.8	140.0	RP	96.0	GL	44.0										
NF Meacham	D16-1	9/20/00	50.0	6.5	325.6	RI	184.3	LP	89.8	RP	51.5								
NF Meacham	D16-2	9/20/00	50.0	5.8	292.4	RP	111.6	RI	116	GL	64.8								
E Meacham	D18-1	9/19/00	50.0	2.9	142.5	RI	51.3	RP	84.0	RI	7.2								
E Meacham	D18-2	9/19/00	50.0	2.9	142.5	RI	51.3	RP	84.0	RI	7.2								
Meacham Creek	D19-1	8/24/00	50.0	3.0	152.0	RI	74.0	LP	78.0										
Meacham Creek	D19-2	8/24/00	50.0	1.0	50.0	RP	50.0												
Umatilla 88	D20-1	8/7/00	101.0	10.6	1069.1	LP	866.3	RI	203										
NF Umatilla	D21-1	8/8/00	39.1	3.7	144.7	RI	83.3	LP	27.0	RI	4.8	LP	29.6						
NF Umatilla	D21-2	8/8/00	40.5	2.3	93.2	LP	14.3	LP	20.9	RI	4.8	LP	20.9	RI	32.2				
Buck	D22-1	6/19/00	50.0	3.5	173.6	RB	36.4	LP	32.4	RB	86.8	PP	0.3	RI	17.8				
Buck	D22-2	6/19/00	50.0	3.8	189.6	RI	174.8	LP	14.8										
Buck	D22-3	6/20/00	50.0	3.1	156.5	RI	42.8	SP	15.4	RB	34.2	RI	64.2						
Buck	D22-4	6/20/00	50.0	4.0	199.5	LP	33.6	LI	1669										
Buck	D22-5	8/9/00	50.0	3.3	163.2	RI	41.8	LP	15.0	RI	14.4	RP	24.0	RP	51.2	RI	16.8		
Buck	D22-6	8/9/00	50.0	3.4	167.5	RI	28.0	LP	33.0	RI	88.0	RP	18.5						
SF Umatilla	D23-1	8/2/00	50.0	5.9	296.0	LP	98.0	RP	198										
SF Umatilla	D23-2	8/2/00	50.0	4.7	233.6	RI	104.6	RP	112	GL	16.8								
Thomas	D24-1	8/2/00	60.1	3.2	192.3	RP	46.8	PP	18.5	RI	62.1	PP	64.9						
Thomas	D24-2	8/2/00	40.0	3.7	148.3	RI	66.0	LP	82.3										
Spring	D25-1	8/15/00	50.0	1.7	82.8	RI	22.1	LP	6.0	RI	8.0	RR	16.2	RI	14.4	RP	4.2	RI	11.9
Spring	D25-2	8/15/00	50.0	2.5	125.0	RP	97.5	RI	27.5										
Total			**2479.4**	**3.9**	**106986**														

* Type RI = Riffle, LP=Lateral Scour Pool, RP=Riffle with Pockets, RB=riffle with boulders, etc. (Moore et al. 1993)

Table 2-7. Summary of fish collected from index sites during the summer of 2000.

Umatilla River Basin Salmonid Surveys, 2000										**Estimates of Non-salmonids Observed**							
Catch Sum. Location	**Site No.**	**River Mile**	**Date**	**Bull Trout**	**Nat. CHS**	**Nat. STS**	**Hat. STS**	**Mt. White Fish**	**Total Sal. Cap.**	**Dace**	**Shine.**	**Scul.**	**Suck.**	**Chis Mth.**	**North. Pike Min.**	**Total Non Sal.**	**Salmonids to non-salmonids**
West Birch Cr.	D1-1	10.5	16-Aug-2000			65			65	50		50				100	0.650
West Birch Cr.	D1-2	10.5	16-Aug-2000			51			51	30		30				60	0.850
East Birch Cr.	D2-1	4.5	17-Aug-2000			94			94	1000		200				1200	0.078
East Birch Cr.	D2-2	4.5	17-Aug-2000			54			54								
East Birch Cr.	D3-1	13	16-Aug-2000			44			44	75		100				175	0.251
East Birch Cr.	D3-2	13	16-Aug-2000			25			25	35		250				285	0.088
Pearson Creek	D4-1	2	17-Jul-2000			70			70			150				150	0.467
Pearson Creek	D4-2	2	17-Jul-2000			90			90								
Buckaroo Cr.	D6-1	1	22-Aug-2000			56	1		57	25		30				55	1.036
Buckaroo Cr.	D6-2	1	22-Aug-2000			9			9			8				8	1.125
Umatilla River	D7-1	74	30-Aug-2000		6	56			62	500	100	200	100			900	0.069
Squaw Creek	D8-1	2.5	22-Aug-2000			72			72	200		100				300	0.240
Squaw Creek	D8-2	2.5	22-Aug-2000			46			46	200		75				275	0.167
Squaw Creek	D9-1	7	25-Aug-2000			37			37	150		75				225	0.164
Squaw Creek	D9-2	7	25-Aug-2000			66			66	200		100				300	0.220
Meacham Cr.	D10-1	3	21-Aug-2000			1			1	300	30					330	0.003
Meacham Cr.	D10-2	3	21-Aug-2000			34		1	35	500		30				530	0.066
Boston Can. Cr.	D11-1	0.6	12-Sep-2000			68			68			70				70	0.971
Boston Can. Cr.	D11-2	0.6	11-Sep-2000			49			49			40				40	1.225
Line Creek	D12-1	0.3	13-Sep-2000			56			56			12				12	4.667
Line Creek	D12-2	0.3	13-Sep-2000			33			33			10				10	3.300
Meacham Cr.	D13-1	9	28-Aug-2000			109			109	500		200				700	0.156
Meacham Cr.	D13-2	9	28-Aug-2000		2	59			61	500		300				800	0.076
Camp Creek	D14-1	0.6	13-Sep-2000			48			48			30				30	1.600
Camp Creek	D14-2	0.6	13-Sep-2000			37			37			20				20	1.850
NF Meacham	D15-1	0.5	20-Sep-2000			79			79	100		250				350	0.226
NF Meacham	D15-2	0.5	20-Sep-2000			77			77	50		100				150	0.513
NF Meacham	D16-1	3	20-Sep-2000			111		1	112	50		200				250	0.448
NF Meacham	D16-2	3	20-Sep-2000			79		1	80	60		200				260	0.308
East. Meacham	D18-1	0.3	19-Sep-2000			31			31			100				100	0.310
East Meacham	D18-2	0.3	19-Sep-2000			17			17			150				150	0.113
Meacham Cr.	D19-1	28.5	24-Aug-2000		1	62			63	65	5	60	18			148	0.426
Meacham Cr.	D19-2	28.5	24-Aug-2000			65			65	200		250	15			465	0.140
Umatilla R.	D20-1	88	7-Aug-2000		6	22		3	31			100				100	0.310
NF Umatilla	D21-1	2.7	8-Aug-2000	6	13	27			46			40				40	1.150
NF Umatilla	D21-2	2.7	8-Aug-2000		12	15		1	28								
Buck Creek	D22-1	1	19-Jun-2000			15			15			7				7	2.143
Buck Creek	D22-2	1	19-Jun-2000			15			15			5				5	3.000
Buck Creek	D22-3	1	20-Jun-2000			30			30			30				30	1.000
Buck Creek	D22-4	1	20-Jun-2000			15			15			7				7	2.143
Buck Creek	D22-5	1	9-Aug-2000			34			34								
Buck Creek	D22-6	1	9-Aug-2000			29			29			50				50	0.580
SF Umatilla	D23-1	4	2-Aug-2000			53			53			40				40	1.325
SF Umatilla	D23-2	4	2-Aug-2000			37			37								
Thomas Creek	D24-1	0.7	2-Aug-2000			76			76			20				20	3.800
Thomas Creek	D24-2	0.7	2-Aug-2000			31			31			30				30	1.033
Spring Creek	D25-1	0.2	15-Aug-2000			59			59			20				20	2.950
Spring Creek	D25-2	0.2	15-Aug-2000			47			47			22				22	2.136
Totals				**6**	**40**	**2355**	**1**	**7**	**2409**	**4790**	**135**	**3761**	**133**	**0**	**0**	**8819**	**0.273**

Table 2-8. Summary of salmonid length data of fish captured from index sites during the summer of 2000.

Umatilla River Basin Salmonid Surveys, 2000				Fish Lengths (mm)																			
Length Summary	**Site**	**River**		**Bull Trout**				**Natural Chinook**				**Natural Steelhead**				**Hatchery Steelhead**				**Mountain Whitefish**			
Location	**No.**	**Mile**	**Date**	**Max**	**Mean**	**Min**	**n**	**Max**	**Mean**	**Min**	**n**	**Max**	**Mean**	**Min**	**n**	**Max**	**Mean**	**Min**	**n**	**Max**	**Mean**	**Min**	**n**
West Birch Creek	D1-1	10.5	16-Aug-2000									236	81.7	40	65								
West Birch Creek	D1-2	10.5	16-Aug-2000									190	92.2	50	51								
East Birch Creek	D2-1	4.5	17-Aug-2000									180	78.9	32	94								
East Birch Creek	D2-2	4.5	17-Aug-2000									146	70.8	39	54								
East Birch Creek	D3-1	13	16-Aug-2000									180	81.2	35	44								
East Birch Creek	D3-2	13	16-Aug-2000									124	78.0	40	25								
Pearson Creek	D4-1	2	17-Jul-2000									170	79.3	29	70								
Pearson Creek	D4-2	2	17-Jul-2000									175	76.1	28	90								
Buckaroo Creek	D6-1	1	22-Aug-2000									126	55.0	38	56	40	40.0	40	1				
Buckaroo Creek	D6-2	1	22-Aug-2000									160	82.9	44	9								
Umatilla River	D7-1	74	30-Aug-2000					92	85.8	72	6	130	74.1	40	56								
Squaw Creek	D8-1	2.5	22-Aug-2000									134	63.5	33	72								
Squaw Creek	D8-2	2.5	22-Aug-2000									122	69.3	44	46								
Squaw Creek	D9-1	7	25-Aug-2000									112	64.8	37	37								
Squaw Creek	D9-2	7	25-Aug-2000									210	92.9	46	66								
Meacham Creek	D10-1	3	21-Aug-2000									148	148.0	148	1								
Meacham Creek	D10-2	3	21-Aug-2000									225	119.0	50	34					95	95.0	95	1
Boston Can. Cr.	D11-1	0.6	12-Sep-2000									109	53.1	29	68								
Boston Can. Cr.	D11-2	0.6	11-Sep-2000									98	55.8	35	49								
Line Creek	D12-1	0.3	13-Sep-2000									130	62.6	27	56								
Line Creek	D12-2	0.3	13-Sep-2000									110	65.2	54	33								
Meacham Creek	D13-1	9	28-Aug-2000					64	64.0	64	1	170	71.6	39	109								
Meacham Creek	D13-2	9	28-Aug-2000					78	78.0	78	1	137	70.1	44	59								
Camp Creek	D14-1	0.6	13-Sep-2000									149	74.6	30	48								
Camp Creek	D14-2	0.6	13-Sep-2000									210	95.0	45	37								
NF Meacham	D15-1	0.5	20-Sep-2000									210	85.9	54	79								
NF Meacham	D15-2	0.5	20-Sep-2000									175	86.2	51	77								
NF Meacham	D16-1	3	20-Sep-2000									285	98.8	45	111					243	243.0	243	1
NF Meacham	D16-2	3	20-Sep-2000									239	95.2	43	79					195	195.0	195	1
East Meacham	D18-1	0.3	19-Sep-2000									205	90.8	45	31								
East Meacham	D18-2	0.3	19-Sep-2000									103	65.3	47	17								
Meacham Creek	D19-1	28.5	24-Aug-2000					78	78.0	78	1	250	108.8	36	62								
Meacham Creek	D19-2	28.5	24-Aug-2000									170	69.9	40	65								
Umatilla River	D20-1	88	7-Aug-2000					89	80.2	68	6	289	134.9	88	22					375	296.7	235	3
NF Umatilla	D21-1	2.7	8-Aug-2000					81	66.5	42	13	196	106.3	43	27								
NF Umatilla	D21-2	2.7	8-Aug-2000					88	70.9	58	12	188	114.1	46	15					200	200.0	200	1
Buck Creek	D22-1	1	19-Jun-2000	115	58.7	37	6					165	129.4	100	15								
Buck Creek	D22-2	1	19-Jun-2000									142	114.3	65	15								
Buck Creek	D22-3	1	20-Jun-2000									230	120.1	75	30								
Buck Creek	D22-4	1	20-Jun-2000									210	123.9	80	15								
Buck Creek	D22-5	1	9-Aug-2000									193	97.7	23	34								
Buck Creek	D22-6	1	9-Aug-2000									210	115.7	34	29								
SF Umatilla	D23-1	4	2-Aug-2000									228	112.4	30	53								
SF Umatilla	D23-2	4	2-Aug-2000									226	91.7	35	37								
Thomas Creek	D24-1	0.7	2-Aug-2000									188	60.2	23	76								
Thomas Creek	D24-2	0.7	2-Aug-2000									181	95.4	35	31								
Spring Creek	D25-1	0.2	15-Aug-2000									158	52.6	26	59								
Spring Creek	D25-2	0.2	15-Aug-2000									200	73.5	30	47								
TOTAL				**115**	**58.7**	**37**	**6**	**92**	**73.3**	**42**	**40**	**289**	**81.8**	**23**	**2355**	**40**	**40.0**	**40**	**1**	**375**	**231.9**	**95**	**7**

Table 2-9. Summary of juvenile salmonid index sites surveyed in the Umatilla River Basin during the summer of 2001.

Umatilla River Salmonid Surveys, 2001				Site Length (m)	Site Width (m)	Site Area (m^2)	No. of Passes	First Pass (Sec)	Second Pass (Sec)	Volts	Sal. Cap. Pass 1	Sal. Cap. Pass 2	Total Est. Sal.	Density (Sal/m^2)	1st Pass CPUE (Sal/Min)
Site Summary Location	**Site Number**	**River Mile**	**Date**												
East Birch Cr.	D3-1	13	13-Aug-01	50	2.5	125.0	2	400	403	300-400	62	17	84	0.67	9.30
East Birch Cr.	D3-2	13	13-Aug-01	50	2.4	122.0	2	575	581	300-400	54	26	100	0.82	5.63
Umatilla R. 74	D7-1	74	27-Aug-01	50	18.6	930.0	2	1950	1950	400-500	26	13	48	0.05	0.80
Umatilla R. 74	D7-2	74	27-Aug-01	50	17.1	853.0	2	1275	1900	400-500	17	8	29	0.03	0.80
Squaw Cr.	D8-1	2.5	28-Aug-01	45	2.5	112.5	2	860	860	200-400	62	32	124	1.10	4.34
Squaw Cr.	D8-2	2.5	28-Aug-01	5	2.5	12.5	2	860	860	200-400	71	32	126	10.08	4.95
Squaw Cr.	D9-1	7	8-Aug-01	50	4.4	219.4	2	1082	1082	300-400	49	28	108	0.49	2.72
Squaw Cr.	D9-2	7	8-Aug-01	50	3.6	182.1	2	610	610	300-400	32	10	45	0.25	3.15
Boston Can. Cr.	D11-1	0.6	10-Aug-01	35	2.0	70.0	2	672	672	300	24	8	34	0.49	2.14
Boston Can. Cr.	D11-2	0.6	10-Aug-01	15	2.3	33.8	2	498	498	300	17	6	24	0.71	2.05
NF Meacham	D15-1	0.5	6-Aug-01	50	6.8	342.0	2	1400	1400	400-500	25	8	35	0.10	1.07
NF Meacham	D15-2	0.5	6-Aug-01	100	4.2	417.5	2	1400	1400	400-500	80	39	152	0.36	3.43
NF Meacham	D16-1	3	14-Aug-01				2	575	575	500	64	28	111		6.68
NF Meacham	D16-2	3	14-Aug-01				2	575	575	500	40	21	80		4.17
Umatilla R. 88	D20-1	88	14-Aug-01	50	11.0	550.0	1	1900		600-700	91				2.87
Umatilla R. 88	D20-2	88	14-Aug-01				1	1275		600-700	48				2.26
NF Umatilla	D21-1	2.7	15-Aug-01	50	4.8	237.5	2	1100	1100	400-600	55	22	89	0.37	3.00
NF Umatilla	D21-2	2.7	15-Aug-01	50	4.4	222.0	2	1625	1625	400-600	86	27	124	0.56	3.18
SF Umatilla	D23-1	4	15-Aug-01				2	1400	1400	400-600	83	42	164		3.56
SF Umatilla	D23-2	4	15-Aug-01				2	1550	1550	400-600	63	26	105		2.44
Thomas Cr.	D24-1	2.5	20-Aug-01	41	3.5	143.5	2	850	850	300-500	129	34	174	1.21	9.11
Thomas Cr.	D24-2	2.5	20-Aug-01	26	3.0	77.0	2	325	325	300-500	50	22	86	1.12	9.23
Spring Cr.	D25-1	0.2	20-Aug-01				2	185	185	300-400	40	8	49		12.97
Spring Cr.	D25-2	0.2	20-Aug-01	21.4	2.5	53.5	2	350	350	300-400	50	14	68	1.27	8.57
Total				**788.4**		**4703.2**		**23292**	**20751**	**1600**	**1318**	**471**	**1959**	**0.42**	**3.40**

Table 2-10. Summary of stream habitat features of index sites surveyed during the summer of 2001.

Umatilla River Salmonid Surveys, 2001				**Total**	**Mean**	**Total**								
Habitat Summary Location	**Site No.**	**River Mile**	**Date**	**Length (M)**	**Wetted Width**	**Area (m^2)**	**Unit 1 Type**	**Area (m^2)**	**Unit 2 Type**	**Area (m^2)**	**Unit 3 Type**	**Area (m^2)**	**Unit 4 Type**	**Area (m^2)**
East Birch Creek	D3-1	13	13-Aug-01	50	2.5	125	RI	125						
East Birch Creek	D3-2	13	13-Aug-01	50	2.4	122	SP	35	LP	35	RI	52		
Umatilla River RM 74	D7-1	74	27-Aug-01	50	18.6	930	RI	510	GL	420				
Umatilla River RM 74	D7-2	74	27-Aug-01	50	17.1	853	LP	156	RI	529	GL	168		
Squaw Creek	D8-1	2.5	28-Aug-01	45	2.5	113	RI	112.5						
Squaw Creek	D8-2	2.5	28-Aug-01	5	2.5	13	GL	12.5						
Squaw Creek	D9-1	7	8-Aug-01	50	4.4	219	SP	24.648	RI	141.75	GL	53		
Squaw Creek	D9-2	7	8-Aug-01	50	3.6	182	GL	76.5	RI	105.6				
Boston Canyon Creek	D11-1	0.6	10-Aug-01	35	2.0	70	RP	70						
Boston Canyon Creek	D11-2	0.6	10-Aug-01	15	2.3	34	RP	33.75						
NF Meacham Creek	D15-1	0.5	6-Aug-01	50	6.8	342	RB	52	RI	170	GL	120		
NF Meacham Creek	D15-2	0.5	6-Aug-01	100	4.2	418	SP	52.5	RP	225	RP	140		
NF Meacham Creek	D16-1	3	14-Aug-01											
NF Meacham Creek	D16-2	3	14-Aug-01											
Umatilla River RM 88	D20-1	88	14-Aug-01	50	11.0	550	RI	550						
Umatilla River RM 88	D20-2	88	14-Aug-01											
NF Umatilla River	D21-1	2.7	15-Aug-01	50	4.8	238	LP	56	RI	137.5	SP	44		
NF Umatilla River	D21-2	2.7	15-Aug-01	50	4.4	222	RP	120	RI	66	LP	36		
SF Umatilla River	D23-1	4	15-Aug-01											
SF Umatilla River	D23-2	4	15-Aug-01											
Thomas Creek	D24-1	2.5	20-Aug-01	41	3.5	144	RP	63	GL	40.5	PD	16	SP	24
Thomas Creek	D24-2	2.5	20-Aug-01	26	3.0	77	PP	40	RI		PP	27		
Spring Creek	D25-1	0.2	20-Aug-01											
Spring Creek	D25-2	0.2	20-Aug-01	21.4	2.5	54	RI	53.5						

Table 2-11. Summary of fish captured from index sites during the summer of 2001.

Umatilla River Basin Salmonid Surveys, 2001							**Mt.**	**Total**				**North.**	**Total**	**Salmonids**
Catch Summary Location	**Site Number**	**River Mile**	**Date**	**Bull Trout**	**Natural Chinook**	**Nat. STS**	**White Fish**	**Sal. Cap.**	**Dace**	**Shiners**	**Sculpin**	**Pike Min.**	**Non-Sal.**	**to-non Salmonids**
East Birch Creek	D3-1	13	13-Aug-01			79		79			60		60	1.317
East Birch Creek	D3-2	13	13-Aug-01			80		80			100		100	0.800
Umatilla River	D7-1	74	27-Aug-01		10	26	3	39	500	100	200	5	805	0.048
Umatilla River	D7-2	74	27-Aug-01		13	5	7	25	350	125	150	2	627	0.040
Squaw Creek	D8-1	2.5	8-Aug-01			77		77						
Squaw Creek	D8-2	2.5	8-Aug-01		1	41		42						
Squaw Creek	D9-1	7	28-Aug-01			94		94						
Squaw Creek	D9-2	7	28-Aug-01			103		103						
Boston Canyon Creek	D11-1	0.6	10-Aug-01			32		32	15		70		85	0.376
Boston Canyon Creek	D11-2	0.6	10-Aug-01			23		23	10		50		60	0.383
NF Meacham Creek	D15-1	0.5	6-Aug-01			31	2	33	175		125		300	0.110
NF Meacham Creek	D15-2	0.5	6-Aug-01			119		119	75		100		175	0.680
NF Meacham Creek	D16-1	3	14-Aug-01			92		92	75		250		325	0.283
NF Meacham Creek	D16-2	3	14-Aug-01			61		61	100		250		350	0.174
Umatilla River	D20-1	88	14-Aug-01	1	21	66	3	91	175		100		275	0.331
Umatilla River	D20-2	88	14-Aug-01	1	15	28	4	48						
NF Umatilla River	D21-1	2.7	15-Aug-01	3	27	46	1	77			80		80	0.963
NF Umatilla River	D21-2	2.7	15-Aug-01	6	42	65		113			75		75	1.507
SF Umatilla River	D23-1	4	15-Aug-01			123		123			675		675	0.182
SF Umatilla River	D23-2	4	15-Aug-01		2	89		91						
Thomas Creek	D24-1	0.7	20-Aug-01			163		163			25		25	6.520
Thomas Creek	D24-2	0.7	20-Aug-01			72		72			12		12	6.000
Spring Creek	D25-1	0.2	15-Aug-01			48		48			10		10	4.800
Spring Creek	D25-2	0.2	15-Aug-01			64		64			12		12	5.333
Total				**11**	**131**	**1627**	**20**	**1789**	**1475**	**225**	**2344**	**7**	**4051**	**0.442**

Table 2-12. General descriptive statistics of the lengths of salmonids captured at index sites in the Umatilla River, 2001.

Umatilla River Salmonid Surveys, 2001				
Fork Length, mm **Length Summary**	**STS**	**CHS**	**MWF**	**BLT**
Mean	76.907806	73.3	166.1	158.5
Standard Error	0.9345516	0.881	17.292	28.594
Median	63	74	172.5	127
Mode	46	74	180	
Standard Deviation	37.696155	10.0779	77.3311	94.8339
Sample Variance	1421.0001	101.5645	5980.0947	8993.4727
Kurtosis	1.6432528	0.4957	-0.9002	6.6107
Skewness	1.2667985	-0.3233	0.5606	2.4199
Range	241	57	229	344
Minimum	25	41	81	76
Maximum	266	98	310	420
Sum	125129	9602	3322	1744
Count	1627	131	20	11
Confidence Level (95.0%)	1.8330532	1.7419863	36.192067	63.710307

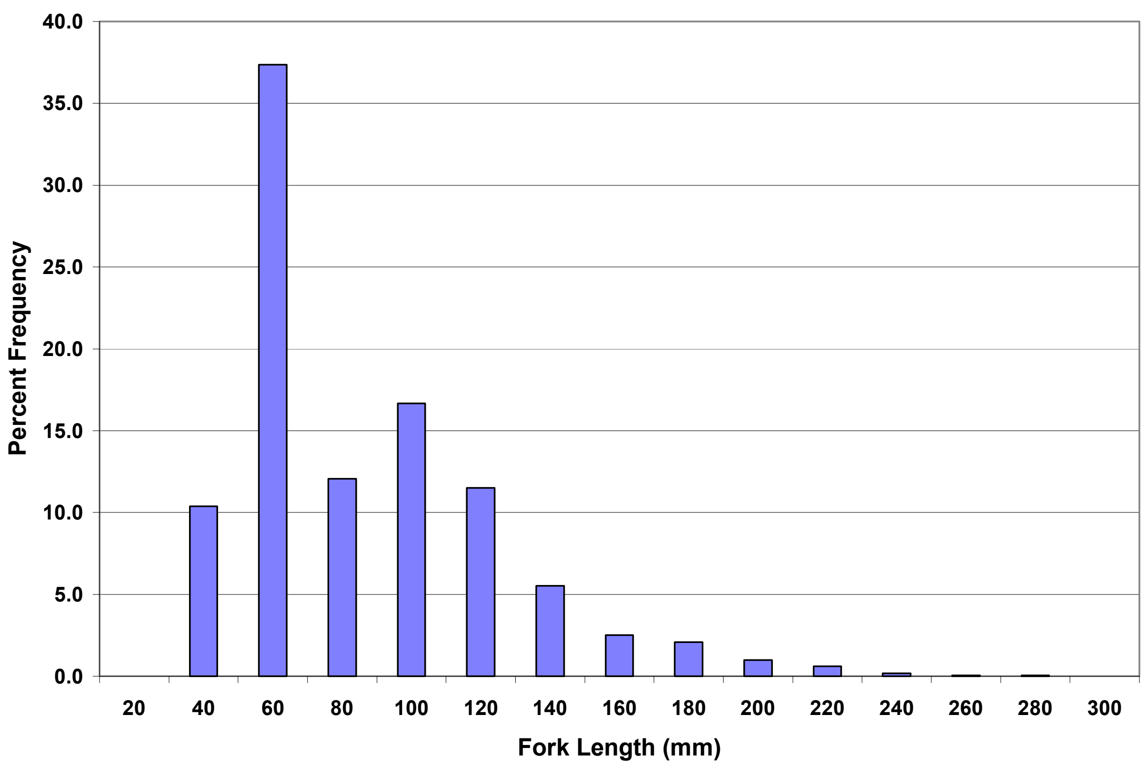

Figure 2-3. Length frequency of juvenile summer steelhead collected in the index sites in the Umatilla River Basin, 2001.

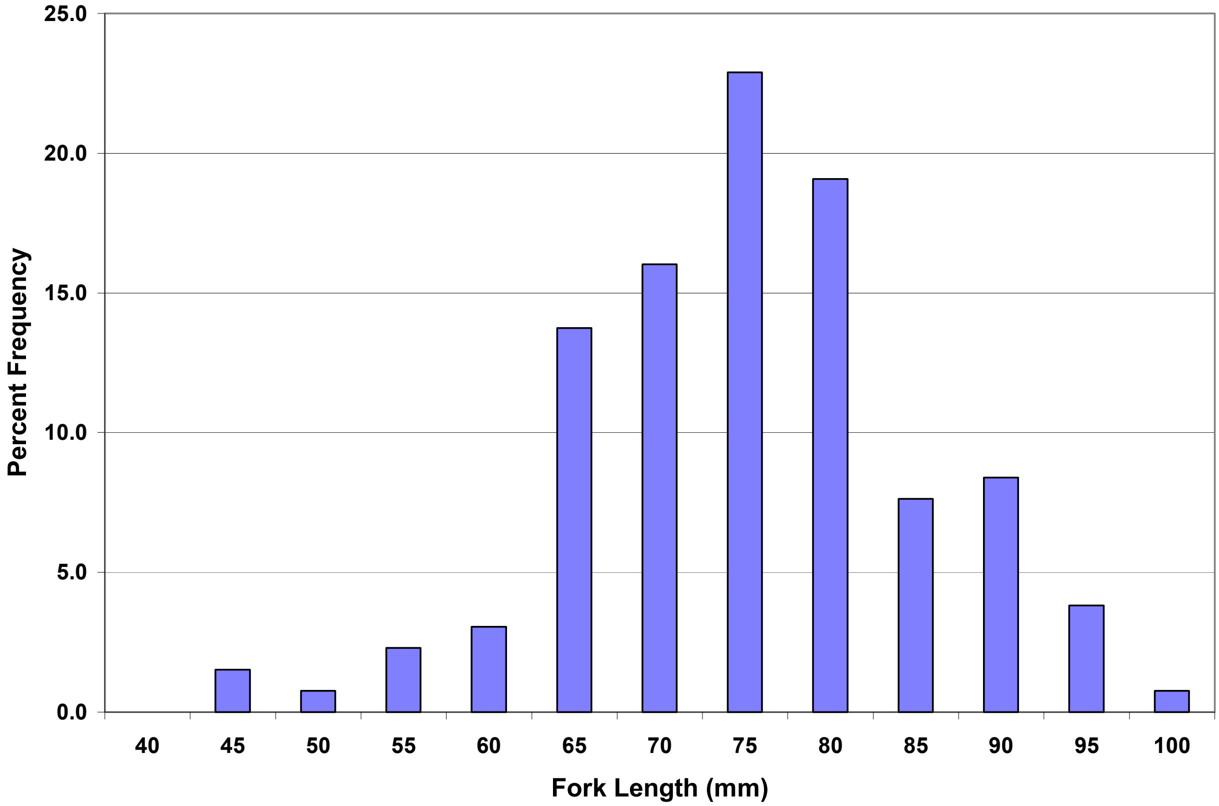

Figure 2-4. Length frequency of juvenile Chinook salmon collected in the index sites in the Umatilla River Basin, 2001.

Table 2-13. Summary of juvenile salmonid index sites surveyed in the Umatilla River Basin during the summer of 2002.

Umatilla River Basin Salmonid Survey, 2002						Electrofishing										Snorkeling		Difference
Site Summary										No. of Salmonids								
Location	Site No.	River Mile	Date	Water Temp (C°)	Area (m^2)	No. of Passes	First Pass (sec)	Second Pass (sec)	Volts, Hertz, Pulse	Pass 1	Pass 2	Pass 3	Total Est.. Sal.	Density Fish/ $100m^2$	1st Pass CPUE (sal/min)	No. Sal. Obs.	Density Fish/ $100m^2$	Between Elec. & Snk. (%)
East Birch Creek	D-03	13	23-Aug-02	13.0	117.3	2	408	408	6-700, 40, 2	34	17		64	54.6	5.00	55	46.9	14.1
Pearson Creek	D-04	4	23-Aug-02	13.0	150.0	2	575	575	6-700, 40, 2	61	20		89	59.3	6.37	89	59.3	0.0
Umatilla River	D-07	74	30-Aug-02		850.0	3	1026	1016	8-900, 40, .5-1	10	6	5	27	3.2	0.58	121	14.2	-77.7
Squaw creek	D-08	2.5	19-Aug-02		143.0	3	627	514	5-600, 40, 2	20	15	7	52	36.4	1.91	61	42.7	-14.8
Squaw Creek	D-09	4.5	20-Aug-02	18.5	183.0	2	437	400	5-700, 40, 2	35	18		68	37.2	4.81	79	43.2	-13.9
Meacham Creek	D-10	3	28-Aug-02	17.0	280.0	3	1722	1670	6-700, 40, 2	16	16	14	158	56.4	0.56	88	31.4	44.3
Boston Canyon	D-11	0.6	26-Aug-02	12.5	75.1	2	350	380	4-500, 40, 2	47	14		65	86.6	8.06	25	33.3	61.5
Line Creek	D-12	0.3	26-Aug-02	12.5	70.0	2	375	390	4-600, 40, 2	84	33		136	194.3	13.44	63	90.0	53.7
Meacham Creek	D-13	9	3-Sep-02	16.5	635.0	2	800	800	6-900, 40, .5	32	13		51	8.0	2.40	35	5.5	31.4
Camp Creek	D-14	0.6	28-Aug-02	16.5	125.1	2	550	550	6-800, 40, 1-2	41	13		58	46.4	4.47	38	30.4	34.5
NF Meacham	D-15	0.5	4-Sep-02	13.0	192.5	3	470	470	800, 40-50, .5-2	38	26	13	95	49.4	4.85	65	33.8	31.6
NF Meacham	D-16	3	4-Sep-02	13.0	248.0	2	625	625	8-900, 40, .5-2	39	19		72	29.0	3.74	64	25.8	11.1
E Meacham	D-18	0.3	29-Aug-02	14.0	130.0	2	500	500	5-700, 40, 1-2	33	16		60	46.2	3.96	9	6.9	85.0
Meacham Creek	D-19	28.5	29-Aug-02	15.0	159.3	2	850	850	6-800, 40, 1-2	51	24		93	58.4	3.60	21	13.2	77.4
Umatilla River	D-20	88	2-Aug-02		1250.0	3	536	418	700, 40, 2-4	13	10	5	35	2.8	1.46	266	21.3	-86.8
NF Umatilla R.	D-21	2.7	1-Aug-02	12.0	622.8	3	1054	1054	700, 40, 4	44	36	24	170	27.3	2.50	76	12.2	55.3
Buck Creek	D-22	1	9-Aug-02	11.0	183.0	2	453	443	500, 40, 2	23	9		35	19.1	3.05	19	10.4	45.7
SF Umatilla R.	D-23	4	30-Jul-02	18.6	533.5	2	1515	1515	5-700, 40, 4-6	66	28		112	21.0	2.61	83	15.6	25.9
Thomas Creek	D-24	2.5	31-Jul-02		421.8	3	420	420	6-800, 40, 1	20	18	16	146	34.6	2.86	74	17.5	49.3
Spring Creek	D-25	0.2	31-Jul-02	12.0	338.6	2	840	840	6-800, 40, 1	24	11		41	12.1	1.71	109	32.2	-62.4
Total					**6707.9**		**14133**	**13838**		**731**	**362**	**84**	**1627**	**24.3**	**3.10**	**1440**	**21.5**	**11.5**

Table 2-14. Summary of juvenile steelhead observed at index sites surveyed during the summer of 2002.

Umatilla River Basin Salmonid Surveys, 2002					Electrofishing (STS/100m^2) size class (mm)				Snorkeling (STS/100 m^2) size class (mm)				Difference (%)
Steelhead Location	Site No.	River Mile	Date	Area (m^2)	$\leq$ 50	51 - 200	$\geq$ 201	Total	$\leq$ 50	51 - 200	$\geq$ 201	Total	Between Elec. and Snk.
East Birch Creek	D-03	13	23-Aug-02	117.3	17.1	35.8	5.1	58.0	4.3	41.8	0.9	46.9	19.1
Pearson Creek	D-04	4	23-Aug-02	150.0	16.7	44.0	0.0	60.7	11.3	47.3	0.7	59.3	2.2
Umatilla River	D-07	74	30-Aug-02	850.0	0.0	0.0	0.0	0.0	0.0	8.1	0.5	8.6	-100.0
Squaw Creek	D-08	2.5	19-Aug-02	143.0	4.9	0.0	0.7	5.6	0.0	40.6	0.0	40.6	-86.2
Squaw Creek	D-09	4.5	20-Aug-02	183.0	0.0	35.0	1.1	36.1	10.4	31.7	1.1	43.2	-16.5
Meacham Creek	D-10	3	28-Aug-02	280.0	0.0	37.5	0.0	37.5	0.0	29.3	0.7	30.0	20.0
Boston Canyon	D-11	0.6	26-Aug-02	75.1	41.3	45.3	0.0	86.6	25.3	8.0	0.0	33.3	61.5
Line Creek	D-12	0.3	26-Aug-02	70.0	114	100.0	0.0	214	31.4	58.6	0.0	90.0	58.0
Meacham Creek	D-13	9	3-Sep-02	635.0	0.0	8.0	0.0	8.0	0.0	5.5	0.0	5.5	31.4
Camp Creek	D-14	0.6	28-Aug-02	125.1	12.0	34.4	0.8	47.2	1.6	28.8	0.0	30.4	35.6
NF Meacham Cr.	D-15	0.5	4-Sep-02	192.5	1.0	54.5	0.5	56.1	0.0	33.2	0.5	33.8	39.8
NF Meacham Cr.	D-16	3	4-Sep-02	248.0	0.4	27.4	1.2	29.0	0.0	25.8	0.0	25.8	11.1
E Meacham Cr.	D-18	0.3	29-Aug-02	130.0	21.5	23.1	0.0	44.6	3.1	3.8	0.0	6.9	84.5
Meacham Creek	D-19	28.5	29-Aug-02	159.3	0.6	57.8	2.5	60.9	0.0	13.2	0.0	13.2	78.4
Umatilla River	D-20	88	2-Aug-02	1250	0.0	0.0	0.0	0.0	1.2	5.1	1.3	7.6	-100.0
NF Umatilla R.	D-21	2.7	1-Aug-02	622.8	1.3	15.9	0.3	17.5	1.3	6.6	0.3	8.2	53.2
Buck Creek	D-22	1	9-Aug-02	183.0	9.3	9.3	0.0	18.6	8.2	1.1	1.1	10.4	44.1
SF Umatilla R.	D-23	4	30-Jul-02	533.5	16.5	10.5	0.6	27.6	6.4	6.9	0.9	14.2	48.3
Thomas Creek	D-24	2.5	31-Jul-02	421.8	0.5	29.9	1.7	32.0	14.5	1.7	1.4	17.5	45.2
Spring Creek	D-25	0.2	31-Jul-02	338.6	0.6	13.9	0.0	14.5	28.9	3.5	0.0	32.5	-55.5
Total				**6707.9**	**12.9**	**29.1**	**0.7**	**42.7**	**7.4**	**20.0**	**0.5**	**27.9**	**34.7**

Table 2-15. Summary of juvenile Chinook salmon observed at index sites surveyed during the summer of 2002.

Umatilla River Basin Salmonid Surveys, 2002					Electrofishing	Snorkel	Difference (%)
Chinook	Site	River		Area	Fish/100m^2	Fish/100m^2	Between
Location	No.	Mile	Date	(m^2)	Total	Total	Elec. and Snk.
East Birch Creek	D-03	13	23-Aug-02	117.3			
Pearson Creek	D-04	4	23-Aug-02	150.0			
Umatilla River	D-07	74	30-Aug-02	850.0	2.0	4.4	-54.1
Squaw Creek	D-08	2.5	19-Aug-02	143.0		2.1	-100.0
Squaw Creek	D-09	4.5	20-Aug-02	183.0			
Meacham Creek	D-10	3	28-Aug-02	280.0	1.4	1.4	0.0
Boston Canyon	D-11	0.6	26-Aug-02	75.1			
Line Creek	D-12	0.3	26-Aug-02	70.0			
Meacham Creek	D-13	9	3-Sep-02	635.0			
Camp Creek	D-14	0.6	28-Aug-02	125.1			
NF Meacham Creek	D-15	0.5	4-Sep-02	192.5			
NF Meacham Creek	D-16	3	4-Sep-02	248.0			
E Meacham Creek	D-18	0.3	29-Aug-02	130.0			
Meacham Creek	D-19	28.5	29-Aug-02	159.3			
Umatilla River	D-20	88	2-Aug-02	1250	0.3	10.5	-97.0
NF Umatilla River	D-21	2.7	1-Aug-02	622.8	5.3	3.1	42.4
Buck Creek	D-22	1	9-Aug-02	183.0			
SF Umatilla River	D-23	4	30-Jul-02	533.5		1.3	-100.0
Thomas Creek	D-24	2.5	31-Jul-02	421.8			
Spring Creek	D-25	0.2	31-Jul-02	338.6			
Total				**6707.9**	**0.5**	**1.1**	**-60.2**

Table 2-16. Summary of salmonid catch per unit effort data from index sites surveyed during the summer of 2002.

Umatilla River Basin Salmonid Surveys, 2002					**First**	**Volts, Hertz,**	**Electrofishing**			**Catch/Unit Effort**		
Catch/Unit Effort	**Site**	**River**		**Area**	**Pass**	**Pulse width**	**First Pass Catch**			**Salmonids/Min**		
Location	**No.**	**Mile**	**Date**	**(m^2)**	**(sec)**	**(V, Hz, ms)**	**CHS**	**STS**	**BLT**	**CHS**	**STS**	**BLT**
East Birch Creek	D-03	13	23-Aug-02	117.3	408	6-700, 40, 2		34			5.00	
Pearson Creek	D-04	4	23-Aug-02	150.0	575	6-700, 40, 2		61			6.37	
Umatilla River *	D-07	74	30-Aug-02	850.0	1026	8-900, 40, .5-1	5	1		0.29	0.06	
Squaw creek	D-08	2.5	19-Aug-02	143.0	627	5-600, 40, 2		17			1.63	
Squaw Creek	D-09	4.5	20-Aug-02	183.0	437	5-700, 40, 2		35			4.81	
Meacham Creek	D-10	3	28-Aug-02	280.0	1722	6-700, 40, 2	2	28		0.07	0.98	
Boston Canyon	D-11	0.6	26-Aug-02	75.1	350	4-500, 40, 2		47			8.06	
Line Creek	D-12	0.3	26-Aug-02	70.0	375	4-600, 40, 2	0	84			13.44	
Meacham Creek	D-13	9	3-Sep-02	635.0	800	6-900, 40, .5		32			2.40	
Camp Creek	D-14	0.6	28-Aug-02	125.1	550	6-800, 40, 1-2		41			4.47	
NF Meacham Creek	D-15	0.5	4-Sep-02	192.5	470	800-1k, 40-50, .5-2		38			4.85	
NF Meacham Creek	D-16	3	4-Sep-02	248.0	625	8-900, 40, .5-2		39			3.74	
E Meacham Creek	D-18	0.3	29-Aug-02	130.0	500	5-700, 40, 1-2		33			3.96	
Meacham Creek	D-19	28.5	29-Aug-02	159.3	850	6-800, 40, 1-2		51			3.60	
Umatilla River*	D-20	88	2-Aug-02	1250.0	536	700, 40, 2-4	3	8		0.34	0.90	
NF Umatilla River*	D-21	2.7	1-Aug-02	622.8	1054	700, 40, 4	9	33	2	0.51	1.88	0.11
Buck Creek	D-22	1	9-Aug-02	183.0	453	500, 40, 2		23			3.05	
SF Umatilla River	D-23	4	30-Jul-02	533.5	1515	5-700, 30-40, 4-6		62			2.46	
Thomas Creek	D-24	2.5	31-Jul-02	421.8	420	6-800, 40, 1		18			2.57	
Spring Creek	D-25	0.2	31-Jul-02	338.6	840	6-800, 40, 1	0	24			1.71	
Total				**6707.9**	**14133.0**		**19.0**	**709.0**	**2.0**	**0.08**	**3.01**	**0.01**

*Mountain Whitefish were captured at site D7 (n=29), D20 (n=40) and D21 (n=3).

Table 2-17. Summary of salmonids observed during snorkeling in pools of index sites surveyed during 2002.

Umatilla River Basin Salmonid Surveys, 2002				**Pool**	**Total**		**Fish Observed in Pools/Total Site**						**Fish/100m²**		**Fish/100m²**	
Snorkeling Pools Only	**Site**	**River**		**Area**	**Area**	**Percent**	**CHS in**	**CHS**	**CHS%**	**STS in**	**STS**	**STS%**	**In Pools**		**Non-Pool Habitat**	
Location	**No.**	**Mile**	**Date**	**(m^2)**	**(m^2)**	**Pool**	**Pools**	**Site**	**in Pools**	**Pools**	**Site**	**in Pools**	**CHS**	**STS**	**CHS**	**STS**
East Birch Creek	D-03	13	23-Aug-02	57.0	117.3	48.6				43	55	78		75.4		19.9
Pearson Creek	D-04	4	23-Aug-02	21.0	150.0	14.0				89	89	100		423.8		0.0
Umatilla River	D-07	74	30-Aug-02	220.0	850.0	25.9	7	37	19	17	73	23	3.2	7.7	4.8	8.9
Squaw Creek	D-08	2.5	19-Aug-02	12.5	143.0	8.7	3	3	100	6	58	10	24.0	48.0	0.0	39.8
Squaw Creek	D-09	4.5	20-Aug-02	99.0	183.0	54.1				73	79	92		73.7		7.1
Meacham Creek	D-10	3	28-Aug-02	40.0	280.0	14.3	1	4	25	27	84	32	2.5	67.5	1.3	23.8
Boston Canyon*	D-11	0.6	26-Aug-02	0.0	75.1	0.0	*			*	25	*	*	*		33.3
Line Creek*	D-12	0.3	26-Aug-02	0.0	70.0	0.0	*			*	63	*	*	*		90.0
Meacham Creek	D-13	9	3-Sep-02	75.0	635.0	11.8				5	35	14		6.7		5.4
Camp Creek	D-14	0.6	28-Aug-02	31.3	125.1	25.0				19	38	50		60.7		20.3
NF Meacham Creek	D-15	0.5	4-Sep-02	40.0	192.5	20.8				30	65	46		75.0		23.0
NF Meacham Creek	D-16	3	4-Sep-02	122.0	248.0	49.2				50	64	78.125		41.0		11.1
E Meacham Creek	D-18	0.3	29-Aug-02	7.5	130.0	5.8				9	9	100		120.0		0.0
Meacham Creek	D-19	28.5	29-Aug-02	120.0	159.3	75.4				17	21	81		14.2		10.2
Umatilla River	D-20	88	2-Aug-02	600.0	1250.0	48.0	121	131	92	70	95	74	20.2	11.7	1.6	3.8
NF Umatilla River	D-21	2.7	1-Aug-02	197.8	622.8	31.8	17	19	89	30	51	59	8.6	15.2	0.5	4.9
Buck Creek	D-22	1	9-Aug-02	12.8	183.0	7.0				8	19	42	0.0	62.5		6.5
SF Umatilla River	D-23	4	30-Jul-02	99.5	533.5	18.7	6	7	86	44	76	58	6.0	44.2	0.2	7.4
Thomas Creek	D-24	2.5	31-Jul-02	92.5	421.8	21.9				74	74	100	0.0	80.0		0.0
Spring Creek	D-25	0.2	31-Jul-02	50.8	338.6	15.0	0			0	109	0	0.0	0.0		37.9
Total				**1898.7**	**6707.9**	**28.3**	**155**	**201**	**77**	**611**	**1182**	**52**	**8.2**	**32.2**	**11.9**	**16.9**

* no pools

Table 2-18. Summary of stream habitat features of index sites surveyed during the summer of 2002

Umatilla River Basin Salmonid Surveys, 2002					Habitat	Total	Ave.		Ave.	Max.	Lg.	Wood
Habitat Location	Index Site	Reach #	River Mile	Date	Unit Type	Length (m)	Width (m)	Area (m^2)	Depth (m)	Depth (m)	Boulders (# >0.5m)	(> 15 cm X 3m)
E Birch Cr.	D-3	2	13	23-Aug-02	BP	10	4	40	0.32	0.55	0	3
E Birch Cr.	D-3	2	13	23-Aug-02	RI	6	3	18	0.09		0	0
E Birch Cr.	D-3	2	13	23-Aug-02	DP	3	3.5	10.5	0.24	0.38	0	3
E Birch Cr.	D-3	2	13	23-Aug-02	RI	11	2	22	0.12		1	0
E Birch Cr.	D-3	2	13	23-Aug-02	LP	6.5	1	6.5	0.16	0.23	0	0
E Birch Cr.	D-3	2	13	23-Aug-02	RI	13.5	1.5	20.25	0.11		1	0
Pearson Cr.	D-4	2	4	23-Aug-02	RP	13	3	39	0.14		5	1
Pearson Cr.	D-4	2	4	23-Aug-02	LP	7	3	21	0.15	0.35	1	2
Pearson Cr.	D-4	2	4	23-Aug-02	RP	30	3	90			14	4
Umatilla R. 74	D-7	2	74	30-Aug-02	LP	15	10	150		1.25	2	0
Umatilla R. 74	D-7	2	74	30-Aug-02	BW	10	7	70		1	0	0
Umatilla R. 74	D-7	2	74	30-Aug-02	RI	35	18	630	0.2		7	0
Squaw Cr. 2.5	D-8	2	2.5	19-Aug-02	GL	14	3	42	0.12	0.23	2	1
Squaw Cr. 2.5	D-8	2	2.5	19-Aug-02	LP	5	2.5	12.5	0.2	0.33	1	0
Squaw Cr. 2.5	D-8	2	2.5	19-Aug-02	RI	6	2	12	0.8		0	0
Squaw Cr. 2.5	D-8	2	2.5	19-Aug-02	GL	14	3.5	49	0.13	0.28	0	0
Squaw Cr. 2.5	D-8	2	2.5	19-Aug-02	RI	11	2.5	27.5	0.1		0	0
Squaw Cr. 7	D-9	2	4.5	20-Aug-02	LP	22	4.5	99	0.34	0.84	0	0
Squaw Cr. 7	D-9	2	4.5	20-Aug-02	RP	28	3	84	0.12		4	0
Meacham Cr. 3	D-10	2	3	28-Aug-02	SP	10	4	40	0.3	0.7	2	1
Meacham Cr. 3	D-10	2	3	28-Aug-02	GL	40	6	240	0.2	0.4	7	0
Boston Can. Cr.	D-11	2	0.6	26-Aug-02	GL	6.5	1.5	9.75	0.13	0.33	2	0
Boston Can. Cr.	D-11	2	0.6	26-Aug-02	RP	43.5	1.5	65.25	0.08		10	2
Line Cr.	D-12	2	0.3	26-Aug-02	RB	10	1	10	0.08		3	0
Line Cr.	D-12	2	0.3	26-Aug-02	TP	6	1.5	9	0.14	0.32	3	0
Line Cr.	D-12	2	0.3	26-Aug-02	CB	34	1.5	51	0.08		7	0
Meacham Cr. 9	D-13	2	9	03-Sep-02	LP	15	5	75	0.22	0.52	2	0
Meacham Cr. 9	D-13	2	9	03-Sep-02	RI	35	16	560	0.13		6	4
Camp Cr.	D-14	2	0.6	28-Aug-02	RP	37.5	2.5	93.75	0.11		7	3
Camp Cr.	D-14	2	0.6	28-Aug-02	TP	12.5	2.5	31.25	0.2	0.58	3	3
NF Meacham 0.5	D-15	2	0.5	04-Sep-02	GL	35	4	140	0.27	0.47	12	0
NF Meacham 0.5	D-15	2	0.5	04-Sep-02	SP	10	4	40	0.26	0.42	1	0
NF Meacham 0.5	D-15	2	0.5	04-Sep-02	RP	5	2.5	12.5	0.13		1	0
NF Meacham 3	D-16	2	3	04-Sep-02	GL	21	4.5	94.5	0.18	0.45	13	0
NF Meacham 3	D-16	2	3	04-Sep-02	SP	22	5.5	121	0.3	0.67	6	0
NF Meacham 3	D-16	2	3	04-Sep-02	RB	7	4.5	31.5	0.12		11	0
NF Meacham 3	D-16	2	3	04-Sep-02	BW	1	1	1	0.1	0.2	0	1
E Meacham 3	D-18	2	0.3	29-Aug-02	RI	10	1.5	15	0.1		1	0
E Meacham 3	D-18	2	0.3	29-Aug-02	LP	5	1.5	7.5	0.21	0.4	1	0
E Meacham 3	D-18	2	0.3	29-Aug-02	RP	15	2.5	37.5	0.12		1	2
E Meacham 3	D-18	2	0.3	29-Aug-02	RI	20	3.5	70	0.07		5	0
Meacham 28.5	D-19	2	28.5	29-Aug-02	PP	10	12	120		1.2	15	0
Meacham 28.5	D-19	2	28.5	29-Aug-02	SR	1.5	0.5	0.75	0.02		0	0
Meacham 28.5	D-19	2	28.5	29-Aug-02	PD	38.5	1	38.5	0.4	0.6	25	2
Umatilla R. 88	D-20	3	88	02-Aug-02	SP	50	12	600		1.2	4	3
Umatilla R. 88	D-20	4	88	02-Aug-02	RB	50	13	650	0.23		22	0

Table 2-* Continued

NF Umatilla R.	D-21	3	2.7	01-Aug-02	RI	50	8.5	425	0.18		5	0
NF Umatilla R.	D-21	4	2.7	01-Aug-02	SP	20	4.5	90		0.72	6	2
NF Umatilla R.	D-21	4	2.7	01-Aug-02	LP	6.5	3	19.5		0.53	0	0
NF Umatilla R.	D-21	4	2.7	01-Aug-02	LP	12	4	48		0.58	0	1
NF Umatilla R.	D-21	4	2.7	01-Aug-02	LP	11.5	3.5	40.25		0.33	1	0
Buck Cr.	D-22	2	1	09-Aug-02	RP	12	3.1	37.2	0.12		2	4
Buck Cr.	D-22	2	1	09-Aug-02	LP	7.1	1.8	12.78		0.37	2	1
Buck Cr.	D-22	2	1	09-Aug-02	RP	30.9	4.3	132.87	0.11		2	4
SF Umatilla R.	D-23	3	4	30-Jul-02	LP	25	3	75		0.85	4	*
SF Umatilla R.	D-23	3	4	30-Jul-02	RP	35	7	245	0.12		10	*
SF Umatilla R.	D-23	4	4	30-Jul-02	LP	7	3.5	24.5		0.52	2	*
SF Umatilla R.	D-23	4	4	30-Jul-02	RP	33	6.3	207.9	0.16		13	*
Thomas Cr.	D-24	3	2.5	31-Jul-02	PP	13	5.5	71.5		0.7	4	0
Thomas Cr.	D-24	3	2.5	31-Jul-02	SL	0.5	6.5	3.25	0.08		0	1
Thomas Cr.	D-24	3	2.5	31-Jul-02	RP	20.5	4	82	0.14		15	1
Thomas Cr.	D-24	3	2.5	31-Jul-02	LP	16	5	80		0.92	9	0
Thomas Cr.	D-24	4	2.5	31-Jul-02	RB	8	1.5	12	0.1		7	0
Thomas Cr.	D-24	4	2.5	31-Jul-02	GL	11	4	44		0.3	9	0
Thomas Cr.	D-24	4	2.5	31-Jul-02	RP	24	4.5	108	0.13		12	1
Thomas Cr.	D-24	4	2.5	31-Jul-02	SP	7	3	21			3	0
Spring Cr.	D-25	3	0.2	31-Jul-02	GL	12	2.5	30		0.28	2	1
Spring Cr.	D-25	3	0.2	31-Jul-02	RP	29	4	116	0.13		11	1
Spring Cr.	D-25	3	0.2	31-Jul-02	SP	9	3.5	31.5		0.52	4	0
Spring Cr.	D-25	4	0.2	31-Jul-02	RP	28	3.5	98	0.14		17	0
Spring Cr.	D-25	4	0.2	31-Jul-02	SP	5.5	3.5	19.25		0.35	4	0
Spring Cr.	D-25	4	0.2	31-Jul-02	RP	10	3	30	0.14		3	0
Spring Cr.	D-25	4	0.2	31-Jul-02	GL	5.5	2.5	13.75		0.4	9	0

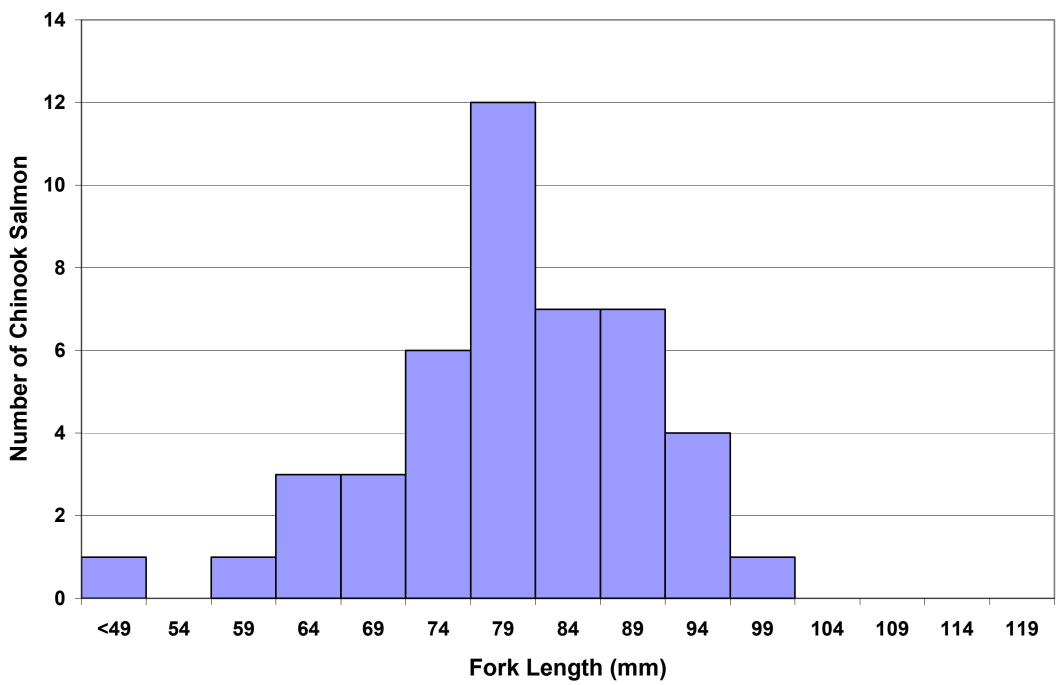

Figure 2-5. Fork lengths of spring Chinook captured from the index sites during the summer of 2002.

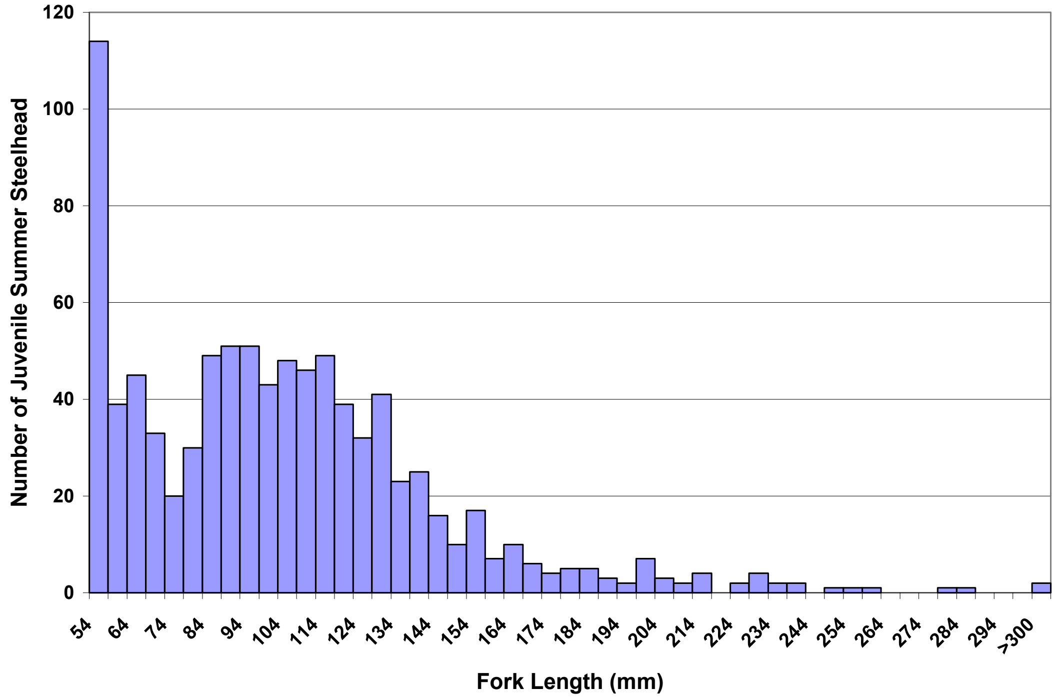

Figure 2-6. Fork lengths of juvenile summer steelhead captured from index sites during the summer of 2002 (an additional 241 young of the year, less than 49 mm were collected but are not on the figure).

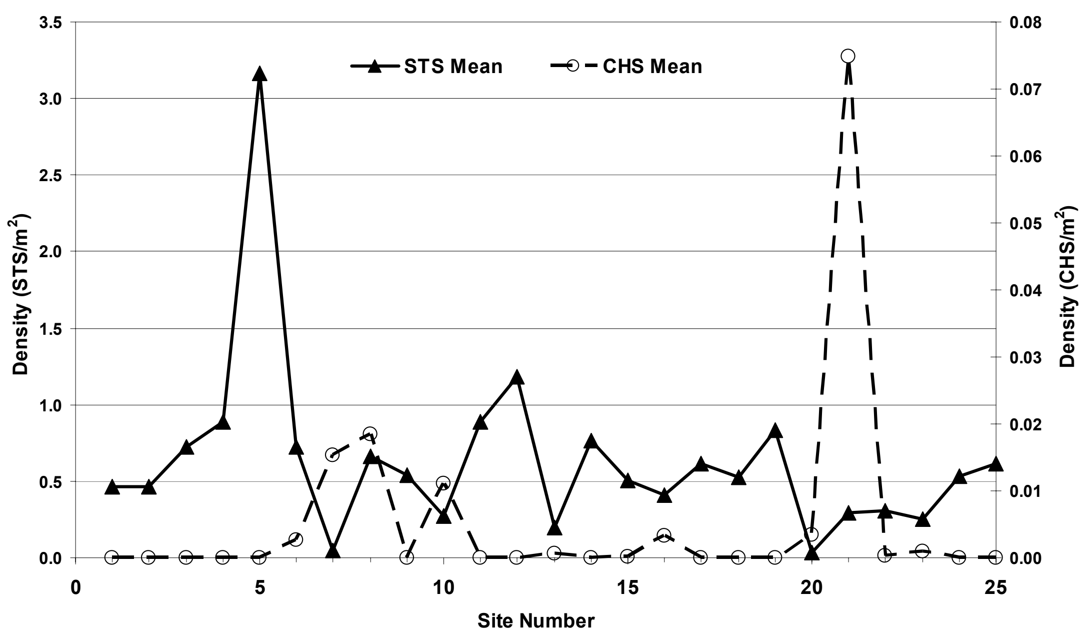

Figure 2-7. Average number of juvenile summer steelhead and spring Chinook per m^2 collected from 25 index sites in the Umatilla River Basin, 1998-2002 during the first electrofishing pass.

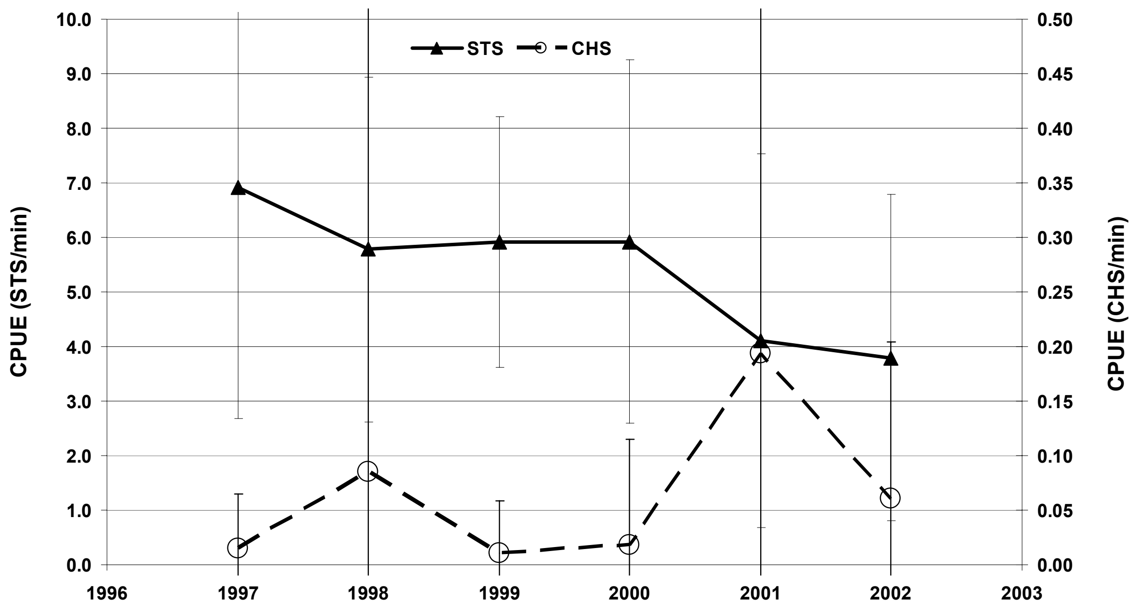

Figure 2-8. Average annual catch per unit effort and standard deviation, by species, from 25 index sites in the Umatilla River Basin, 1997-2002.

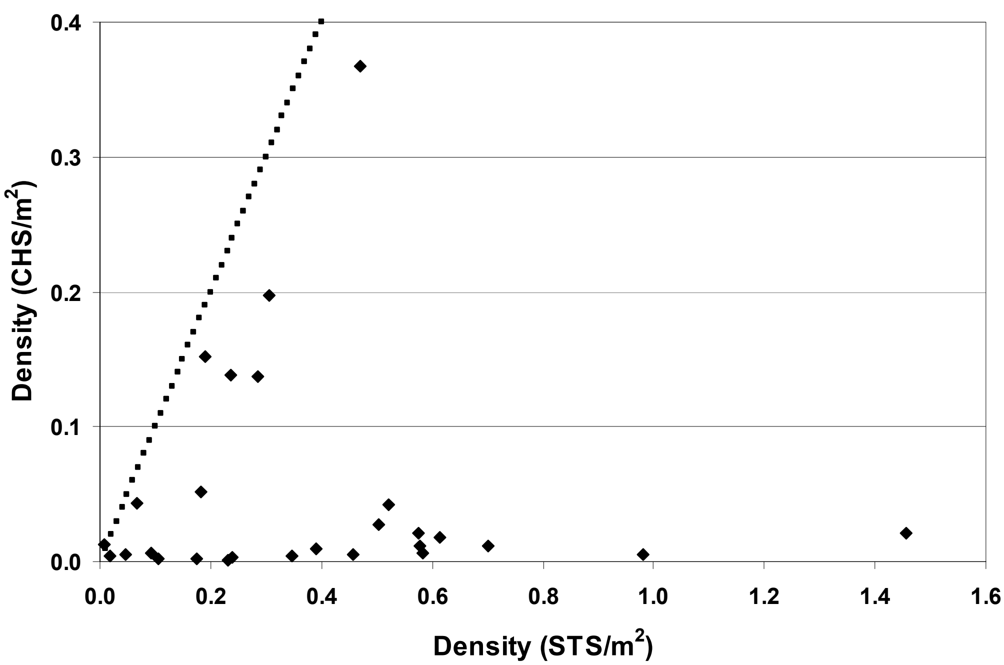

Figure 2-9. The number of juvenile summer steelhead and Chinook observed per m^2 during the first pass electrofishing in 25 index sites in the Umatilla River, 1998-2002 (equal density line denoted).

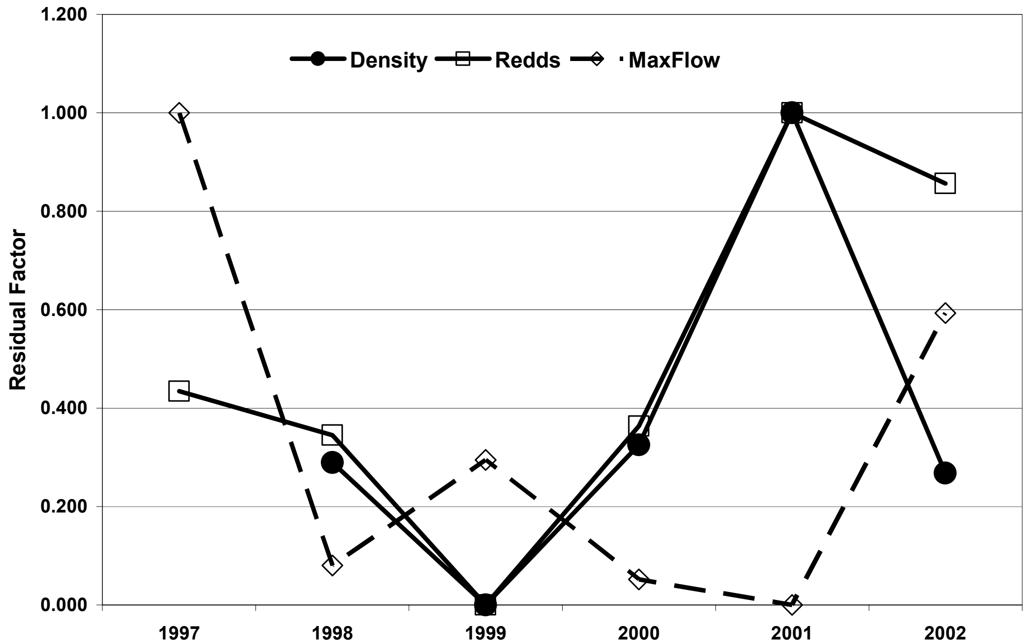

Figure 2-10. Data from 25 index sites in the Umatilla River (summers of 1997-2002) showing juvenile Chinook mean densities, Chinook redds observed the previous year, and maximum flows recorded during the previous winter (the Y axis has been standardized through the use of a residual factor such that the highest data value in each data set was converted to 1.00, the lowest value was converted to 0.0, and the intermediate data was proportionally distributed.

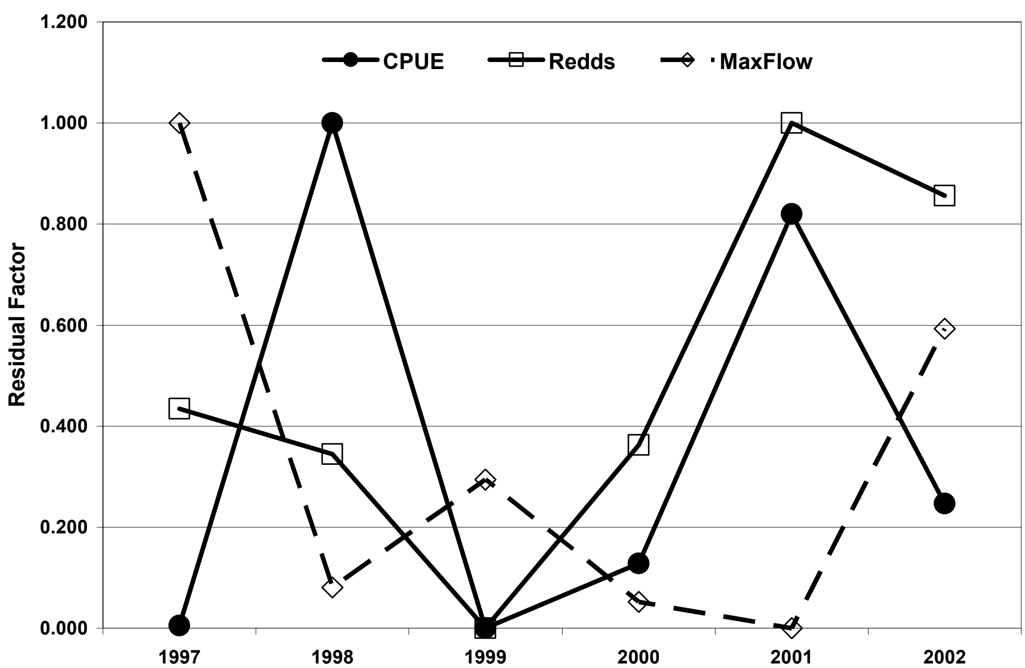

Figure 2-11. Same as Figure 2-10 above except with mean catch per unit effort data (CPUE).

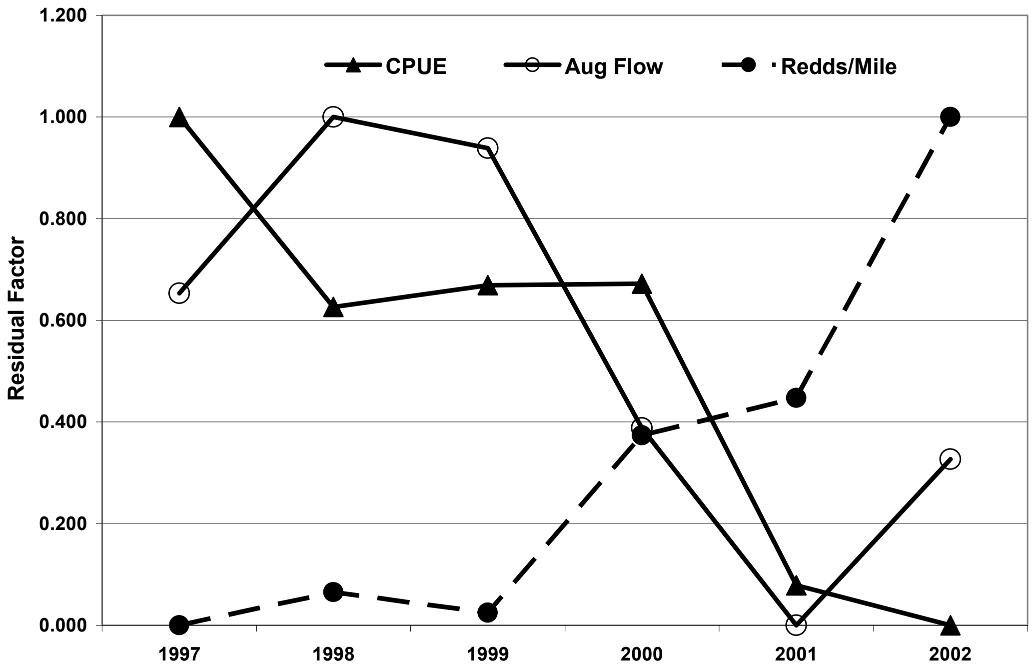

Figure 2-12. Data from 25 index sites in the Umatilla River, summers of 1997-2002, showing juvenile summer steelhead mean CPUE data, steelhead redds observed the previous year, and August flows recorded at the Umatilla Gage near Gibbon (Y axis is a residual factor as in Figures 2-10 and 2-11).

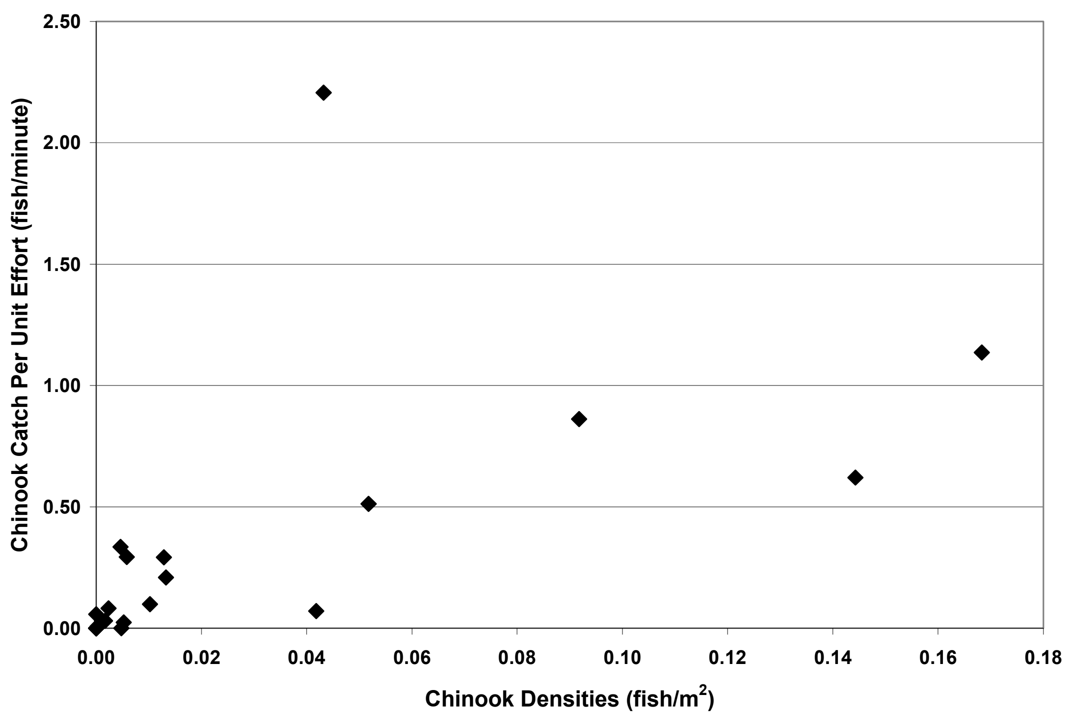

Figure 2-13. Comparison between CPUE and density data for juvenile spring Chinook from 25 index sites in the Umatilla River Basin 1998-2002, n=17.

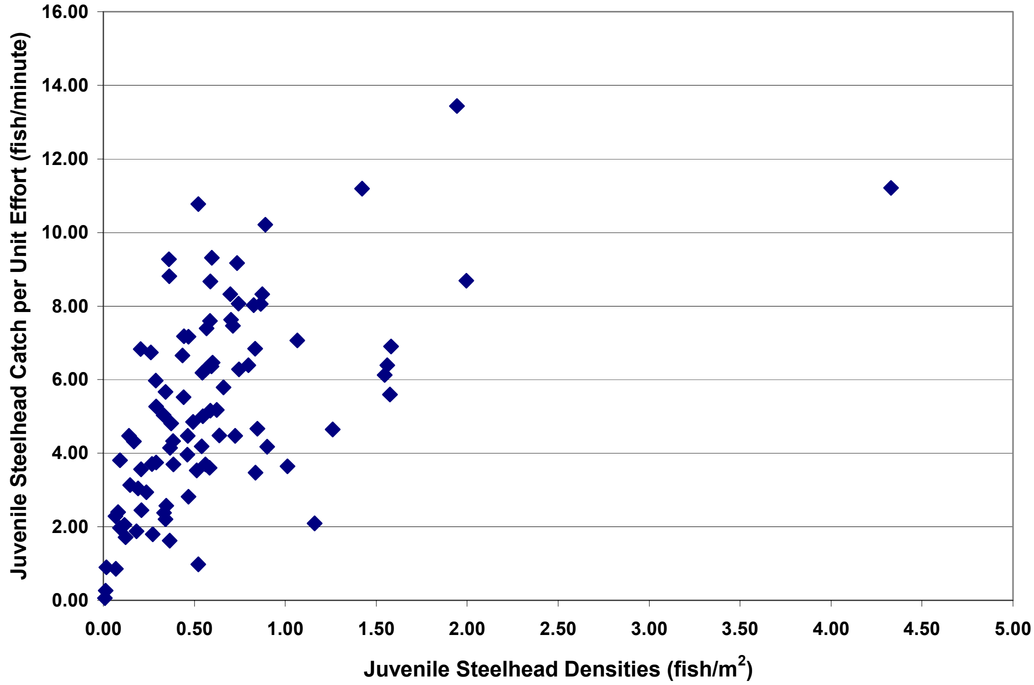

Figure 2-14. Comparison between CPUE and density data for juvenile summer steelhead from 25 index sites in the Umatilla River Basin 1998-2002, n=92.

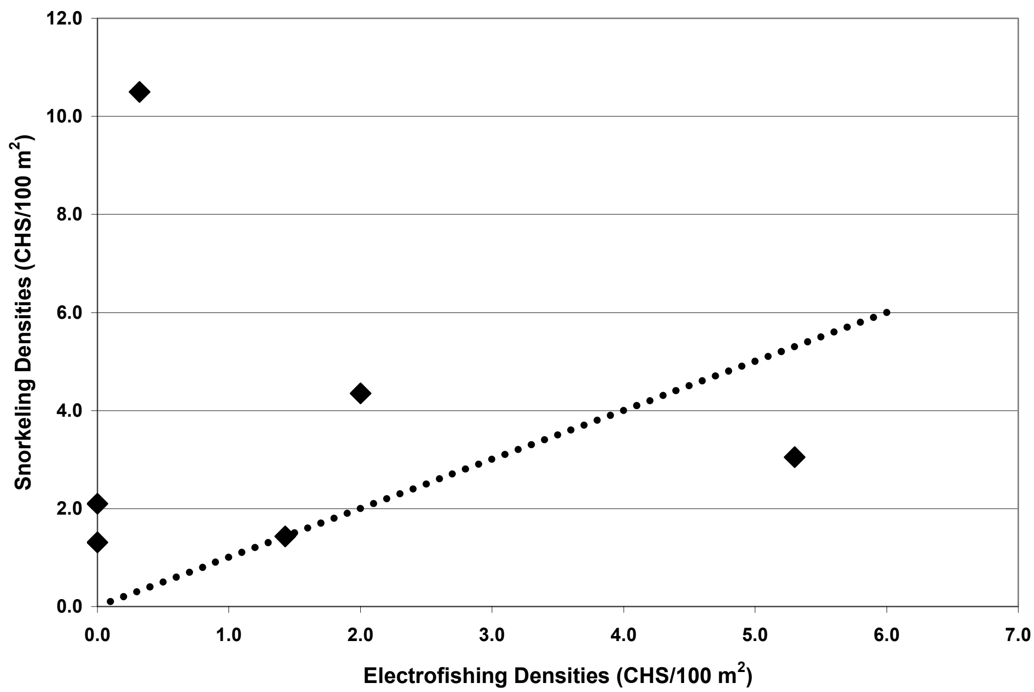

Figure 2-15. Comparison between electrofishing and snorkeling density estimates of juvenile Chinook at 20 index sites in the Umatilla River Basin, 2002 (Chinook were only observed in six of the 20 sites).

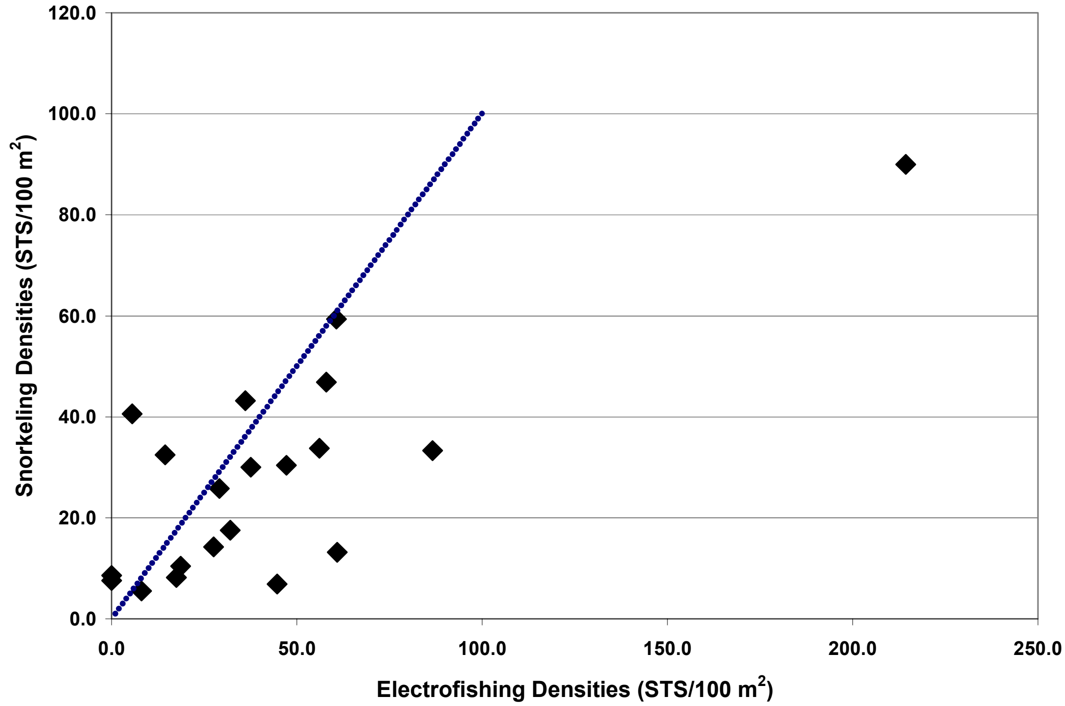

Figure 2-16. Comparison between electrofishing and snorkeling density estimates of juvenile summer steelhead at 20 index sites in the Umatilla River Basin, 2002.

Table 2-19. Summary of salmonid fry surveys and presence/absence surveys, 1999.

Umatilla River, Fry Surveys, 1999				**Water Temp (C)**	**Site Length (m)**	**Site Width (m)**	**Site Area (m^2)**	**Electro-Fishing Seconds**	**Volts**	**Salmonids First Pass**	**1st Pass CPUE (Sal/Min)**
Site Summary Location	**River Mile**	**Date**	**Time**								
McKay Creek 1	21.5	6/29/99	9:40	18	50	6.5	329	309	400	1	0.19
McKay Creek 2	21.5	6/29/99	10:27	19	60.7	5.8	357	378	400-500	4	0.63
McKay Creek 3	21.5	6/29/99	11:24	20	50	5.8	290	349	400-600	5	0.86
Umatilla at Maxwell Dam	15.3	05/28/99						298	500	0	0.00
Umatilla at Maxwell Dam	15.3	09/15/99		18				734	600-1000	5	0.41
Maxwell Canal near head gate	n/a	09/15/99		23				504	600	0	0.00
Umatilla at Stanfield Bridge	23	05/28/99						240		0	0.00
Umatilla at Stanfield Bridge	23	09/15/99		18				649	600	2	0.18
Umatilla 1/2 mile below Echo Bridge	26	05/28/99		15				927	300	7	0.45
Umatilla 1/2 mile below Echo Bridge	26	09/14/99		17	175	7	1225	1051	400-1000	3	0.17
Umatilla below Westland Dam	27.1	09/14/99		19	150	5	750		400-800	5	
Umatilla below Feed Canal Dam	28	09/14/99		15	150	15	2250	763	400-600	22	1.73
Umatilla at Nolin Rail Road Bridge	33.2	05/11/99								49	
Umatilla at Yoakum Bridge	37	05/11/99								1	
Umatilla at Yoakum Bridge	37	09/14/99	9:57	16	150	15	2250		400	8	
Umatilla below Barnhart RR Bridge	42.1	05/11/99								32	
Umatilla below Barnhart RR Bridge	42.1	09/13/99		19	175	15	2625	1341	300-700	10	0.45
Umatilla at Barnhart	45	05/11/99								5	
Umatilla at Barnhart	45	09/13/99		17	175	5	875	914	600-700	5	0.33
Umatilla at McKay Cr.	50.5	09/13/99		16	120	20	2400	738	600	29	2.36
Umatilla at Tutuilla C.	52.3	05/19/99						433		9	1.25
Umatilla at Tutuilla C.	52.3	09/15/99		17	175			982	500-800	2	0.12
Umatilla, Pendleton, Little League Park	52.7	05/19/99						407		3	0.44
Umatilla at Mission Bridge	59.5	05/19/99						464		9	1.16
Umatilla, 1 mile above Mission Bridge	60.5	05/25/99						369		1	0.16
Umatilla at Minthorn	65	05/18/99						586		41	4.20
Umatilla at Thorn Hollow Bridge	73.5	05/18/99						323		3	0.56
Umatilla near Shaplish Cr.	75	05/25/99		14				320		1	0.19
Spring near Umatilla RM 75.1	0.1	05/25/99		9				327		1	0.18
Umatilla, just above Shaplish Cr.	75.1	05/25/99		12.5				320		2	0.38
Umatilla, near Clarks	85	06/29/99		21				2197		162	4.42

Table 2-20. Summary of fish captured during fry index surveys, 1999.

Fry Presence/Absence Surveys Catch Summary Location	**River Mile**	**Date**	**Nat CHS**	**Nat STS**	**Hat STS**	**Nat Coho**	**Hat Coho**	**Mt. White Fish**	**Total Sal Cap.**	**Dace**	**Shiners**	**Sculp.**	**Suck.**	**Chisel-mouth**	**Or. Pike Min.**	**Small-mouth Bass**	**Total Non-Sal.**	**Ratio of Sal to Non-Sal.**
McKay Creek 1	21.5	6/29/99		2					2	65	50	20			15		145	0.014
McKay Creek 2	21.5	6/29/99		4					4	100	60	15			20		195	0.02
McKay Creek 3	21.5	6/29/99		6					6									n/a
Umatilla at Maxwell Dam	15.3	05/28/99								50	12						62	0.0
Umatilla at Maxwell Dam	15.3	09/15/99		3		2			5	1000	1000		350	175	50		2575	0.002
Maxwell Canal near head gate	n/a	09/15/99								100			300	1000	200	15	1615	0.0
Umatilla at Stanfield Bridge	23	05/28/99								200	100	50					350	0.0
Umatilla at Stanfield Bridge	23	09/15/99		1				1	2	1000	1000		250	150	50		2450	0.0008
Umatilla 1/2 mile below Echo Bridge	26	05/28/99				7			7	1500	500			150			2150	0.003
Umatilla 1/2 mile below Echo Bridge	26	09/14/99		2				1	3								0	n/a
Umatilla below Westland Dam	27.1	09/14/99		3		1		1	5	1000			500				1500	0.003
Umatilla below Feed Canal Dam	28	09/14/99		7		5		10	22	1000	1000		1000				3000	0.007
Umatilla at Nolin Rail Road Bridge	33.2	05/11/99				48	1		49								0	n/a
Umatilla at Yoakum Bridge	37	05/11/99															0	n/a
Umatilla at Yoakum Bridge	37	09/14/99	1	8					9								0	n/a
Umatilla below Barnhart RR Bridge	42.1	05/11/99	1			31			32								0	n/a
Umatilla below Barnhart RR Bridge	42.1	09/13/99		1		9			10								0	n/a
Umatilla at Barnhart	45	05/11/99				5			5								0	n/a
Umatilla at Barnhart	45	09/13/99				5			5								0	n/a
Umatilla at McKay Cr.	50.5	09/13/99		23				6	29								0	n/a
Umatilla at Tutuilla C.	52.3	05/19/99				9			9								0	n/a
Umatilla at Tutuilla C.	52.3	09/15/99		2					2	1000	1000		300	500	300		3100	0.0006
Umatilla, Pendleton, Little League Park	52.7	05/19/99				3	1		4								0	n/a
Umatilla at Mission Bridge	59.5	05/19/99				9			9								0	n/a
Umatilla 1 mile above Mission Bridge	60.5	05/25/99				1			1	30	200	15					245	0.004
Umatilla at Minthorn	65	05/18/99	1			40			41								0	n/a
Umatilla at Thorn Hollow Bridge	73.5	05/18/99	1	1	1				3								0	n/a
Umatilla near Shaplish Cr.	75	05/25/99				1			1	25	15	30					70	0.014
Spring near Umatilla RM 75.1	0.1	05/25/99				1			1	200	400	100					700	0.001
Umatilla just above Shaplish Cr.	75.1	05/25/99		1		1			2	50		70					120	0.017
Umatilla, near Clarks*	85	06/29/99	16	141				4	163*									n/a
Totals			**20**	**193**	**1**	**178**	**2**	**23**	**431**	**7320**	**5337**	**300**	**2700**	**1975**	**635**	**15**	**18,282**	

* One bull trout 182 mm was collected on the Umatilla River, RM 85 on June 29, 1999, 21 degrees C,

Table 2-21. Summary of salmonid length data of fish captured during fry and presence absence surveys, 1999.

Fry Surveys, 1999	Site	Date	Natural Chinook				Natural Steelhead				Mountain Whitefish				Natural Coho				Hatchery Coho			
Fork Lengths (mm)	River		Max	Mean	Min	n	Max	Mean	Min	n	Max	Mean	Min	n	Max	Mean	Min	n	Max	Mean	Min	n
Location	Mile																					
McKay Creek 1	21.5	06/29/99					295	260.0	225	2												
McKay Creek 2	21.5	06/29/99					290	258.3	210	4												
McKay Creek 3	21.5	06/29/99					325	213.8	40	6												
Umatilla at Maxwell Dam	15.3	5/28/1999																				
Maxwell Canal near head gate	15.3	9/15/1999																				
Umatilla Below Maxwell Dam	n/a	9/15/1999					177	131.7	83	3					105	99.0	93	2				
Umatilla at Stanfield Bridge	23	5/28/1999									110	110.0	110	1								
Umatilla at Stanfield Bridge	23	9/15/1999					130	130.0	130	1												
Umatilla 1/2 mile below Echo Bridge	26	5/28/1999													66	46.4	28	7				
Umatilla 1/2 mile below Echo Bridge	26	9/14/1999					185	157.5	130	2	135	135.0	135	1								
Umatilla River below Westland Dam	27.1	9/14/1999					100	91.0	75	3	125	125.0	125	1	113	113.0	113	1				
Umatilla River, below Feed Canal	28	9/14/1999					127	111.9	90	7	224	181.6	130	10	90	87.6	85	5				
Umatilla at Nolin Rail Road Bridge	33.2	5/11/1999													154	43.3	30	48	85	85.0	85	1
Umatilla at Yoakum Bridge	37	5/11/1999																				
Umatilla at Yoakum Bridge	37	9/14/1999	120	120.0	120	1	130	112.8	90	8												
Umatilla below Barnhart RR Bridge	42.1	5/11/1999	50	50.0	50	1									150	45.7	30	31				
Umatilla below Barnhart RR Bridge	42.1	9/13/1999					145	145.0	145	1					110	100.0	90	9				
Umatilla at Barnhart	45	5/11/1999													80	48.6	35	5				
Umatilla at Barnhart	45	9/13/1999													117	99.0	87	5				
Umatilla at McKay Cr.	50.5	9/13/1999					300	112.3	69	23	241	208.0	115	6								
Umatilla at the mouth of Tutuilla C.	52.3	5/19/1999													50	45.0	38	9				
Umatilla at the mouth of Tutuilla C.	52.3	9/15/1999					115	100.0	85	2												
Umatilla in Pendleton, L. L. Park	52.7	5/19/1999													46	41.3	38	3	219	219.0	219	1
Umatilla at Mission Bridge	59.5	5/19/1999													62	52.0	40	9				
Umatilla 1 mile above Mission Br.	60.5	5/25/1999													45	45.0	45	1				
Umatilla at Minthorn	65	5/18/1999	113	113.0	113	1									58	49.2	30	40				
Umatilla at Thorn Hollow Bridge*	73.5	5/18/1999	46	46.0	46	1	100	100.0	100	1												
Umatilla near Shaplish Cr.	75	5/25/1999													60	60.0	60	1				
Spring near Umatilla RM 75.1	0.1	5/25/1999													68	68.0	68	1				
Umatilla just above Shaplish Cr.	75.1	5/25/1999					86	86.0	86	1					50	50.0	50	1				
Umatilla, Near Clarks**	85	06/29/99	92	79.9	70	16	310	117.4	40	140												
Totals			**120**	**81.8**	**46**	**20**	**325**	**141.8**	**40**	**204**	**241**	**151.9**	**110**	**19**	**154**	**64.3**	**28**	**178**	**219**	**152.0**	**85**	**2**

*One juvenile hatchery steelhead (130 mm) was collected from the Umatilla River, RM 73.5, May 18, 1999

** One bull trout (182 mm) was collected from the Umatilla River, RM 85, June 29, 1999, 21 C.

Table 2-22. Summary of salmonid fry surveys and presence/absence surveys, 2000

Fry and Presence Absence Surveys, 2000				Water	Site	Site	Site	No.	Electro-			Sal.	1st Pass
Site Summary	River			Temp	Length	Width	Area	of	Fishing			First	CPUE
Location	Mile	Date	Time	('C)	(m)	(m)	(m2)	Passes	Seconds	Volts	Setting	Pass	(Sal/Min)
Buck Cr. 1-1	1.8	15-Jun-00	11:20	9.5	50	3.4	170.35	2	298	400-500	O5	5	1.01
Buck Cr. 1-2	1.8	15-Jun-00	12:35	9.5	49.8	3	149.8	2	293	500	O5	12	2.46
Buck Cr. 2-1	2.4	14-Jun-00	12:51	10.5	50	4.46	223.22	2	226	400	O5	12	3.19
Buck Cr. 2-2	2.4	14-Jun-00	13:39	10.5	50	3.2	160.87	2	239	400	O5	11	2.76
East Birch Creek near flow gage	4.3	21-Apr-00	10:45	12	~100	~2		1	1528	500	K5	40	1.57
East Birch Cr. Index Site-1	13	17-Jul-00	13:52	15	50	~2		2	477	300-400	O5	47	5.91
East Birch Cr. Index Site-2	13	17-Jul-00			50	~2		2	345	300	O5	47	8.17
West Birch Cr. Mouth of Bear Cr.	5.1	19-Apr-00		8	400	~2		1	1372	400		5	0.22
West Birch Cr. Road Bridge	8.4	20-Apr-00	11:51	10	~100	~2		1	1895	400	L6	5	0.16
Minthorn Springs, Upper	0.1	11-Apr-00	12:15	10	~100	~2		1	1111	300	M5	26	1.40
Patawa Cr., at mouth	0	5-May-00			~100	~2		1		300	D5	1	
Tutuilla Cr., at mouth of Patawa Cr.	1.6	5-May-00			~100	~2		1		300	D5	2	
McKay Cr. near mouth	0.1	24-Jul-00	10:35	12	~100-150	~2		1	511	300-500	D3	11	1.29
McKay Cr. near mouth	0.2	27-Jun-00	3:00	13	~100-150	~2		1	558	400	D3	8	0.86
McKay Cr. near mouth	0.2	18-Jul-00	2:00	14	~100-150	~2		1	707	300-500	D5	9	0.76
McKay Cr. below Kirk Ave.	1.7	27-Jun-00	1:40	12	~100-150	~2		1	573	300	D4	16	1.68
McKay Cr. just above Kirk Ave.	2	18-Jul-00	12:50	12	~100-150	~2		1	773	300-500	D5	37	2.87
McKay Cr. near pond below 395 Br.	5.3	27-Jun-00	12:35	10	~100-150	~2		1	518	400-500	D5	8	0.93
McKay Cr. near pond below 395 Br.	5.3	18-Jul-00	11:30	10	~100-150	~2		1	882	300-500	D5	16	1.09
McKay Cr. at highway 395 bridge	5.5	24-Jul-00	9:15	10	~100-150	~2		1	743	300-400	D5	8	0.65
McKay Cr. below dam, near foot bridge	6	27-Jun-00	10:15	10	~100-150	~2		1	283	400-500	D5	0	0.00
McKay Cr. below dam, near foot bridge	6	18-Jul-00	10:15	10	~100-150	~2		1	543	300-500	D5	37	4.09
Umatilla, at Chinaman's Hole	1.1	18-Apr-00		11	~100	~2		1	493	400	D4	31	3.77
Umatilla, at Chinaman's Hole	1.1	28-Jun-00	8:30	18	~100	~2		1	1227	500	O1	3	0.15
Umatilla, at Chinaman's Hole	1.1	7-Sep-00	10:00	19	~100	~2		1	564	300-400	O2	0	0.00
Umatilla, Grapevine Hole	3	28-Jun-00	11:05	20	~100	~2		1	976	500-1000	O4	0	0.00
Umatilla, Below Three Mile Dam	4	28-Jun-00	12:30	19	~100	~2		1	509	400-500	O1	0	0.00
Umatilla, Stanfield Bridge	23	13-Apr-00	12:45	13	200	~2		1	794	400	M7	2	0.15
Umatilla, Stanfield Bridge	23	29-Jun-00	9:45	20	~100	~2		1	1304	400	O1	0	0.00
Umatilla, 1 mile below Echo	25	13-Apr-00	14:10	13	~100	~2		1	1162	400	M7	24	1.24
Umatilla, Echo Bridge	26.3	3-Jul-00	10:00	16	~100	~2		1	907	400	M4	4	0.26
Umatilla, Below Westland	27.1	7-Sep-00	13:50	20	~100	~2		1	915	300-400	O3	0	0.00
Umatilla, Below Feed Diversion	27.5	12-Apr-00	15:11	13	~100	~2		1	1192	300	M4	14	0.705
Umatilla, Below Feed Diversion	27.5	28-Apr-00	15:00	15	~100	~2		1	1180	400	K5	85	4.32
Umatilla, Below Feed Diversion	27.5	3-Jul-00	11:21	15	~100	~2		1	1131		T3	1	0.05
Umatilla, Above Stanfield Dam	32.5	3-Jul-00	12:28	16	~100	~2		1	719	300	K3	18	1.50
Umatilla, Above Stanfield Dam	32.5	18-Jul-00	3:02	23	~100	~2		1	624	300-400	O5	3	0.29
Umatilla, Cunningham RR Bridge	33.3	12-Apr-00	13:35	13	200	~2		1	1249	300	M4	48	2.31
Umatilla, Cunningham RR Bridge	33.3	5-Jul-00	10:00	15	~100	~2		1	800	400-500	K5	3	0.23
Umatilla, Yoakum Bridge	37	12-Apr-00			~100	~2		1	444	300	M4	3	0.41
Umatilla near Barnhart	42.1	10-Apr-00	12:30	10	~100	~2		1	1223	300-400	D4	62	3.04
Umatilla, Lower Barnhart	42.1	5-Jul-00	11:30	14	~100	~2		1	810	400-500	K5	6	0.44
Umatilla Anderson's Quarry	44	10-Apr-00	2:20		~100	~2		1	560	300	D4	5	0.54
Umatilla, Anderson's Quarry	44	5-Jul-00	12:40	17	~100	~2		1	582	400	M5	25	2.58
Umatilla, Combs Canyon	46.5	21-Jul-00	9:45	13.5	~100	~2		1		300-500	P5	1	
Umatilla, Rieth Bridge	48.5	21-Jul-00	10:20	14	~100	~2		1		300-500	O3	0	
Umatilla, Mouth of McKay	50.5	21-Jul-00	11:15	16	~100	~2		1		300-500	K5	0	
Umatilla, Cayuse RR Bridge	67	17-Apr-00	14:00	11	~100	~2		1	737	400	D4	11	0.90
Umatilla, at Mouth of Moonshine Cr.	67.2	17-Apr-00	15:00	15	~100	~2		1	443	300	D4	4	0.54

Table 2-23. Summary of fish captured during fry index surveys, 2000

Fry and Presence Absence Surveys, 2000

Catch Summary Location	RM	Date	Time	Nat CH	Nat STS	Hat STS	Nat Coho	Hat Coho	Sal. Cap.	Dace	Sculp.	Suck.	Shin.	Pike Min.	Chisel Mouth	SM Bass	Lamp.	Non-Sal.	Sal. to Non-Sal.
Buck Cr. 1-1	1.8	15-Jun-00	11:20		7				7		1							1	7.000
Buck Cr. 1-2	1.8	15-Jun-00	12:35		16				16		3							3	5.333
Buck Cr. 2-1	2.4	14-Jun-00	12:51		17				17		3							3	5.667
Buck Cr. 2-2	2.4	14-Jun-00	13:39		12				12		10							10	1.200
East Birch Creek near flow gage	4.3	21-Apr-00	10:45						0										
East Birch Cr. Index Site-1	13	17-Jul-00	13:52		60				60		50							50	1.200
East Birch Cr. Index Site-2	13	17-Jul-00			67				67		150							150	0.447
West Birch Cr. Mouth of Bear Cr.	5.1	19-Apr-00			5				5										
West Birch Cr. Road Bridge	8.4	20-Apr-00	11:51						0										
Minthorn Springs, Upper	0.1	11-Apr-00	12:15		5	3	18		26										
Patawa Cr., at mouth	0	5-May-00			1				1										
Tutuilla Cr., at mouth of Patawa Cr.	1.6	5-May-00			2				2										
McKay Cr. near mouth	0.1	24-Jul-00	10:35		3		8		11	50	20	30	10					110	0.100
McKay Cr. near mouth	0.2	27-Jun-00	3:00	1			7		8	100	50							150	0.053
McKay Cr. near mouth	0.2	18-Jul-00	2:00		4		5		9	100	100		5					205	0.044
McKay Cr. below Kirk Ave.	1.7	27-Jun-00	1:40				16		16	40	60							100	0.160
McKay Cr. just above Kirk Ave.	2	18-Jul-00	12:50		5		32		37	50	100							150	0.247
McKay Cr. near pond below 395 Br.	5.3	27-Jun-00	12:35	1			7		8		10							10	0.800
McKay Cr. near pond below 395 Br.	5.3	18-Jul-00	11:30		4		12		16		60							60	0.267
McKay Cr. at highway 395 bridge	5.5	24-Jul-00	9:15		1		8		9		20							20	0.450
McKay Cr. near foot bridge	6	27-Jun-00	10:15						0		5							5	0.000
McKay Cr. near foot bridge	6	18-Jul-00	10:15		20		17		37		100							100	0.370
Umatilla, at Chinaman's Hole	1.1	18-Apr-00					2	29	31							3		3	10.333
Umatilla, at Chinaman's Hole	1.1	28-Jun-00	8:30		2	1			3	100		100	500			1		701	0.004
Umatilla, at Chinaman's Hole	1.1	7-Sep-00	10:00						0	300		250	250		300		2	1102	0.000
Umatilla, Grapevine Hole	3	28-Jun-00	11:05						0	1000		200				6		1206	0.000
Umatilla, Below Three Mile Dam	4	28-Jun-00	12:30						0	1500								1500	0.000
Umatilla, Stanfield Bridge	23	13-Apr-00	12:45				2		2	500	12	20	150					682	0.003
Umatilla, Stanfield Bridge	23	29-Jun-00	9:45						0										
Umatilla, 1 mile below Echo	25	13-Apr-00	14:10	1			16	7	24										
Umatilla, Echo Bridge	26.3	3-Jul-00	10:00		2		2		4	3000	10		300					3310	0.001
Umatilla, Below Westland	27.1	7-Sep-00	13:50						0	3000	200	2000	4000					9200	0.000
Umatilla, Below Feed Diversion	27.5	12-Apr-00	15:11	4			13		17										
Umatilla, Below Feed Diversion	27.5	28-Apr-00	15:00	13			71		84										
Umatilla, Below Feed Diversion	27.5	3-Jul-00	11:21		1				1	3000	15		350					3365	0.000
Umatilla, Above Stanfield Dam	32.5	3-Jul-00	12:28		3		15		18		80		400					480	0.038
Umatilla, Above Stanfield Dam	32.5	18-Jul-00	3:02		1		2		3	10	15	1						26	0.115
Umatilla, Cunningham RR Bridge	33.3	12-Apr-00	13:35	5			44		49										
Umatilla, Cunningham RR Bridge	33.3	5-Jul-00	10:00		1		2		3	2500	300	150	200		100			3250	0.001
Umatilla, Yoakum Bridge	37	12-Apr-00					3		3	100			20					120	0.025
Umatilla near Barnhart	42.1	10-Apr-00	12:30				12	50	62										
Umatilla near Barnhart	42.1	5-Jul-00	11:30		2		4		6	300	100	50	300		50			800	0.008
Umatilla Anderson's Quarry	44	10-Apr-00	2:20			1	3	1	5										
Umatilla Anderson's Quarry	44	5-Jul-00	12:40				28		28	200	30	50	200		25			505	0.055
Umatilla, Combs Canyon	46.5	21-Jul-00	9:45		1				1	500	100		200					800	0.001
Umatilla, Rieth Bridge	48.5	21-Jul-00	10:20						0	200	100		20	1				321	0.000
Umatilla, Mouth of McKay	50.5	21-Jul-00	11:15						0	300	100	25	90		1			516	0.000
Umatilla, Cayuse RR Bridge	67	17-Apr-00	14:00	11					11										
Umatilla, Mouth of Moonshine Cr.	67.2	17-Apr-00	15:00				4		4										
Totals				**36**	**50**	**2**	**335**	**87**	**510**	**16850**	**1587**	**2876**	**6995**	**1**	**476**	**10**	**2**	**28797**	

Table 2-24. Summary of salmonid length data of fish captured during fry and presence absence surveys, 2000.

Fry and Presence Absence Surveys, 2000			Chinook				Coho Salmon				Hatchery Coho				Steelhead				Hatchery Steelhead			
Sites	RM	Date	Max	Mean	Min	n	Max	Mean	Min	n	Max	Mean	Min	n	Max	Mean	Min	n	Max	Mean	Min	n
Buck Cr. 1-1	1.8	15-Jun-00													165	126	75	7				
Buck Cr. 1-2	1.8	15-Jun-00													170	117	73	16				
Buck Cr. 2-1	2.4	14-Jun-00													185	122	64	17				
Buck Cr. 2-2	2.4	14-Jun-00													175	103	61	12				
East Birch Creek near flow gage	4.3	21-Apr-00													222	110	75	40				
East Birch Cr. Index Site-1	13	17-Jul-00													135	68.2	30	60				
East Birch Cr. Index Site-2	13	17-Jul-00													142	57.4	26	67				
West Birch Cr. Mouth of Bear Cr. *	5.1	19-Apr-00													178	125	83	4				
West Birch Cr. Road Bridge	8.4	20-Apr-00													225	130	89	5				
Minthorn Springs, Upper	0.1	11-Apr-00					126	67.3	30	18					127	112	92	5	190	178	160	3
Patawa Cr., at mouth	0	5-May-00													150	150	150	1				
Tutuilla Cr., at mouth of Patawa Cr.	1.6	5-May-00													160	145	129	2				
McKay Cr. near mouth	0.1	24-Jul-00					117	90.6	78	8					64	48.7	40	3				
McKay Cr. near mouth	0.2	27-Jun-00	69	69	69	1	70	55.9	25	7												
McKay Cr. near mouth	0.2	18-Jul-00					81	74.4	66	5					62	45.8	35	4				
McKay Cr. below Kirk Ave.	1.7	27-Jun-00					90	61.4	24	16												
McKay Cr. just above Kirk Ave.	2	18-Jul-00					93	47.3	25	32					101	54.2	35	5				
McKay Cr. near pond below 395 Br.	5.3	27-Jun-00	54	54	54	1	68	32.9	25	7												
McKay Cr. near pond below 395 Br.	5.3	18-Jul-00					87	61.3	28	12					38	35.8	33	4				
McKay Cr. at highway 395 bridge	5.5	24-Jul-00					86	60	32	7					37	37	37	1				
McKay Cr. near foot bridge	6	27-Jun-00																				
McKay Cr. near foot bridge	6	18-Jul-00					42	35.5	30	17					42	34.2	24	20				
Umatilla, at Chinaman's Hole **	1.1	18-Apr-00					121	115	109	2	161	138.4	120	29								
Umatilla, at Chinaman's Hole	1.1	28-Jun-00													210	205	199	2	205	205	205	1
Umatilla, at Chinaman's Hole **	1.1	7-Sep-00																				
Umatilla, Grapevine Hole	3	28-Jun-00																				
Umatilla, Below Three Mile Dam	4	28-Jun-00																				
Umatilla, Stanfield Bridge	23	13-Apr-00					42	38.5	35	2												
Umatilla, Stanfield Bridge	23	29-Jun-00																				
Umatilla, 1 mile below Echo	25	13-Apr-00	32	32	32	1	86	39.8	29	16	140	123.1	110	7								
Umatilla, Echo Bridge	26.3	3-Jul-00					75	74	73	2					64	59.8	55	2				
Umatilla, Below Westland	27.1	7-Sep-00																				
Umatilla, Below Feed Diversion	27.5	12-Apr-00	50	41.8	37	4	90	42	34	13												
Umatilla, Below Feed Diversion	27.5	28-Apr-00	43	37.8	24	12	51	42.9	37	72												
Umatilla, Below Feed Diversion	27.5	3-Jul-00													80	80	80	1				
Umatilla, Above Stanfield Dam	32.5	3-Jul-00					87	81.1	73	15					77	74.3	70	3				
Umatilla, Above Stanfield Dam	32.5	18-Jul-00					81	79.5	78	2					57	57	57	1				
Umatilla, Cunningham RR Bridge	33.3	12-Apr-00	47	40.2	31	5	95	36.6	31	44												
Umatilla, Cunningham RR Bridge	33.3	5-Jul-00					85	81.5	78	2					65	65	65	1				
Umatilla, Yoakum Bridge	37	12-Apr-00					35	34.3	34	3												
Umatilla near Barnhart	42.1	10-Apr-00					108	86.6	41	12	109	109	109	1								
Umatilla near Barnhart	42.1	5-Jul-00					127	74.3	50	4					70	67.5	65	2				
Umatilla Anderson's Quarry ***	44	10-Apr-00					37	36	35	3									325	325	325	1
Umatilla Anderson's Quarry	44	5-Jul-00					87	76.2	68	28												
Umatilla, Combs Canyon	46.5	21-Jul-00													85	85	85	1				
Umatilla, Rieth Bridge	48.5	21-Jul-00																				
Umatilla, Mouth of McKay	50.5	21-Jul-00																				
Umatilla, Cayuse RR Bridge	67	17-Apr-00	58	52.4	48	11																
Umatilla, at Mouth of Moonshine Cr.	67.2	17-Apr-00					58	53.5	50	4												
Total			69	44.3	24	35	127	53.7	24	353	161	134.8	109	37	225	81	24	286	325	213	160	5

Catch Included *a 550 mm spawned out adult steelhead **4 Smallmouth Bass 52-105 mm *** 2 lamprey 180 and 190 mm

Table 2-25. Summary of survey sites for the fry and presence absence surveys conducted in the Umatilla River Basin during 2001.

Umatilla River Fry and Presence/Absence Surveys, 2001					Site	Site	Site	No.	First			Sal.		1st Pass
Site Summary	**River**			**Water**	**Length**	**Width**	**Area**	**of**	**Pass**			**Cap.**	**Density**	**CPUE**
Location	**Mile**	**Date**	**Time**	**Temp**	**(m)**	**(m)**	**(m^2)**	**Passes**	**(Sec)**	**Volts**	**Setting**	**Pass 1**	**(Sal/m^2)**	**(Sal/Min)**
McKay Cr. Near Mouth	0.1	29-Jun-2001	10:30	10	79	4.0	316	1	732	400	F5	26	8.2	2.13
McKay Cr. Behind Rest Home	1.7	29-Mar-2001	11:45	12.9	190	4.2	795	1	1201	500	F6	38	4.8	1.90
McKay Cr. Kirk Ave.	2	29-Jun-2001	11:20	10.5	100	6.0	600	1	650	400	F5	0	0.0	0.00
McKay Cr. Near McKay School	2.3	29-Jun-2001	11:55	10.9	95	5.0	475	1	742	400	G5	15	3.2	1.21
McKay Cr. Heaven Lane Br.	3.7	29-Jun-2001	12:50	10	70	5.0	350	1	815	400	G5	12	3.4	0.88
McKay Cr. At Gage Below Dam	5.8	30-Mar-2001	1:30	9	190	7.2	1362	1	1206	500	F6	44	3.2	2.19
McKay Cr. Habitat Project Area 1	21.3	2-Oct-2001	9:30	13	60.7	5.7	344.07	1	375	3-400	F-4		0.0	0.00
McKay Cr. Habitat Project Area 2	21.4	2-Oct-2001	9:30	13	50	6.1	304.03	1	415	3-400	F-4		0.0	0.00
McKay Cr. Habitat Project Area 3	21.6	2-Oct-2001	9:30	13	50	5.3	264.3	1	350	3-400	F-4	1	0.4	0.17
Mission Cr. Above St. Andrews Culvert	3	1-Oct-2001	10:35	11.6	50	0.9	44.5	2	1211	300	F-4	39	87.6	1.93
Mission Cr. Below St. Andrews Culvert	3	1-Oct-2001	10:35	11.6	50	0.9	46	2	1261	300	F-4	50	108.7	2.38
N.F. Umatilla River	1.5	21-Jun-2001		13.1	200	2.0	400	1	1000	500	F-6	137	34.3	8.22
N.F. Umatilla River at Coyote Cr.	2.7	21-Jun-2001		11.7	200	2.0	400	1	1000	500	F-6	173	43.3	10.38
S.F. Umatilla, Above Mouth of Thomas Cr.	3.2	11-Jun-2001	13:30	10.7	200	2.0	400	1	1000	400	I-6	55	13.8	3.30
S.F. Umatilla, Below Mouth of Thomas Cr.	3.1	11-Jun-2001	12:30	10.7	200	2.0	400	1	1000	400	I-6	66	16.5	3.96
Thomas Cr, Mouth	0.1	11-Jun-2001	15:00	10.7	200	2.0	400	1	1000	400	I-6	63	15.8	3.78
Umatilla R. at Chinaman's Hole	1.1	4-Apr-2001	12:30	8.3	200	2.0	400	1	1200	400	F-6	509	127.3	25.45
Umatilla R. Near Barnhart	42.2	4-Apr-2001	9:30	5.3	200	2.0	400	1	1200	400	E-6	9	2.3	0.45
Umatilla R. Below Mouth of McKay	50.5	5-Jun-2001	14:00	10.7	200	2.0	400	1	1000	500	G-5	3	0.8	0.18
Umatilla R. Above Mouth of McKay	50.6	5-Jun-2001	16:00	15.7	200	2.0	400	1	1000	500	E-5	7	1.8	0.42
Umatilla R. Above Cayuse Bridge	67.5	18-Jun-2001	11:30	11.6	200	2.0	400	1	1000	400	E-6	20	5.0	1.20
Umatilla R. at Thorn Hollow Br.	73.5	18-Jun-2001	9:00	13.0	200	2.0	400	1	1000	400	E-6	72	18.0	4.32
Umatilla R. Below Fred Grays Br.	80	15-Jun-2001	12:00	13.4	200	2.0	400	1	1000	500	F-5	150	37.5	9.00
Umatilla River , Beeches Habitat Project	85	25-Sep-2001	9:30	11.5	75	2.0	150	1	800	300	F-4	24	16.0	1.80
Umatilla R.	85	5-Oct-2001	10:00	8.5	50	2.0	100	1	2300	3-500	F-4	583	583.0	15.21
Umatilla R. Above Station 29	87.2	11-Jul-2001	9:30		193	6.9	1333.4	1	1030	400	F-4	11	0.8	0.64
Umatilla R. Below Mouth of N.F. Umatilla	89.5	15-Jun-2001	10:00	10.6	65.2	14.1	916.6	1	1000	400	F-6	145	15.8	8.70
Total					3767.9	3.2	12,201		26,488			2252	18.5	5.10

Table 2-26. Summary of fish catch data of fish captured from the Umatilla River Basin during fry and presence absence surveys, 2001.

Umatilla River Fry and Presence/Absence Surveys, 2001 Catch Summary Location	River Mile	Date	Nat CHS	Hat CHS	Nat STS	Hat STS	Nat Coho	Hat Coho	Mt. White Fish	Bull Trout	Total Sal Cap.	Dace	Shin.	Sclp.	Suck.	Chisel-mouth	Or. Pike Min.	Total Non-Sal.	Ratio of Sal to Non-Sal.
McKay Cr. Near Mouth	0.1	29-Jun-2001	5				21				26	200		50				250	0.104
McKay Cr. Behind Rest Home	1.7	29-Mar-2001			27		6		5		38	50	225	375	25	5	15	695	0.055
McKay Cr. Kirk Ave.	2	29-Jun-2001									0	75		200				275	0.000
McKay Cr. Near McKay School	2.3	29-Jun-2001	1				14				15	10		150	1			161	0.093
McKay Cr. Heaven Lane Br.	3.7	29-Jun-2001	2		40		10				52								
McKay Cr. At Gage Below Dam	5.8	30-Mar-2001					4				4			125				125	0.032
McKay Cr. Habitat Project Area 1	21.3	2-Oct-2001									0								
McKay Cr. Habitat Project Area 2	21.4	2-Oct-2001									0								
McKay Cr. Habitat Project Area 3	21.6	2-Oct-2001									0								
Mission Cr. Above St. Andrews Rd.	3	1-Oct-2001			39						39								
Mission Cr. Below St. Andrews Rd.	3	1-Oct-2001			50						50								
N.F. Umatilla River	1.5	21-Jun-2001	64		68				2	3	137								
N.F. Umatilla River at Coyote Cr.	2.7	21-Jun-2001	78		88					7	173								
S.F. Umatilla, Above Thomas Cr.	3.2	11-Jun-2001			55						55			150				150	0.367
S.F. Umatilla, Below Thomas Cr.	3.1	11-Jun-2001			66						66			250				250	0.264
Thomas Cr, Mouth	0.1	11-Jun-2001			63						63			100				100	0.630
Umatilla R. at Chinaman's Hole	1.1	4-Apr-2001		150	3		6	350			509	35	100	5	25	10	25	205	2.483
Umatilla R. Near Barnhart	42.2	4-Apr-2001		2			7				9	100	40	35	15	5	15	210	0.043
Umatilla R. Below Mouth of McKay	50.5	5-Jun-2001	1		1		1				3	450	325	275	60	40	15	1167	0.003
Umatilla R. Above Mouth of McKay	50.6	5-Jun-2001	4	1			2				7	700	200	200	100	15	15	1240	0.006
Umatilla R. Above Cayuse Bridge	67.5	18-Jun-2001			9		11				20	300	100	75			25	500	0.040
Umatilla R. at Thorn Hollow Br.	73.5	18-Jun-2001	7		58		7				72	175	10	100			5	291	0.247
Umatilla R. Below Fred Grays Br.	80	15-Jun-2001	76		52		20		2		150	100		75				175	0.857
Umatilla River , Beeches Project	85	25-Sep-2001					24				24								
Umatilla R.	85	5-Oct-2001	479		104						583								
Umatilla R. Above Station 29	87.2	11-Jul-2001	1		9				1		11	300		400				700	0.016
Umatilla R. Below N.F. Umatilla	89.5	15-Jun-2001	76		68				1		145			75				75	1.933
Total			794	153	800	0	133	350	11	10	2251	2495	1000	2640	226	75	115	6569	0.343

One lamprey was captured from the Umatilla River near Thorn Hollow (RM 73.5),
Five bullfrog tadpoles were collected near the mouth of McKay (RM 50.5).
Five smallmouth bass were collected in the Umatilla River near Chinaman’s Hole (RM 1.1)

Table 2-27. Summary of salmonid length data of fish captured during fry and presence absence surveys, 2001.

Umatilla River Fry and Presence/Absence Surveys, 2001																						
Length Summary	**River**		**Natural Chinook**				**Natural Steelhead**				**Natural Coho**				**Mountain Whitefish**				**Bull Trout**			
Location	**Mile**	**Date**	**Max**	**Mean**	**Min**	**n**	**Max**	**Mean**	**Min**	**n**	**Max**	**Mean**	**Min**	**n**	**Max**	**Mean**	**Min**	**n**	**Max**	**Mean**	**Min**	**n**
McKay Cr. Near Mouth	0.1	29-Jun-2001	90	83	72	5					84	73	62	21								
McKay Cr. Behind Rest Home	1.7	29-Mar-2001					327	161	88	27	187	152	124	6	308	286	248	5				
McKay Cr. Kirk Ave.	2	29-Jun-2001																				
McKay Cr. Near McKay School	2.3	29-Jun-2001			86	1					80	71	55	14								
McKay Cr. Heaven Lane Br.	3.7	29-Jun-2001	87	64.5	42	2					72	59	50	10								
McKay Cr. At Gage Below Dam	5.8	30-Mar-2001	175	127	84	40					146	421	137	4								
McKay Cr. Habitat Project Area 1	21.3	2-Oct-2001																				
McKay Cr. Habitat Project Area 2	21.4	2-Oct-2001																				
McKay Cr. Habitat Project Area 3	21.6	2-Oct-2001																				
Mission Cr. Above St. Andrews Rd.	3	1-Oct-2001					230	74.8	52	39												
Mission Cr. Below St. Andrews Rd.	3	1-Oct-2001					215	92.5	53	50												
N.F. Umatilla River	1.5	21-Jun-2001	83	52.4	41	64	188	87.4	29	68					335	303	270	2	145	113	95	3
N.F. Umatilla River at Coyote Cr.	2.7	21-Jun-2001	90	49.4	42	78	212	92.6	30	88									112	100	85	7
S.F. Umatilla, Above Thomas Cr.	3.2	11-Jun-2001					165	77.7	26	55												
S.F. Umatilla, Below Thomas Cr.	3.1	11-Jun-2001					148	87.5	25	66												
Thomas Cr, Mouth	0.1	11-Jun-2001					166	90.6	28	63												
Umatilla R. at Chinaman's Hole	1.1	4-Apr-2001					161	137	105	3	120	105	90	6								
Umatilla R. Near Barnhart	42.2	4-Apr-2001									120	82	35	7								
Umatilla R. Below McKay Cr.	50.5	5-Jun-2001			47	1			136	1			63	1								
Umatilla R. Above McKay Cr.	50.6	5-Jun-2001	59	50.5	46	4					68	65	62	2								
Umatilla R. Above Cayuse Bridge	67.5	18-Jun-2001					41	36.1	31	9	90	78	62	11								
Umatilla R. at Thorn Hollow Br.	73.5	18-Jun-2001	75	70	60	7	50	38.8	26	58	72	70	66	7								
Umatilla R. Below Fred Grays Br.	80	15-Jun-2001	80	60.2	51	76	133	54	29	52	80	69	53	20	270	253	235	2				
Umatilla River , Beeches Project	85	25-Sep-2001									111	85	71	24								
Umatilla R.	85	5-Oct-2001	101	79	38	479	298	115	11	104												
Umatilla R. Above Station 29	87.2	11-Jul-2001			227	1	135	112	83	9							260	1				
Umatilla R. Below N.F. Umatilla	89.5	15-Jun-2001	73	51.8	45	76	136	67.3	27	68							290	1				
Total			**227**	**69.4**	**8**	**794**	**327**	**87.9**	**25**	**800**	**187**	**81**	**35**	**133**	**335**	**281**	**235**	**11**	**145**	**104**	**85**	**10**

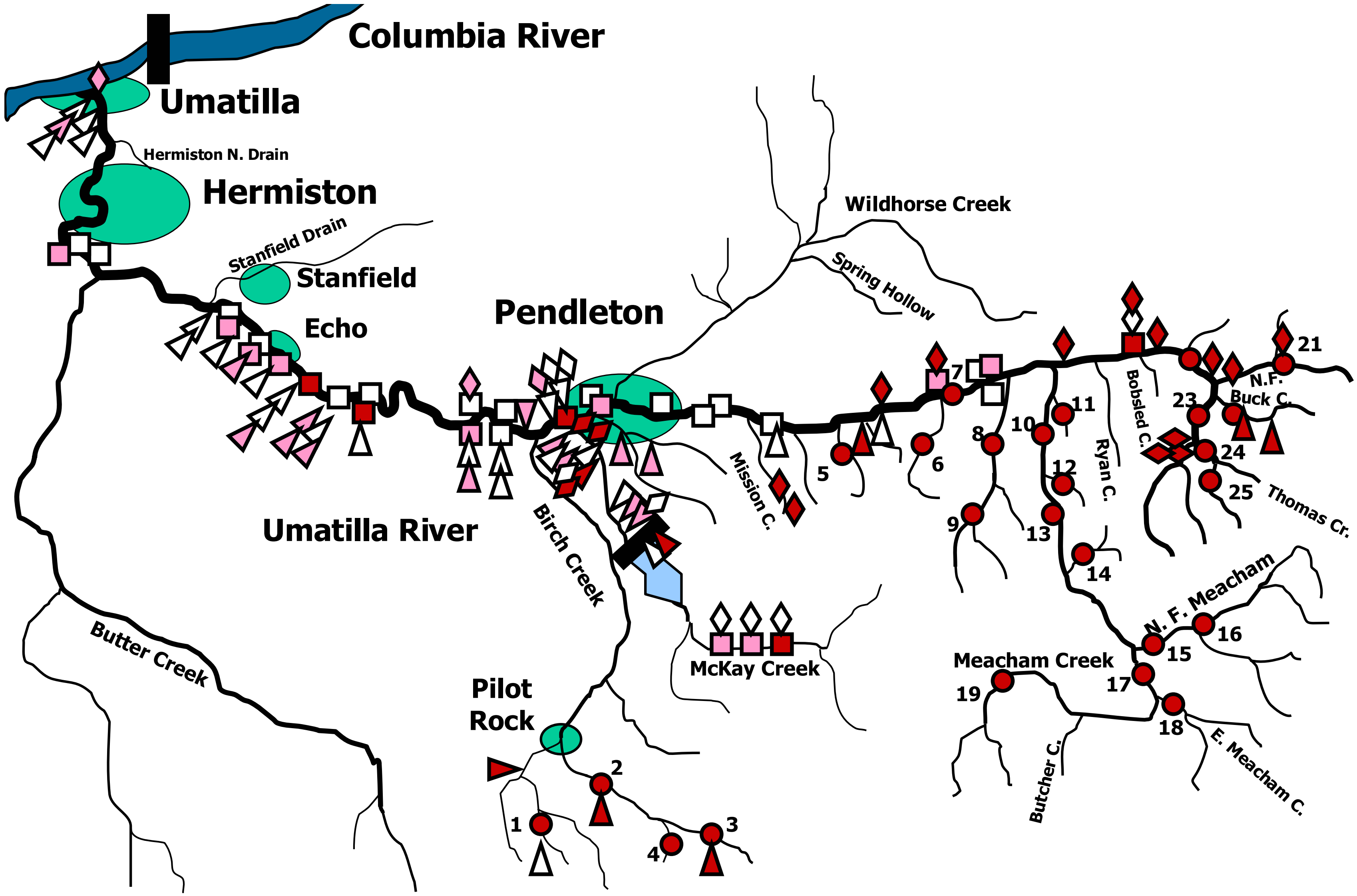

Figure 2-17. Summary of juvenile summer steelhead collected from the Umatilla River Basin, 1999-2002 by location. Circles represent index sites (1999-2002). Squares, triangles and diamonds represent presence absence surveys conducted during 1999, 2000 and 2001 respectively. Dark symbols denote moderate to high numbers. Lightly colored symbols represent low numbers. Juvenile steelhead were not captured at locations denoted by white symbols. The figure does not include catch from salvage activities (see Figure 2-1 for clarity on index site location).

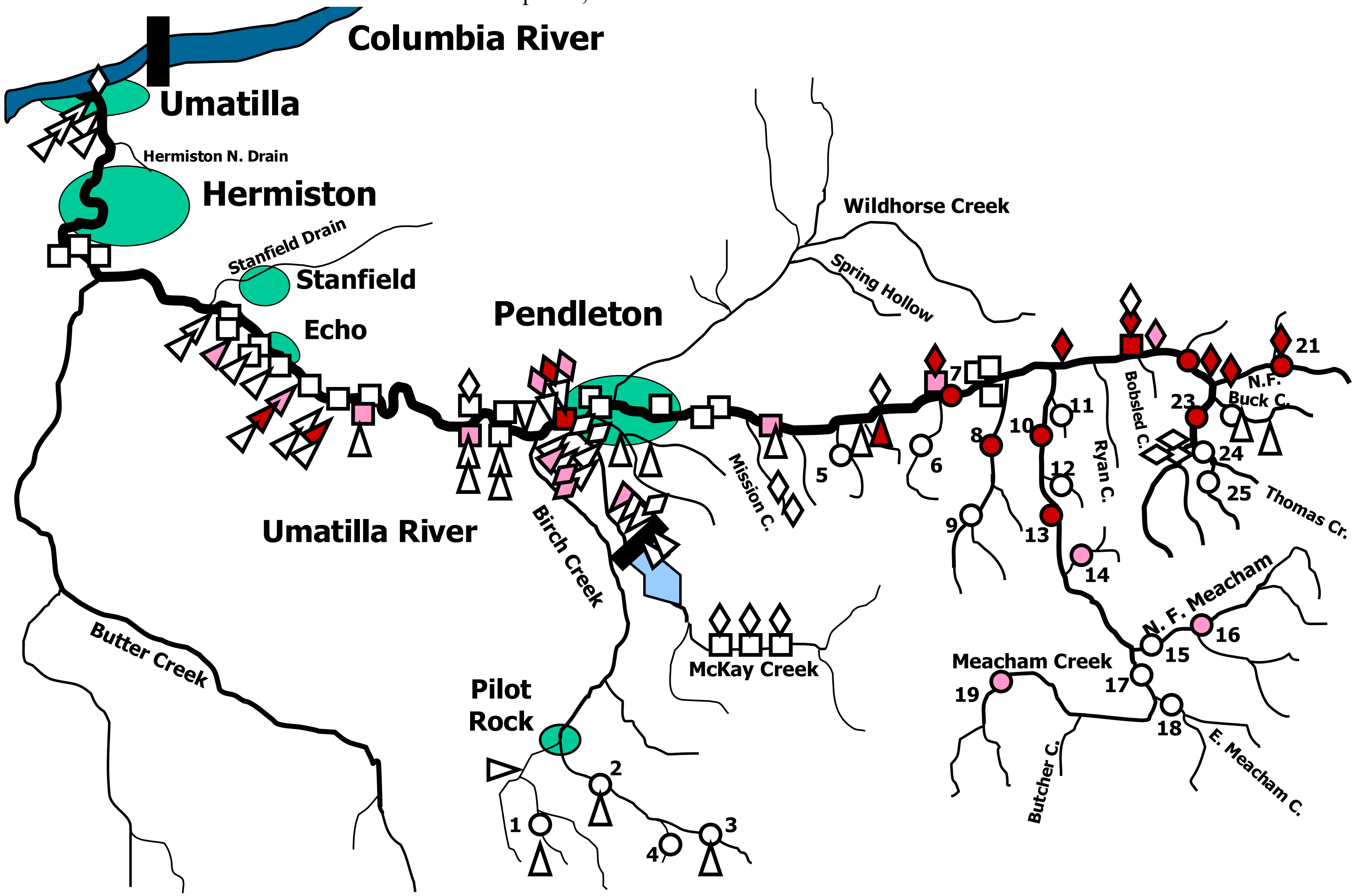

Figure 2-18. Summary of juvenile Chinook salmon collected from the Umatilla River Basin, 1999-2002 by location. Circles represent index sites (1999-2002). Squares, triangles and diamonds represent presence absence surveys conducted during 1999, 2000 and 2001 respectively. Dark symbols denote moderate to high numbers. Lightly colored symbols represent low numbers. Juvenile Chinook were not captured at locations denoted by white symbols. The figure does not include catch from salvage activities (see Figure 2-1 for clarity on index site location).

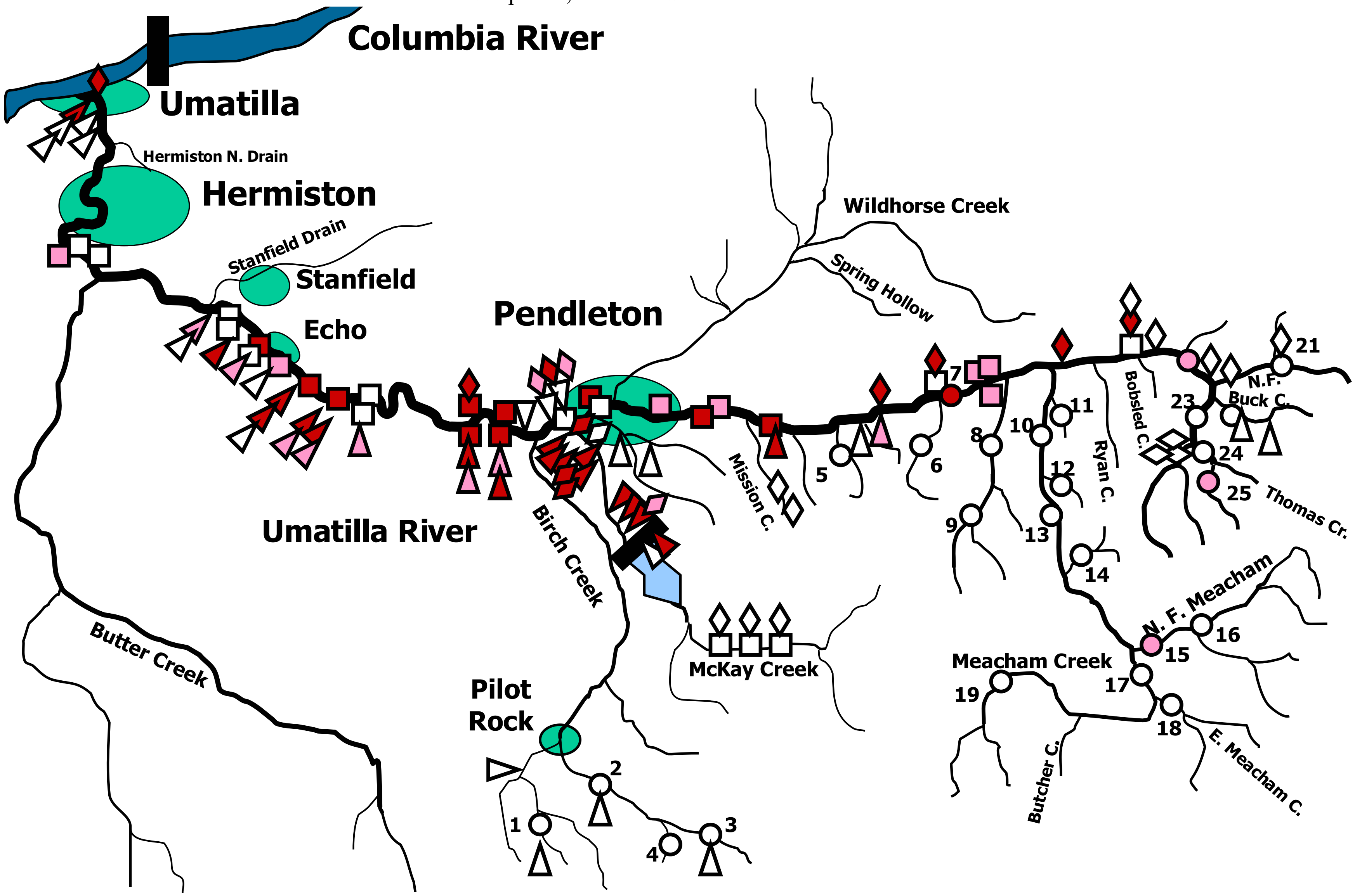

Figure 2-19. Summary of juvenile coho salmon collected from the Umatilla River Basin, 1999-2002 by location. Circles represent index sites (1999-2002). Squares, triangles and diamonds represent presence absence surveys conducted during 1999, 2000 and 2001 respectively. Dark symbols denote moderate to high numbers. Lightly colored symbols represent low numbers. Juvenile coho were not captured at locations denoted by white symbols. The figure does not include catch from salvage activities (see Figure 2-1 for clarity on index site location).

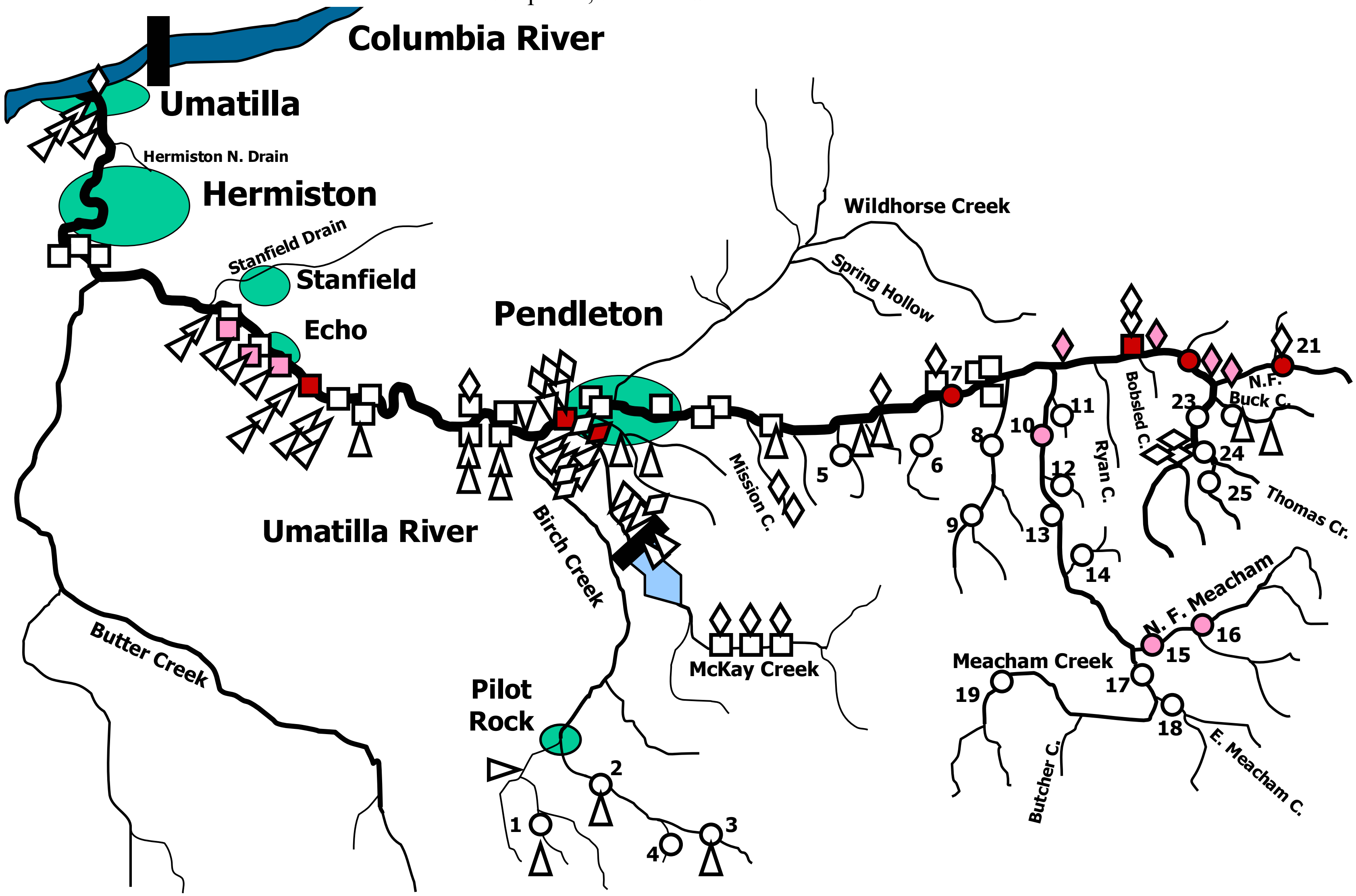

Figure 2-20. Summary of mountain whitefish collected from the Umatilla River Basin, 1999-2002 by location. Circles represent index sites (1999-2002). Squares, triangles and diamonds represent presence absence surveys conducted during 1999, 2000 and 2001 respectively. Dark symbols denote moderate to high numbers. Lightly colored symbols represent low numbers. Mountain whitefish were not captured at locations denoted by white symbols. The figure does not include catch from salvage activities (see Figure 2-1 for clarity on index site location).

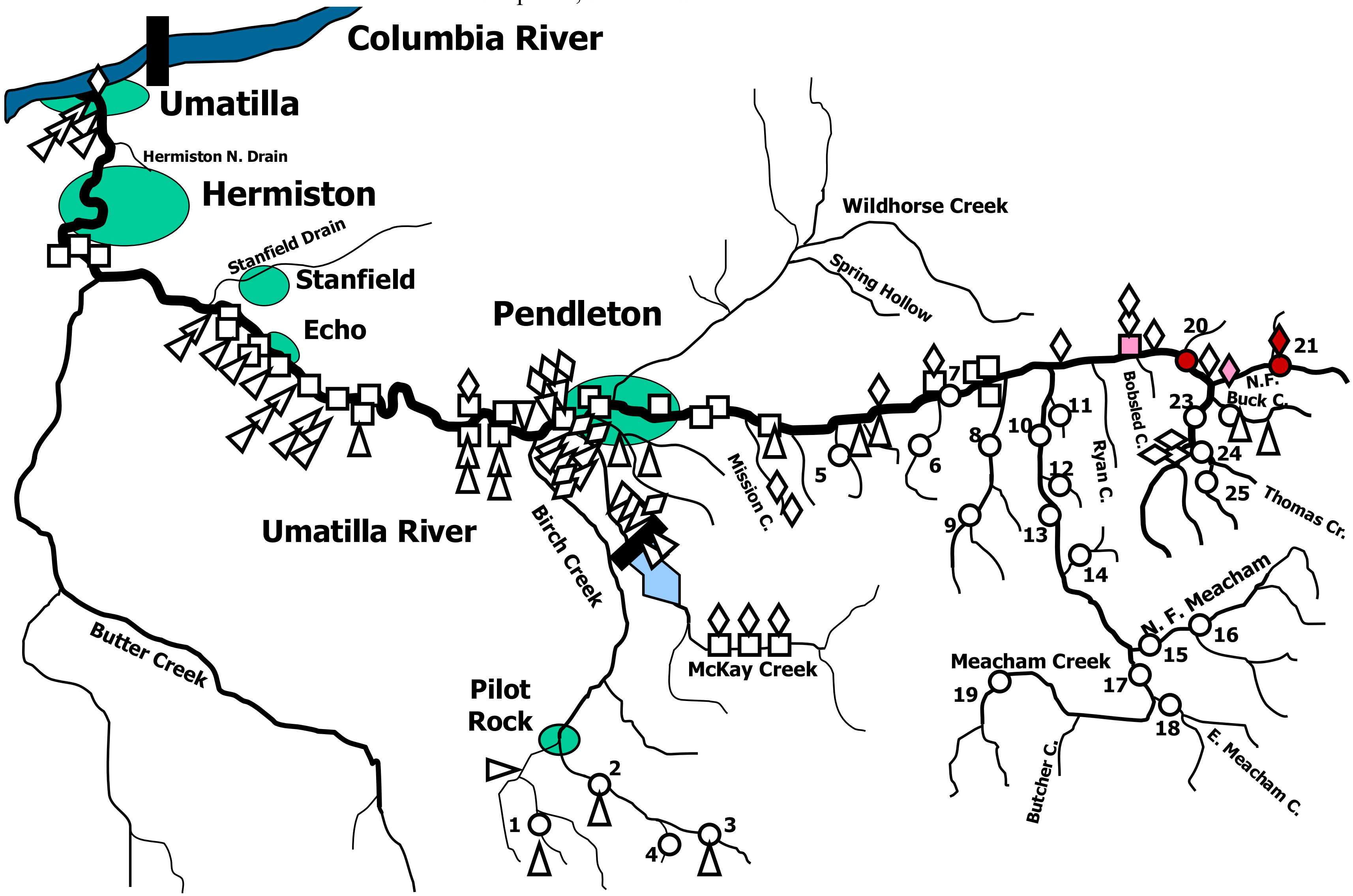

Figure 2-21. Summary of bull trout collected from the Umatilla River Basin, 1999-2002 by location. Circles represent index sites (1999-2002). Squares, triangles and diamonds represent presence absence surveys conducted during 1999, 2000 and 2001 respectively. Dark symbols denote moderate to high numbers. Lightly colored symbols represent low numbers. Bull trout were not captured at locations denoted by white symbols. The figure does not include catch from salvage activities (see Figure 2-1 for clarity on index site location).

ACKNOWLEDGEMENTS

This project was funded by Bonneville Power Administration to mitigate, in part, for salmon and steelhead losses associated with the construction and operation of Columbia and Snake River Dams. The Confederated Tribes of the Umatilla Indian Reservation thank Jonathan McCloud and other BPA personnel for their contributions.

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CHAPTER THREE: EVALUATION OF JUVENILE SALMONID OUTMIGRATION AND SURVIVAL

THE UMATILLA BASIN NATURAL PRODUCTION MONITORING AND EVALUATION PROJECT

Progress Report
1999-2002

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Executive Summary

This report presents the results of analysis of available PIT tag data to evaluate outmigration timing of natural Umatilla Basin salmonids to John Day Dam and survival from release sites in the Umatilla Basin to John Day Dam. We evaluated the effects on timing and survival of several release parameters including origin, year, release location, tagging season, size at release and capture method. PIT tagging activities were not specifically targeted at answering all the questions addressed in this report. Effects of release parameters were evaluated as allowed by the data.

1. Between 1999 and 2002 CTUIR and ODFW PIT tagged 8,178 natural summer steelhead, 2,980 Chinook[3] and 805 coho that we used in this analysis.

2. Timing differences between natural and hatchery fish were dependent on the species and year. Natural steelhead passed John Day Dam significantly earlier than hatchery fish in both 2001 and 2002. In 1999 and 2000, John Day Dam passage dates were similar between natural and hatchery steelhead. Natural Chinook passed John Day Dam later than hatchery Chinook in both 1999 and 2001, the only years comparisons were possible.

3. Chinook tagged in the fall passed John Day next spring at similar times to Chinook tagged in the spring. Chinook was the only species where comparisons of tagging season could be made.

4. Release location did not influence timing past John Day Dam. We were able to compare between upriver and downriver releases for both steelhead and Chinook. In two comparisons, there was no significant difference in John Day Dam passage timing.

5. In most cases, smaller fish passed John Day Dam later in the migration season than larger fish. In one of two comparisons with steelhead, smaller fish passed John Day Dam later than larger fish. Two of three comparisons of Chinook showed that Chinook passing John Day Dam late in the season were shorter than those that passed earlier.

5. Differences in survival between the rearing types generally favored natural fish. In all eight comparisons amongst steelhead, natural fish survived at a higher rate than did hatchery fish. Among Chinook, natural fish survived better in both comparisons in 1999, and hatchery fish had a higher survival rate in both comparisons in 2001.

6. Survival rates of Chinook tagged in the fall of 2000 survived to John Day Dam at 15.9% compared to Chinook tagged in the same location the following spring that survived at 33.4%.

7. Both steelhead and Chinook released in the lower river survived better to John Day Dam than did steelhead or Chinook released at similar time periods in the upper basin.

8. Evaluation of the effects of capture method was complicated by the nature of the data. Our estimates of survival rate indicated that steelhead captured via screw trap survived to John Day Dam better than those captured via electrofishing. However, fish caught via screw trapping are actively migrating. Fish captured via electrofishing may or may not be migrating, and may be rearing longer in freshwater than those caught by screw trap.

INTRODUCTION

Chinook, coho and steelhead juveniles marked with Passive Integrated Transponder (PIT) tags have been released into the Umatilla Basin every year since 1999 by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and the Oregon Department of Fish and Wildlife (ODFW). To date, however, the data from detections of PIT-tagged fish emigrating from the basin has not been examined. This report presents analysis of migration timing and survival of PIT-tagged, naturally- produced outmigrants from the lower Umatilla Basin.

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[3] In this report Chinook is capitalized in recognition of the Chinook Tribe. While the American Fisheries Society does not capitalize Chinook, they do capitalize Apache trout, Gila trout, Paiute sculpin and Umatilla dace. These fish all bear the names of tribes and are capitalized. We also capitalize Chinook salmon to be consistent with English language dictionaries and standard conventions.

The Umatilla River originates on the west slope of the Blue Mountains, east of Pendleton, and flows in a northwesterly direction for 115 miles, entering the Columbia River just below McNary Dam at RM 289 (Figure 3-1). Mean annual precipitation ranges from 10 inches/year at the town of Umatilla near the mouth, to 50 inches/year in the headwaters (Taylor 1993). The basin can be roughly divided into two physiographic regions. The lower river, west of Pendleton, has cut a low valley into a broad upland plain called the Deschutes-Umatilla Plateau. Foothills and the Blue Mountains dominate the region east of Pendleton. Extreme low flows are common during summer, especially in the lower river.

Objective and Tasks

This chapter summarizes the smolt monitoring activities completed during the contract years form September 30, 1999 through December 31, 2002.

Juvenile Outmigration Monitoring

Objective B: (Objective 2 in the 1999-2002 statements of work). Estimate timing and survival of juvenile salmon and steelhead migrating form the headwaters of the Umatilla River Basin to the lower Columbia River.

Task B.1 Complete a peer reviewed sample design and protocol for monitoring the out-migration of juvenile summer steelhead, spring Chinook salmon, fall Chinook salmon and coho salmon in the Umatilla River Basin (see Chapter Six).

Task B.2 Monitor traps and Pit tag natural juvenile Chinook and summer steelhead collected in the Umatilla River Basin with traps, electrofishing and other methods.

Task B.3 Develop and submit tagging, mortality and release files to PTAGIS.

Task B.4 Extract, examine and summarize PIT tag detection data from PTAGIS after the end of the smolt migration year.

Task B.5 Estimate timing and minimum survival from PIT tag detections at all down-river interrogation sites and compare with other tagged groups

Task B.6 Estimate smolt to adult survival of PIT tagged fish from adult detections at lower Columbia River dams and at TMD in future years when sufficient numbers of detections allow.

Task B.7 Report findings and discuss management implications.

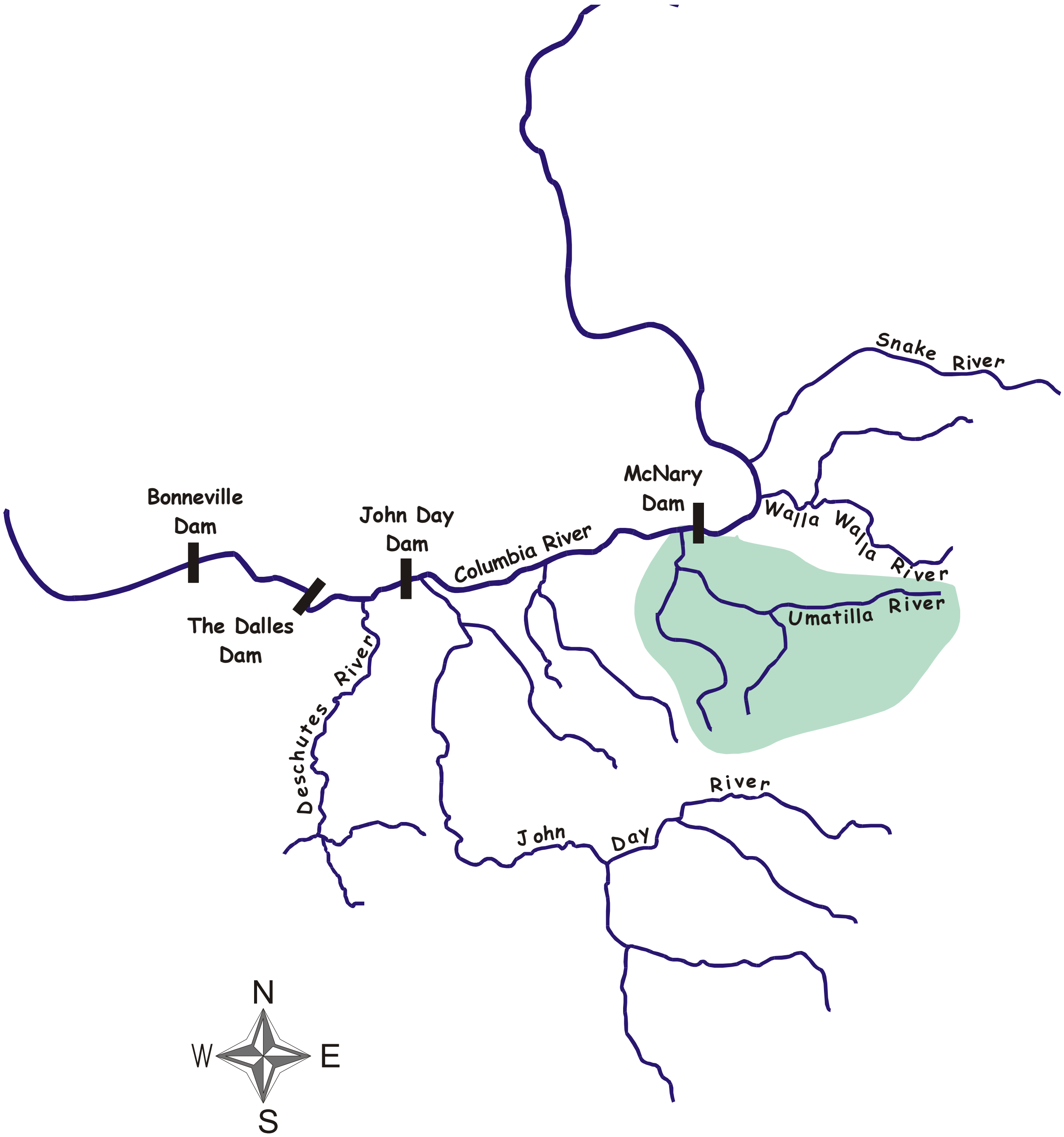


Figure 3-1. Location of the Umatilla Basin within the mid-Columbia River Basin and with respect to dams on the mainstem Columbia River.

The lower Umatilla River is highly developed and there are a number of management issues related to juvenile fish passage such as flow augmentation, water quality, operation of irrigation diversions, etc. There is concern that effects of human activities in the lower Umatilla River are causing significant mortality of natural and hatchery outmigrants. The goal of this report is to use PIT tag detections to determine migration timing and survival of naturally-produced steelhead, Chinook, and coho as they migrated from the Umatilla River to John Day Dam in the Columbia River.

DATA INVENTORY

PIT tag data for the Umatilla Basin is tracked in a comprehensive database maintained by Pacific States Marine Fisheries Commission (PSMFC). Tag release and detection data is available since 1999 for sites throughout the basin. The CTUIR has been PIT tagging juvenile summer steelhead, spring Chinook, and coho since the fall of 1998. Tagging has been conducted in October through May at numerous locations in the upper Umatilla Basin (Table 3-1, Figure 3-2). Juveniles were captured and PIT tagged in their rearing areas so that they could later be detected as they migrated past dams en route to the ocean. Salmonids were collected with seines, screw traps, and electrofishing, depending on the season and location (Figure 3-2). The CTUIR has PIT tagged only those juvenile Chinook and coho salmon greater than 75 mm, and steelhead with smolt or partial smolt characteristics (primarily 2+). Fish were anesthetized with MS222 (tricaine methane-sulfonate) and tagged by hand with sterile syringes. PIT-tagged fish were measured, allowed to recover, and released.

Table 3-3-1. Release locations of PIT-tagged salmonid juveniles that were naturally produced in the Umatilla Basin (1999-2002). River miles are denoted as distance from Umatilla mouth, with periods separating river mile from confluence with next larger stream. For example: East Birch Creek sample site was 0-16 miles from the mouth of East Birch Creek, which is 16 miles from Birch Creek mouth, and which is 48 miles from the Umatilla River mouth. Distances obtained from Pacific States Marine Fisheries Commission PIT tag release files.

Release Location	***River Mile***	**Miles from Umatilla Mouth**
ODFW Screw trap	001	1.2
Three Mile Falls Dam	004	3.7
Umatilla River	040	40.0
Birch Cr.	048.000	48.1
EFK Birch	048.016.000-016	64.4-80.4
WFK Birch	048.016.000-005	64.4-69.4
McKay Cr.	051.000	51.3
Umatilla River	051	51.3
Pendleton Acc. Pond	056	56.3
Cottonwood Cr.	066.000	65.6
Moonshine Cr.	067.000	67.5
Minthorn Cr.	064	63.8
Thorn Hollow Acc. Pond	071	70.6
Buckaroo Cr.	073.000-01	72.7
Pearson Cr.	048.016.011	75.6
Imeques Acc. Pond	080	80
CTUIR Umatilla River Screw Trap	081.000	81.7
Squaw Cr.	077.000	76.7
Meacham Cr.	079.000	78.9
Imeques Acclimation Pond	080.000	79.5
Bonifer Springs Acc. Pond on Meacham Cr.	081	81.3
Umatilla River	083.0	82.9

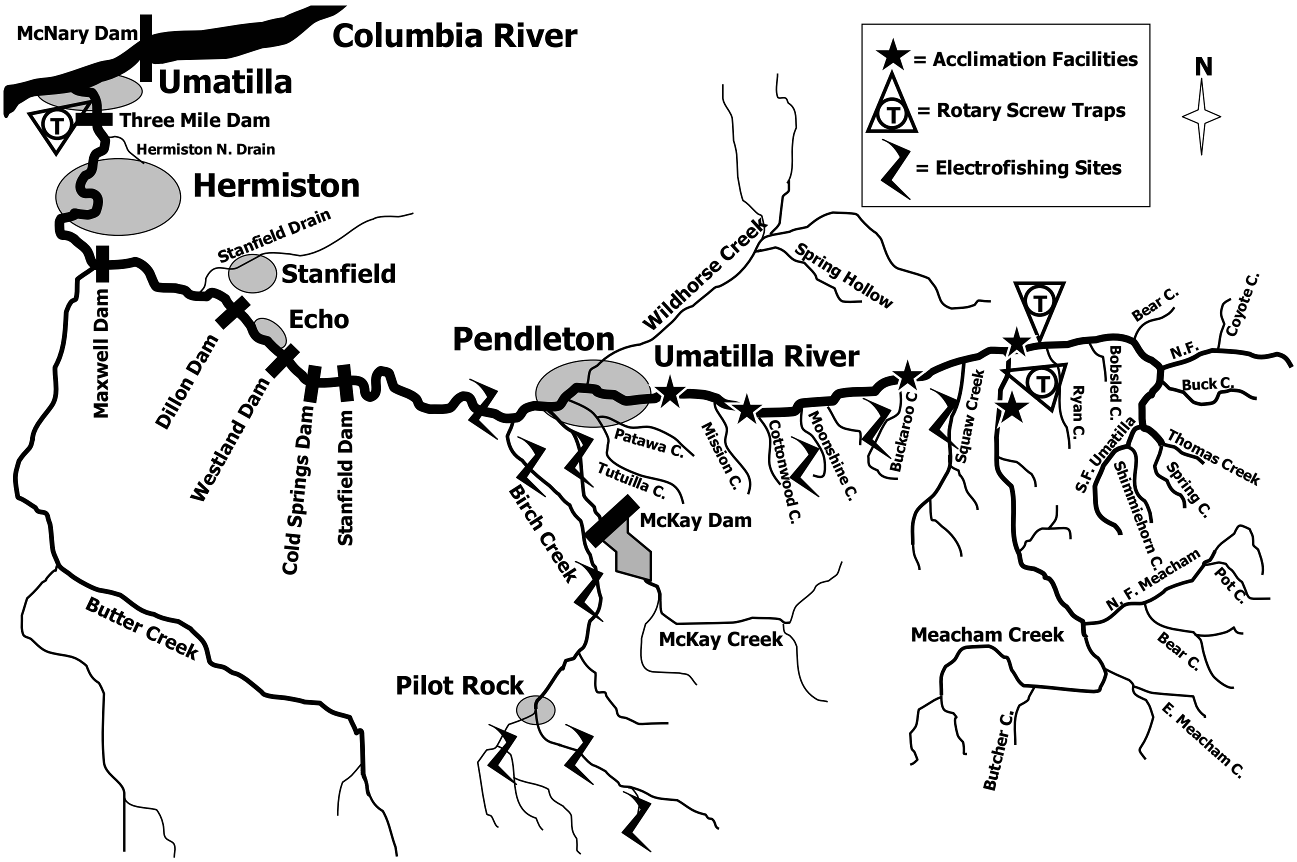


Figure 3-2. Release locations of juvenile natural salmonids PIT tagged in the Umatilla Basin (1999-2002).

ODFW, with the assistance of CTUIR, supplements tagging of summer steelhead, Chinook, and coho at the West Extension canal bypass at Three Mile Dam and at their screw trap at RM 1.2 (Figure 3-2). Spring Chinook juveniles are not distinguishable from fall Chinook juveniles as they pass these collection points in the lower Umatilla River. Lengths are available only for a portion of the fish tagged by ODFW. Both CTUIR and ODFW submit the appropriate tagging information to PSMFC for incorporation into the comprehensive PIT tag data base.

Releases

Steelhead were the dominant species PIT tagged and released in each of the four years (Figure 3-3). Most of the tagging took place at Three Mile Dam and at the screw traps at Meacham Creek and in the mainstem Umatilla River at RM 81 (Figure 3-4). Some fish captured at the screw trap at RM 81 were held for a short time and released at Imeques Acclimation Pond (RM 80).

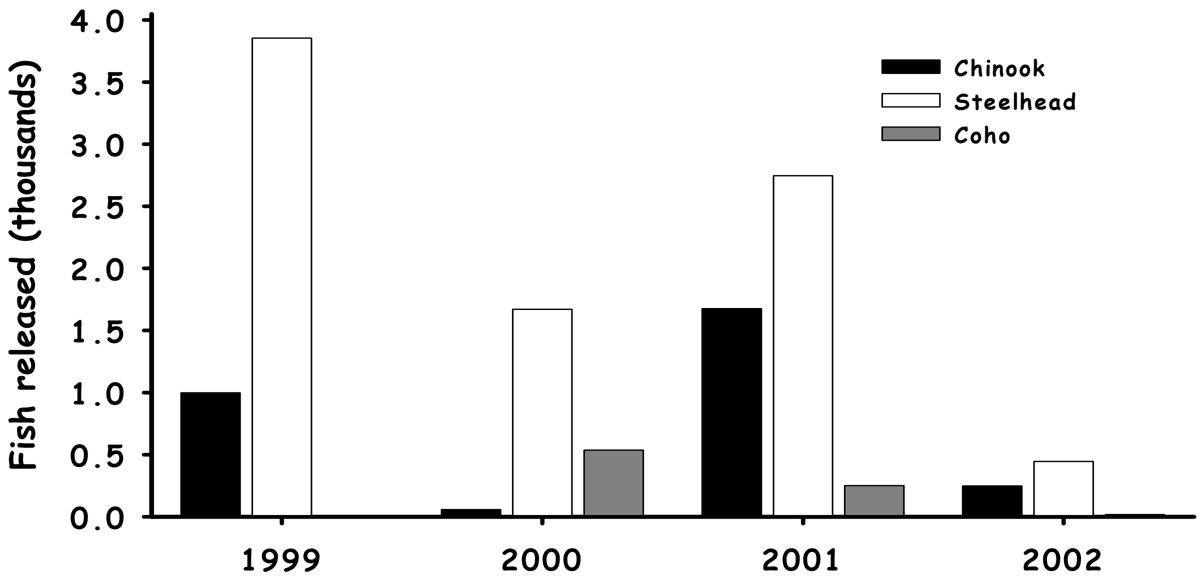


Figure 3-3. Number of natural Chinook, steelhead and coho that were PIT tagged and released each year in the Umatilla Basin.

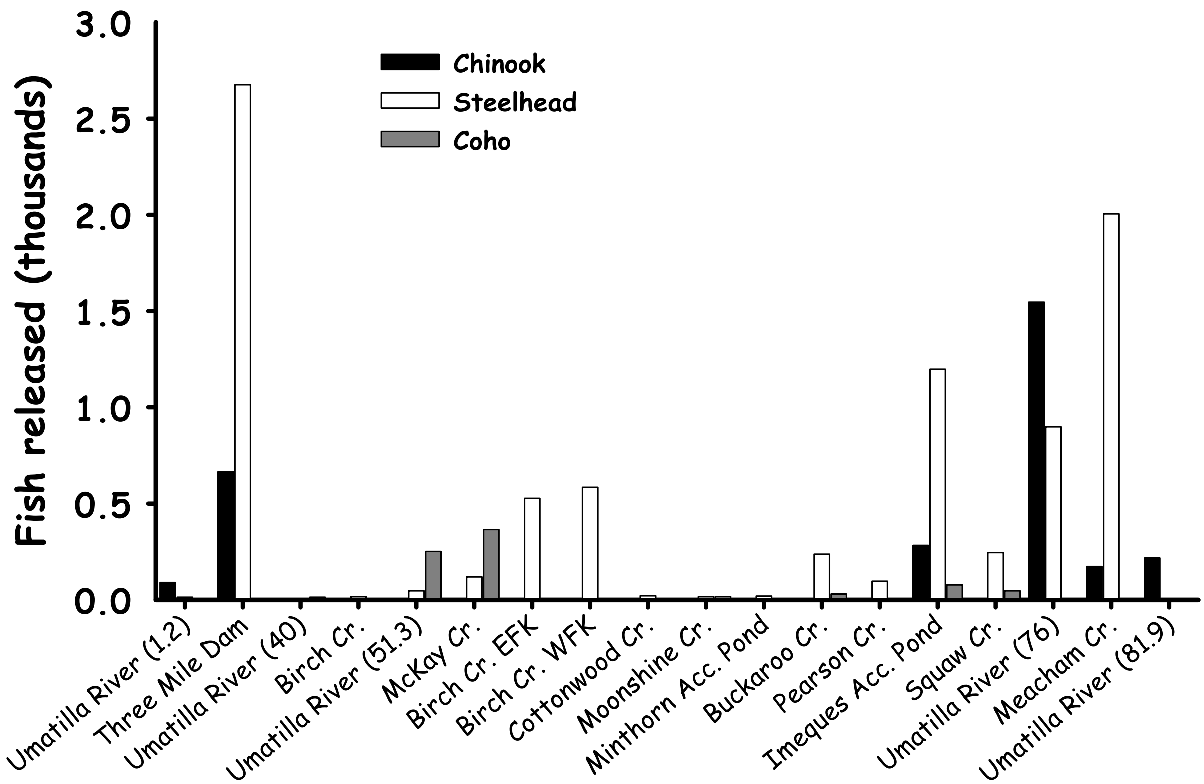


Figure 3-4. Number of natural Chinook, steelhead and coho that were PIT tagged and released for all years combined by release location. River miles are in parenthesis for mainstem sites

Steelhead

The CTUIR and ODFW PIT-tagged 8,718 natural steelhead for the migration years 1999-2002 (Table 3-3-2). These fish were captured and released at 14 different locations in the Umatilla Basin. Fish were generally tagged in November through June in each migration year. Yearly numbers of steelhead tagged by capture method, location and month are presented in Table 3-3-3. Fork lengths of PIT-tagged natural steelhead generally ranged from 100-180mm, except at Three Mile Dam, where, measured and PIT-tagged, steelhead were 160-200mm (Figure 3-5).

Table 3-3-2. PIT-tagged natural steelhead released by CTUIR and ODFW in the Umatilla Basin by capture method and year.

Migration		**Number of PIT-tagged Steelhead Released**		
Year	Capture Method	**CTUIR**	**ODFW**	**Total**
1999	Bypass Sub-sample	--	1,831	1,831
	Screw Trap	1,307	14	1,321
	Electrofish	703	--	703,
Subtotal		**2,010**	**1,845**	**3,855**
2000	Bypass Sub-sample	98	19	117
	Screw Trap	871	--	871
	Electrofish	683	--	683
Subtotal		**1,652**	**19**	**1671**
2001	Bypass Sub-sample	--	281	281
	Screw Trap	1,887	--	1,887
	Electrofish	578	--	578
Subtotal		**2,465**	**281**	**2,746**
2002	Bypass Sub-sample	--	446	446
Total		**6,127**	**2,591**	**8,718**

Table 3-3-3. PIT-tagged natural steelhead released by the CTUIR and the ODFW in the Umatilla Basin by location, capture method, month and year.

Migration Year	Release Site	Capture Method	River Mile	Month 10	11	12	1	2	3	4	5	6	7	Total
1999	Umatilla River	Screw Trap	1.2	--	--	2	10	1	1	--	--	--	--	14
	Umatilla River	Bypass Canal	3.7	--	--	--	--	--	88	249	1,353	140	1	1,831
	Birch Cr.	Electrofish	48.1	--	--	--	--	--	16	--	--	--	--	16
	Birch Cr. EFK	Electrofish	64.4	--	--	--	--	--	43	97	--	--	--	140
	Birch Cr. WFK	Electrofish	64.4	--	--	--	--	--	52	234	--	--	--	286
	Buckaroo Cr.	Electrofish	72.7	--	--	--	--	--	128	55	--	--	--	183
	Pearson Cr.	Electrofish	75.6	--	--	--	--	--	39	--	--	--	--	39
	Imeques Acc. Pond	Screw Trap	80	--	--	--	3	4	56	116	112	--	--	291
	Squaw Cr.	Electrofish	77.1	--	--	--	--	--	39	--	--	--	--	39
	Meacham Cr.	Screw Trap	78.9	--	--	--	8	--	128	561	309	10	--	1,016
Subtotal				**--**	**--**	**2**	**21**	**5**	**590**	**1,312**	**1,774**	**150**	**1**	**3,855**
2000	Umatilla River	Bypass Canal	3.7	--	--	--	--	--	--	1	108	8	--	117
	McKay Cr.	Electrofish	51.3	--	--	119	--	--	--	--	--	--	--	119
	Birch Cr. EFK	Electrofish	64.4	--	--	--	--	--	--	163	--	--	--	163
	Birch Cr. WFK	Electrofish	64.4	--	--	--	--	--	--	94	--	--	--	94
	Cottonwood Cr.	Electrofish	65.6	--	--	--	--	--	--	21	--	--	--	21
	Moonshine Cr.	Electrofish	67.5	--	--	16	--	--	--	--	--	--	--	16
	Minthorn Cr.	Electrofish	63.8	--	--	19	--	--	--	--	--	--	--	19
	Buckaroo Cr.	Electrofish	72.7	--	--	54	--	--	--	--	--	--	--	54
	Pearson Cr.	Electrofish	75.6	--	--	--	--	--	--	58	--	--	--	58
	Imeques Acc. Pond	Screw Trap*	80	--	--	80	5	--	--	643	179	--	--	907
	Squaw Cr.	Electrofish	77.1	--	34	49	--	--	--	20	--	--	--	103
Subtotal				**--**	**34**	**337**	**5**	**--**	**--**	**1,000**	**287**	**8**	**--**	**1,671**
2001	Umatilla River	Bypass Canal	3.7	--	--	--	--	--	--	2	271	8	--	281
	Umatilla River	Electrofish	51.3	--	--	46	--	--	--	--	--	--	--	46
	Birch Cr. EFK	Electrofish	64.4	--	--	--	224	--	--	--	--	--	--	224
	Birch Cr. WFK	Electrofish	64.4	--	--	--	204	--	--	--	--	--	--	204
	Squaw Cr.	Electrofish	77.1	--	--	--	104	--	--	--	--	--	--	104
	Imeques Acc. Pond	Screw Trap	80	6	24	16	1	38	686	116	11	--	--	898
	Meacham Cr.	Screw Trap	78.9	--	26	24	1	93	845	--	--	--	--	989
Subtotal				**6**	**50**	**86**	**534**	**131**	**1,531**	**118**	**282**	**8**	**--**	**2,746**
2002	Umatilla River	Bypass Canal	3.7	--	--	--	--	--	46	162	220	18	--	**446**
Total				**6**	**84**	**425**	**560**	**136**	**2,167**	**2,592**	**2,563**	**184**	**1**	**8,718**

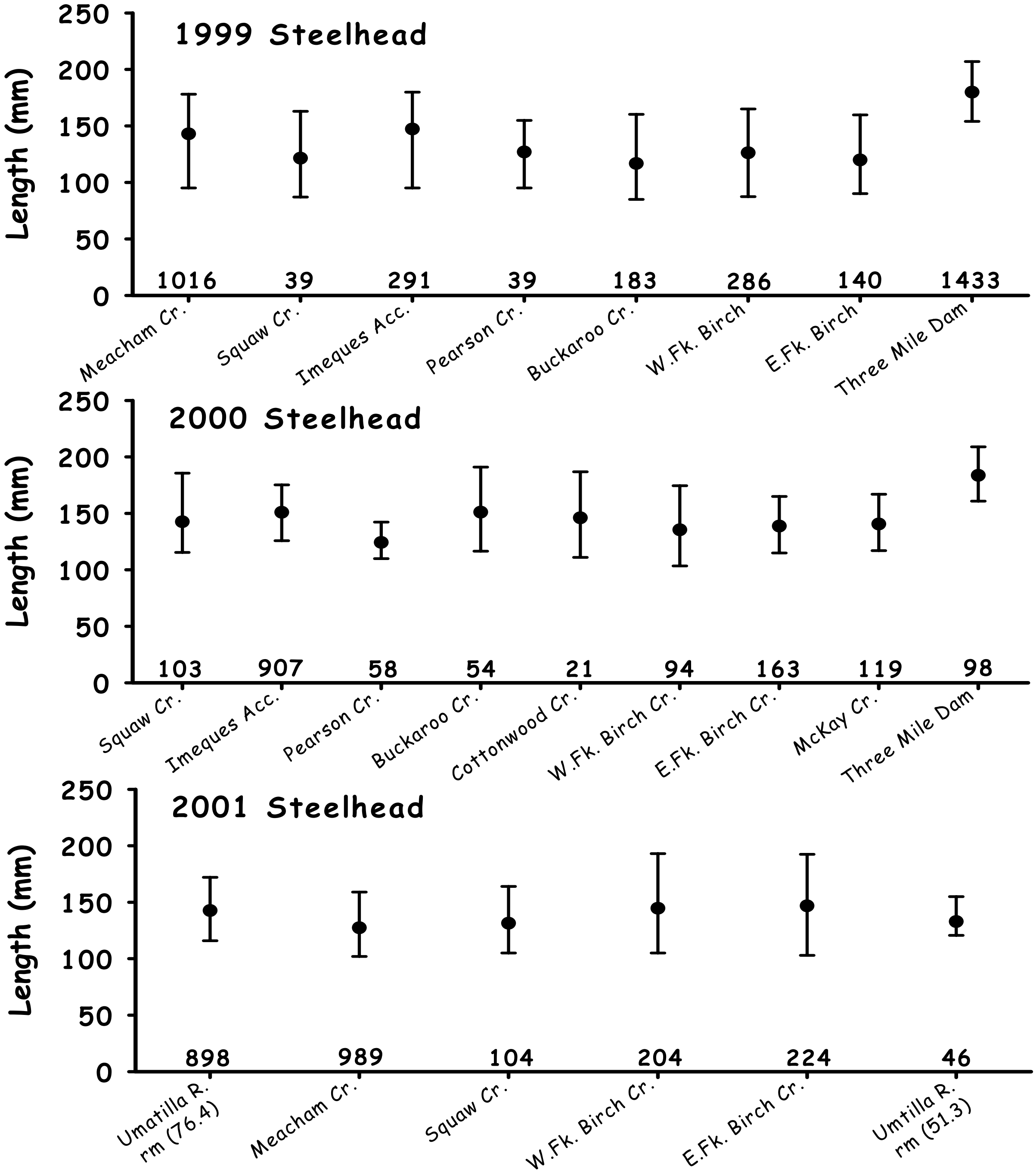


Figure 3-5. Lengths of PIT-tagged natural steelhead released by the CTUIR and the ODFW in the Umatilla Basin by year and location. Points represent mean length and bars indicate the 10th and 90th percentiles. Numbers represent sample size. Data are only presented for locations with 20 or more fish measured.

Chinook

CTUIR and ODFW combined to tag 2,980 natural Chinook salmon, of which a majority (at least 80%) were spring Chinook (Table 3-3-4). Fish were generally tagged in October through May in each migration year (Table 3-3-5).

Table 3-3-4. Number of PIT-tagged natural Chinook released by the CTUIR and the ODFW in the Umatilla Basin by capture method and year.

Migration	Capture	Number of PIT-tagged Chinook Released		
Year	**Method**	**CTUIR**	**ODFW**	**Total**
1999	Bypass Sub-Sample	--	634	634
	Screw Trap	275	90	365
Subtotal		**275**	**724**	**999**
2000	Screw Trap	56	--	56
	Electrofish	1	--	1
Subtotal		**57**	**--**	**57**
2001	Screw Trap	1,671	--	1,671
	Electrofish	5	--	5
Subtotal		**1,676**	**--**	**1,676**
2002	Bypass Sub-Sample	--	31	31
	Electrofish	217	--	217
Subtotal		**217**	**31**	**248**
Total		**2,225**	**755**	**2,980**

Table 3-3-5. Number of PIT-tagged natural Chinook released by the CTUIR and the ODFW in the Umatilla Basin by location, capture method, month, and year.

Migration Year	Release Site	Capture Method	River Mile	Month 10	11	12	1	2	3	4	5	Total
1999	Umatilla River	Screw Trap	1.2	--	--	12	59	--	19	--	--	90
	Umatilla River	Bypass Canal	3.7	--	--	--	--	--	107	394	133	634
	Imeques Acc. Pond	Screw Trap	80	--	--	--	46	109	54	18	--	227
	Meacham Cr.	Screw Trap	78.9	--	--	--	5	6	32	5	--	48
Subtotal				**--**	**--**	**12**	**110**	**115**	**212**	**417**	**133**	**999**
2000	Minthorn Cr.	Electrofish	63.8	--	--	1	--	--	--	--	--	1
	Imeques Acc. Pond	Screw Trap	80	--	--	34	19	--	--	1	2	56
Subtotal				**--**	**--**	**35**	**19**	**--**	**--**	**1**	**2**	**57**
2001	Umatilla River	Electrofish	51.3	--	--	1	--	--	--	--	--	1
	Squaw Cr.	Electrofish	77.5	--	--	--	4	--	--	--	--	4
	Imeques Acc. Pond	Screw Trap	80	86	550	170	45	82	597	15	1	1546
	Meacham Cr.	Screw Trap	78.9	--	29	39	2	11	44	--	--	125
Subtotal				**86**	**579**	**210**	**51**	**93**	**641**	**15**	**1**	**1676**
2002	Umatilla River	Bypass Canal	3.7	--	--	--	--	--	31	--	--	31
	Umatilla River	Electrofish	81.9	217	--	--	--	--	--	--	--	217
Subtotal				**217**	**--**	**--**	**--**	**--**	**31**	**--**	**--**	**248**
Total				**303**	**579**	**257**	**180**	**208**	**884**	**433**	**136**	**2,980**

CTUIR tagged 2,225 natural spring Chinook, and ODFW tagged an additional 2,008 natural Chinook in the same years (Table 3-3-4). 153 of the fish tagged by the ODFW were identified as spring Chinook. The remaining Chinook were unknown race, and it was necessary to determine if these Chinook were yearlings or subyearlings because these age classes have different outmigration patterns. Of the remaining 1,855 Chinook PIT tagged by the ODFW, lengths were only available for 657 of them. We wanted to use as many of these Chinook as possible to increase our potential number of detections. We examined length frequency histograms by month, and seasonal outmigration patterns of Chinook salmon in the Umatilla Basin, and determined that if we only used PIT-tagged fish greater than or equal to 90mm in length, and only used fish PIT tagged between March 1 and May 31, we could be reasonably certain that all of these fish were yearling outmigrants. These criteria allowed us to use 602 additional fish PIT tagged by the ODFW in our analysis of timing and survival for Chinook salmon. Fork lengths of PIT-tagged natural Chinook generally ranged from 85-115mm. There was little variation in average lengths between release locations and years (Figure 3-6).

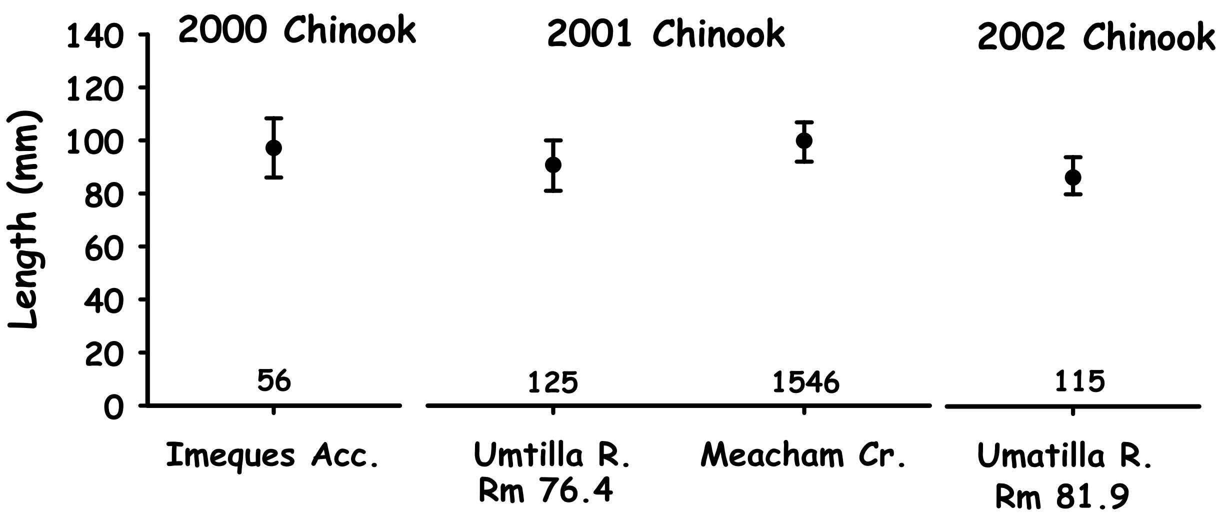


Figure 3-6. Lengths of PIT-tagged natural Chinook released by the CTUIR and the ODFW in the Umatilla Basin by year and location. Points represent mean length and bars indicate the 10th and 90th percentiles. Numbers represent sample size. Data are only presented for locations with 20 or more fish measured.

Coho

The CTUIR and ODFW PIT tagged 805 natural coho for the migration years 2000-2002 (Table 3-6). Fish were generally tagged in November and December and collected by electrofishing (Table 3-7).

Table 3-6. Number of PIT-tagged natural coho released by the CTUIR and the ODFW in the Umatilla Basin by capture method and year.

Migration Year	Capture Method	PIT tags Applied CTUIR	ODFW	Total
2000	Screw Trap	51	--	51
	Electrofish	485	--	485
Subtotal		**536**	**--**	**536**
2001	Electrofish	251	--	251
2002	Bypass Sub-Sample	--	5	5
	Electrofish	13	--	13
Subtotal		**13**	**5**	**18**
Total		**800**	**5**	**805**

Table 3-7. Number of PIT-tagged natural coho released by the CTUIR and the ODFW in the Umatilla Basin by location, capture method, month and year.

Migration Year	Release Site	Capture Method	River Mile	Month 9	11	12	4	5	6	Total
2000	McKay Cr.	Electrofish	51.3	--	--	365	--	--	--	365
	Minthorn Cr.	Electrofish	63.8	--	--	17	--	--	--	17
	Buckaroo Cr.	Electrofish	74.4	--	--	30	--	--	--	30
	Imeques Acc. Pond	Screw Trap*	80	--	--	26	22	29	--	77
	Squaw Cr.	Electrofish	77.1	--	36	5	6	--	--	47
Subtotal				--	**36**	**443**	**28**	**29**	**--**	**536**
2001	Umatilla River	Electrofish	51.3	--	148	103	--	--	--	**251**
2002	Umatilla River	Bypass Canal	3.7	--	--	--	--	--	5	5
	Umatilla River	Electrofish	40	13	--	--	--	--	--	13
Subtotal				**13**	**--**	**--**	**--**	**--**	**5**	**18**
Total				**13**	**184**	**546**	**28**	**29**	**5**	**805**

* Twenty six of these fish were captured by electrofishing

Fork lengths of PIT-tagged natural coho varied depending on year and tag location. Lengths in Squaw Creek and Buckaroo Creek ranged from 75-100mm. At the Imeques Acclimation Pond, McKay Creek, and the Umatilla River (RM 51.3) lengths ranged from 100-150mm (Figure 3-7). Tagging season was primarily in the fall for all locations except at the Imeques Acclimation Pond where 66% of tagging occurred in the spring.

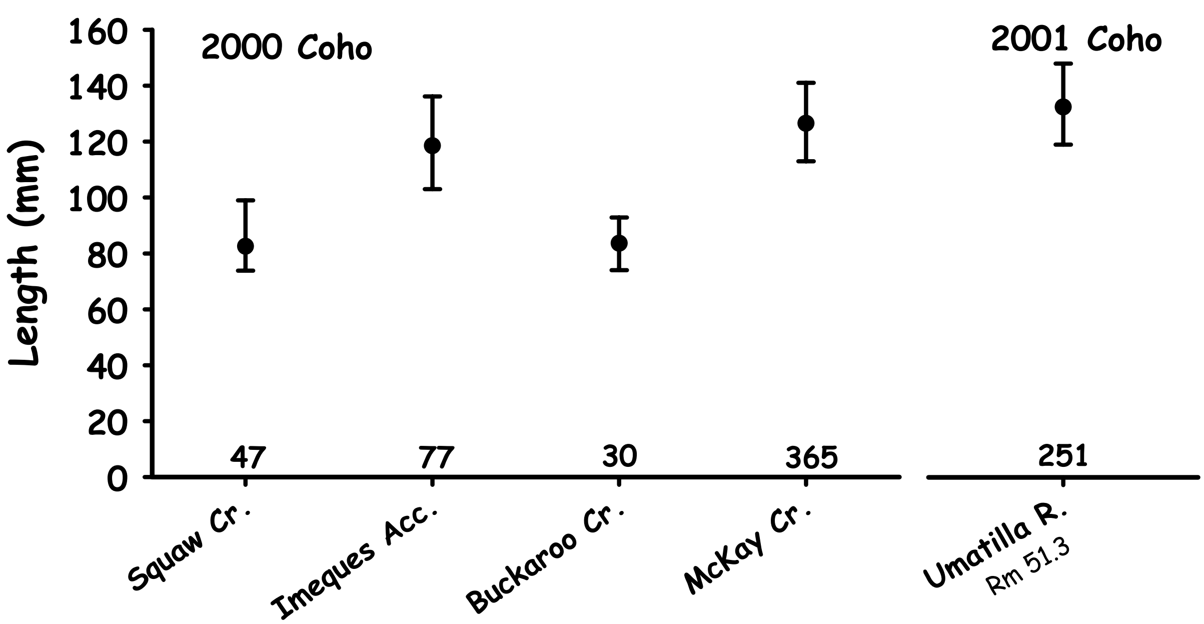


Figure 3-7. Lengths of PIT-tagged natural coho released by CTUIR and ODFW in the Umatilla Basin by year and location. Points represent mean length and bars indicate the 10th and 90th percentiles. Numbers represent sample size. Data are only presented for locations with 20 or more fish measured.

Detections

Steelhead were the most detected species, followed by Chinook and finally coho. Two thousand, seven hundred two (2,702) steelhead were detected in migration years 1999-2002 at Three Mile Dam, John Day Dam, Bonneville Dam and the Columbia River estuary (Table 3-8). Nine hundred one (901) Chinook and 72 coho were detected at the same locations during the same years (Tables 3-9 and 3-10). Detections at John Day Dam were highest for steelhead, followed by Chinook, and then coho (Table 3-8).

Table 3-8. Detections at Three Mile Dam, John Day Dam, Bonneville Dam and the Columbia River estuary of natural steelhead PIT tagged in the Umatilla River. In capture method, B = Bypass canal; E = Electrofishing; S = Screw trap.

Steelhead

Migration Year	Release Site	River Mile	Capture Method	Observation Site				
				Three Mile	**John Day**	**Bonneville**	**Estuary**	**Total**
1999	Umatilla River	3.7	B	382	462	239	19	1,102
	EFK Birch Cr.	64.4	E	7	5	0	0	12
	WFK Birch Cr.	64.4	E	15	9	5	1	30
	Buckaroo Cr.	72.7	E	4	2	1	0	7
	Birch Cr.	75.6	E	0	3	0	0	3
	Pearson Cr.	75.6	E	1	2	1	0	4
	Imeques Acc. Pond	80	S	36	29	13	3	81
	Squaw Cr.	77.1	E	1	0	0	0	1
	Meacham Cr.	78.9	S	105	114	48	3	270
Subtotal				**551**	**626**	**307**	**26**	**1,510**
2000	Umatilla River	3.7	B	28	7	0	2	10
	McKay Cr.	51.3	E	7	5	5	0	16
	EFK Birch Cr.	64.4	E	9	3	3	1	9
	WFK Birch Cr.	64.4	E	3	4	2	0	232
	Moonshine Cr.	67.5	E	0	2	2	0	4
	Minthorn Cr.	63.8	E	2	0	0	0	17
	Buckaroo Cr.	72.7	E	1	6	3	0	2
	Pearson Cr.	75.6	E	3	1	1	0	4
	Imeques Acc. Pond	80	S	127	64	33	8	5
	Imeques Acc. Pond	80	E	3	1	0	0	22
	Squaw Cr.	77.1	E	9	8	5	0	37
Subtotal				**192**	**101**	**54**	**11**	**358**
2001	Umatilla River	3.7	B	73	28	23	1	125
	Umatilla River	51.3	E	1	1	0	0	2
	EFK Birch Cr.	64.4	E	17	17	9	0	43
	WFK Birch Cr.	64.4	E	12	8	5	1	26
	Imeques Acc. Pond	80	S	69	98	63	5	235
	Squaw Cr.	77.5	E	2	6	3	0	11
	Meacham Cr.	78.9	S	49	68	55	6	178
Subtotal				**223**	**226**	**158**	**13**	**620**
2002	Umatilla River	3.7	B	89	83	41	1	214
Total				**1,055**	**1,036**	**560**	**51**	**2,702**

Table 3-9. Detections at Three Mile Dam, John Day Dam, Bonneville Dam and the Columbia River estuary of natural Chinook PIT tagged in the Umatilla River. In capture method, B = Bypass canal; E = Electrofishing; S = Screw trap.

Chinook

Migration Year	Release Location	River Mile	Capture Method	Observation Site Three Mile	John Day	Bonneville	Estuary	Total
1999	Umatilla River	1.2	S	0	11	6	2	19
	Umatilla River	3.7	B	188	132	84	5	409
	Imeques Acc. Pond	80	S	29	29	12	0	70
	Meacham Creek	78.9	S	8	9	5	1	23
Subtotal				**225**	**181**	**107**	**8**	**521**
2000	Minthorn Cr.	63.8	E	0	1	0	0	1
	Imeques Acc. Pond	80	S	1	4	5	0	10
Subtotal				**1**	**5**	**5**		**11**
2001	Imeques Acc. Pond	80	S	68	168	83	9	328
	Squaw Creek	77.5	E	1	0	0	0	1
	Meacham Creek	78.9	S	1	9	7	1	18
Subtotal				**70**	**177**	**90**	**10**	**347**
2002	Umatilla River	3.7	B	1	5	2	0	8
	Umatilla River	40	E	6	6	2	0	14
Subtotal				**7**	**11**	**4**	**0**	**22**
Total				**303**	**374**	**206**	**18**	**901**

Table 3-10. Detections at Three Mile Dam, John Day Dam, Bonneville Dam and the Columbia River estuary of natural coho PIT tagged in the Umatilla River. In capture method, B = Bypass canal; E = Electrofishing; S = Screw trap.

Coho

Migration Year	Release Site	River Mile	Capture Method	Observation Site Three Mile	John Day	Bonneville	Estuary	Total
2000	Buckaroo Cr.	72.7	E	2	0	0	0	2
	Imeques Acc. Pond	80	S	12	3	1	0	16
	Imeques Acc. Pond	80	E	3	3	3	0	9
	McKay Cr.	51.3	E	13	3	7	0	23
	Minthorn Cr.	63.8	E	1	0	1	0	2
	Squaw Cr.	77.1	E	5	3	0	0	8
Subtotal				**36**	**12**	**12**	**0**	**60**
2001	Umatilla River	51.3	E	2	6	4	0	12
Total				**38**	**18**	**16**	**0**	**72**

Methods

Detection Locations and Probabilities

PIT-tagged fish released in the Umatilla Basin pass three dams with PIT-tag detection facilities on their way to the Pacific Ocean. Three Mile Dam, John Day Dam, and Bonneville Dam are equipped with remote PIT tag detection capabilities. Only those PIT-tagged fish that entered the bypass system can be detected. PIT-tagged fish passing through the turbines or over the spillway do not pass tag detectors and are therefore not detected. In order to estimate survival with any degree of certainty, it is necessary to estimate what proportion of fish passing a particular dam were susceptible to detection at the time of passage.

We used methods described by Cramer et al. (1995) and improved by Neeley (1996) for estimating detection probability at John Day Dam. This method uses PIT-tagged fish of the same species from all sources to estimate the proportion detected during a specified time period. The more traditional Cormack-Jolly-Seber method uses the detections of fish of a particular release group as they arrive at Bonneville Dam to determine the proportion that were previously detected as they passed John Day Dam. We believe the Cramer et al (1995) method is more accurate, because it incorporates the changing detection probabilities at John Day Dam over time, rather than using an average for a range of detection probabilities the fish actually experienced. As an added benefit, our method allows for use of a much larger data set to estimate detection probability, because all PIT-tagged fish approaching the John Day Dam can be included, rather than just those fish starting at a given location and date. All fish of the same species approaching John Day Dam experience similar conditions as they move downstream, and thus are properly included in estimating probability of being detected by the detectors in place there. This increased the number of detections by over 100 fold that we could use to estimate detection probabilities for each species. The ability to use other releases to calculate detection probabilities has added value because of the low release numbers used in this analysis.

We estimated detection probabilities at John Day Dam using detections at Bonneville Dam. All PIT-tagged fish reaching Bonneville Dam had to pass John Day Dam, so the tagged fish detected at Bonneville Dam were used to determine the percentage of PIT-tagged fish that had been detected upstream at John Day Dam as they passed there. This percentage was an estimate of the detection probability at John Day Dam. The estimation of detection probability can be described by the following equation:

> Detection Probability equals the number of detections at Bonneville Dam previously detected at John Day Dam divided by the total Bonneville Dam Detections.

The proportion of fish subject to detection may change from day to day, as environmental conditions change at the dam, especially proportion of flow spilled. For instance, daily detection probability estimates of summer steelhead at John Day Dam in 2001 ranged from 10% to 81% among days when 10 or more PIT tags were detected at both John Day-Bonneville Dams. By examining detections of PIT-tagged fish downstream from John Day Dam it is possible to come up with a day-by-day of week-by-week estimate of the detection probability at John Day Dam.

We estimated detection probabilities for distinct passage periods. Because fish from any group starting on a single day at any upstream site in the Umatilla Basin arrive at John Day Dam over a period of several weeks, the fish in the release group experience different conditions as they pass John Day Dam, and may pass during times of differing detection probability.

We estimated daily collection efficiencies separately for summer steelhead, spring Chinook and coho at John Day Dam for 1999 – 2002, and then aggregated the estimates over periods of homogeneous conditions at the dam. We attempted to aggregate over periods resulting in large enough sample sizes to provide useful confidence bounds on our estimates, while also keeping the period short enough that collection efficiencies would be relatively homogeneous within the period. We set the dividing dates between periods of similar detection probability according to two criteria: (1) the number of PIT tags detected at both John Day Dam and Bonneville Dam was at least 15 for the period, and (2) there was no trend of change in daily estimates of detection probability. The number of detections criterion was given priority over the trend change in probability criterion. Counts of PIT-tagged fish detected at John Day Dam are expanded by referencing the probability of detection at John Day Dam at the time the fish actually passed.

For a more thorough explanation of the methods used for estimating detection probability, see appendix A.

Data Analysis

All releases of PIT-tagged steelhead, Chinook, and coho in the Umatilla Basin and all detections at Three Mile Dam, John Day Dam, and Bonneville Dam and the Columbia River estuary from migration years 1999-2002 were downloaded from the PSMFC database.

We estimated survival to and passage timing at John Day Dam for natural and hatchery PIT-tagged release groups. We expanded the number of PIT-tagged fish detected at John Day Dam according to the estimated detection efficiency at John Day Dam for when fish were detected.

Survival Estimates

For the number of PIT-tagged juveniles released at upstream locations, survival between Umatilla Basin release sites and John Day Dam was estimated by dividing the expanded number of PIT tags estimated to pass at John Day Dam by total number of PIT-tagged fish in the release group.

$\text{Survival} = {}_{I}(\text{Detections}_{IJ}\ /\text{Detection Efficiency})/\text{Tagged}_{I}$

Where:	Detections	= Number of PIT tags detected at John Day
	Detection Efficiency	= Proportion of PIT tags detected at John Day Dam
	Tagged	= Number of PIT-tagged fish released
	I	= Group of interest
	J	= Period of detection

Methods for calculating the standard error and confidence intervals on survival estimates are described by Neely 1996.

Release Groups

We estimated and compared passage timing and survival to John Day Dam for numerous Umatilla Basin release groups within each species. Release groups were defined by isolating factors likely to influence timing and survival. Factors evaluated include:

1) species
2) run
3) migration year
4) rearing origin
5) release location
6) release date
7) length at tagging
8) collection method

Previous studies have indicated that these factors may influence migration timing or survival (Beamesderfer et al. 2001, Monzyk et al 2000). Each release group was assigned a unique code. Throughout the report, release groups are identified by their code and defining criteria.

We maximized the number of valid comparisons were could make to evaluate the effects of the above listed parameters. The PIT tagging activities were not designed to specifically address these effects and thus the number and size of groups we could compare was limited by the nature of the release data.

Statistical Analysis

We performed a Kruskal-Wallis test on the dates of detection, expressed as day of the year, to test for significant differences between migration timing ($\alpha = 0.05$). We chose this test because the pattern of migration timing was not normally distributed in most instances. The Kruskal-Wallis test ranks observations lowest to highest and tests the null hypothesis that the medians of the two samples are equal.

Comparisons of survival rate estimates were evaluated using the t-test for two independent samples. Our approximate t-test was run using the pooled variances of samples being compared. We say “approximate” because the individual variances of each survival rate are approximate (Neeley 1996).

RESULTS AND DISCUSSION

Detection Probability Periods

Detection probabilities at John Day Dam for each species were calculated separately using detections at both John Day and Bonneville Dams. PIT tag detections from releases made throughout the Columbia Basin upstream of the Umatilla River were used to estimate detection probabilities at John Day Dam.
Detections at Bonneville Dam were high enough in each year (1999-2002) to estimate detection probability at John Day Dam for several periods per year for steelhead and Chinook (Figure 3-8). Bonneville Dam detections of coho were not as high, and limited the number of detection probability periods that could be delineated at John Day Dam.

Detection probabilities at John Day Dam varied to different degrees depending on date, year and species. Detection probabilities for each species and each detection period can be found in Tables 3-11 through 3-13.

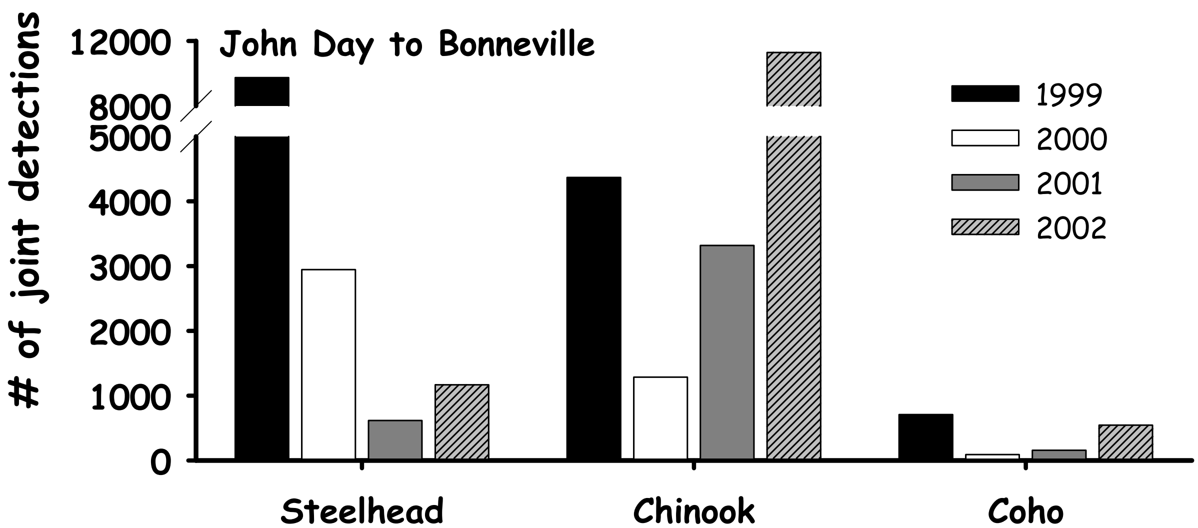


Figure 3-8. Number of PIT-tagged fish detected jointly between dams, and used to calculate detection probabilities at John Day Dam for migration years 1999-2002. Joint detections between John Day and Bonneville dams include fish PIT-tagged throughout the Columbia Basin

Table 3-11. Steelhead detection probability periods at John Day Dam

John Day Dam Detection Probability Periods (Steelhead)

1999

Begin Date	End Date	Detection Probability
1/1/1999	4/24/1999	0.22
4/25/1999	4/28/1999	0.21
4/29/1999	5/1/1999	0.12
5/2/1999	5/20/1999	0.29
5/21/1999	5/22/1999	0.35
5/23/1999	5/30/1999	0.39
5/31/1999	6/3/1999	0.33
6/4/1999	6/6/1999	0.43
6/7/1999	6/20/1999	0.29
6/21/1999	6/26/1999	0.42
6/27/1999	6/30/1999	0.25
7/1/1999	12/31/1999	0.10

2000

Begin Date	End Date	Detection Probability
1/1/2000	4/13/2000	0.66
4/14/2000	4/18/2000	0.38
4/19/2000	5/4/2000	0.26
5/5/2000	5/7/2000	0.19
5/8/2000	5/17/2000	0.14
5/18/2000	12/31/2000	0.08

2001

Begin Date	End Date	Detection Probability
1/1/2001	4/30/2001	0.80
5/1/2001	5/17/2001	0.66
5/18/2001	5/19/2001	0.51
5/20/2001	5/24/2001	0.66
5/25/2001	5/25/2001	0.28
5/26/2001	6/21/2001	0.11
6/22/2001	7/29/2001	0.29

2002

Begin Date	End Date	Detection Probability
1/1/2002	4/21/2002	0.45
4/22/2002	4/26/2002	0.20
4/27/2002	4/30/2002	0.09
5/1/2002	5/5/2002	0.23
5/6/2002	5/18/2002	0.11
5/19/2002	5/22/2002	0.20
5/23/2002	5/27/2002	0.05
5/28/2002	5/29/2002	0.19
5/30/2002	6/9/2002	0.06
6/10/2002	6/11/2002	0.20
6/12/2002	6/16/2002	0.31
6/17/2002	7/2/2002	0.10
7/3/2002	12/31/2002	0.39

Table 3-12. Chinook detection probability periods at John Day Dam.

John Day Dam Detection Probabilities (Chinook)

1999		
Begin Date	**End Date**	**Detection Probability**
1/1/1999	4/24/1999	0.30
4/25/1999	4/25/1999	0.16
4/26/1999	4/28/1999	0.34
4/29/1999	4/29/1999	0.22
4/30/1999	5/1/1999	0.07
5/2/1999	5/3/1999	0.23
5/4/1999	5/6/1999	0.29
5/7/1999	5/9/1999	0.21
5/10/1999	5/10/1999	0.31
5/11/1999	5/11/1999	0.36
5/12/1999	5/12/1999	0.30
5/13/1999	5/15/1999	0.20
5/16/1999	5/16/1999	0.28
5/17/1999	5/18/1999	0.33
5/19/1999	5/24/1999	0.20
5/25/1999	5/31/1999	0.14
6/1/1999	6/1/1999	0.23
6/2/1999	6/4/1999	0.30
6/5/1999	6/7/1999	0.39
6/8/1999	6/16/1999	0.27
6/17/1999	6/19/1999	0.26
6/20/1999	6/28/1999	0.35
6/29/1999	12/31/1999	0.14

2000		
Begin Date	**End Date**	**Detection Probability**
1/1/2001	5/8/2001	0.60
5/9/2001	5/11/2001	0.61
5/12/2001	5/14/2001	0.49
5/15/2001	5/21/2001	0.56
5/22/2001	5/23/2001	0.41
5/24/2001	5/24/2001	0.63
5/25/2001	5/25/2001	0.29
5/26/2001	5/28/2001	0.06
5/29/2001	5/29/2001	0.13
5/30/2001	6/1/2001	0.23
6/2/2001	6/4/2001	0.15
6/5/2001	6/6/2001	0.29
6/7/2001	6/9/2001	0.42
6/10/2001	6/14/2001	0.28
6/15/2001	6/17/2001	0.39
6/18/2001	6/19/2001	0.70
6/20/2001	12/31/2001	0.74

2000		
Begin Date	**End Date**	**Detection Probability**
1/1/2000	4/14/2000	0.57
4/15/2000	4/16/2000	0.50
4/17/2000	4/19/2000	0.36
4/20/2000	4/28/2000	0.30
4/29/2000	5/1/2000	0.36
5/2/2000	5/3/2000	0.32
5/4/2000	5/5/2000	0.24
5/6/2000	5/9/2000	0.17
5/10/2000	5/15/2000	0.08
5/16/2000	12/31/2000	0.03

2000		
Begin Date	**End Date**	**Detection Probability**
1/1/2002	4/25/2002	0.30
4/26/2002	5/1/2002	0.23
5/2/2002	5/8/2002	0.32
5/9/2002	5/9/2002	0.26
5/10/2002	5/13/2002	0.14
5/14/2002	5/14/2002	0.32
5/15/2002	5/15/2002	0.35
5/16/2002	5/16/2002	0.28
5/17/2002	5/17/2002	0.24
5/18/2002	5/18/2002	0.16
5/19/2002	5/20/2002	0.10
5/21/2002	5/21/2002	0.15
5/22/2002	5/22/2002	0.23
5/23/2002	5/23/2002	0.28
5/24/2002	5/24/2002	0.22
5/25/2002	5/25/2002	0.17
5/26/2002	5/27/2002	0.13
5/28/2002	5/28/2002	0.24
5/29/2002	5/29/2002	0.32
5/30/2002	5/30/2002	0.38
5/31/2002	5/31/2002	0.40
6/1/2002	6/1/2002	0.31
6/2/2002	6/2/2002	0.23
6/3/2002	6/8/2002	0.17
6/9/2002	6/10/2002	0.28
6/11/2002	6/13/2002	0.23
6/14/2002	6/14/2002	0.38
6/15/2002	6/17/2002	0.26
6/18/2002	12/31/2002	0.33

Table 3-13. Coho detection probability periods at John Day Dam.

John Day Dam Detection Probability Periods (Coho)

1999		
Begin Date	**End Date**	**Detection Probability**
1/1/1999	5/8/1999	0.09
5/9/1999	5/15/1999	0.12
5/16/1999	5/29/1999	0.16
5/30/1999	6/1/1999	0.35
6/2/1999	6/5/1999	0.46
6/6/1999	6/6/1999	0.65
6/7/1999	6/19/1999	0.41
6/20/1999	6/26/1999	0.55
6/27/1999	12/31/1999	0.15

2000		
Begin Date	**End Date**	**Detection Probability**
1/1/2000	5/25/2000	0.22
5/26/2000	12/31/2000	0.09

2001		
Begin Date	**End Date**	**Detection Probability**
1/1/2001	5/20/2001	0.46
5/21/2001	5/26/2001	0.26
5/27/2001	6/14/2001	0.15
6/15/2001	6/20/2001	0.30
6/21/2001	12/31/2001	0.59

2002		
Begin Date	**End Date**	**Detection Probability**
1/1/2002	5/14/2002	0.32
5/15/2002	6/7/2002	0.13
6/8/2002	6/12/2002	0.20
6/13/2002	12/31/2002	0.31

Joint detections by John Day Dam passage date for all three species can be found in Appendix B.

Steelhead

Several groups of steelhead used for evaluating timing and survival had fish detected at John Day Dam one full year after their expected migration year (Table 3-14)). In most instances these late migrants comprised a small proportion of the release group. These fish reared an extra year in the Umatilla River and incurred a mortality not incurred by others in their release group. We did not include these fish in analysis of John Day Dam passage timing. We did, however, incorporate these fish in survival rate estimates because they reflect a life history expressed by portions of steelhead populations throughout the interior Columbia Basin.

Table 3-14. Release groups with steelhead that outmigrated one year after expected, and proportion of total expanded John Day Dam detections comprised by those fish.

Release Group	Migration Year	Rear Type	Release Locations	Release Dates	Length (mm)	Expanded # Detected the Following Yr.	% of Total Expanded Detections
STH 3	2000	N	All	All	All	8	1.2
STH 4	2000	H	All	All	All	2	0.1
STH 5	2001	N	All	All	All	18	3.9
STH 6	2001	H	All	All	All	12	0.6
STH 21	2001	N	Meacham Cr. Trap	11/1-3/31	All	18	15

Steelhead Timing

We defined 19 release groups of steelhead that allowed us to examine effects of hatchery vs. natural origin, year, and release location on timing of passage at John Day Dam. We also examined the effects of length at release on timing. Release groups were defined after carefully examining release numbers by year, location, date of release and capture method.

Effects of Origin on Timing

Natural fish tended to pass John Day Dam earlier than hatchery fish in 2001 and 2002, and at similar times as hatchery fish in 1999 and 2000. Sixteen of the 19 release groups defined for steelhead were used to compare passage timing of natural and hatchery fish. In each comparison, the migration year was the same in both release groups. In four of the comparisons, we compared timing for all releases of natural and hatchery steelhead within that year. In the other four comparisons, we held other factors including sample location, sample method, and release date constant because tagging season and locations were not consistent between hatchery and natural steelhead (Table 3-15). Hatchery steelhead were generally released later in the season and lower in the watershed (Figure 3-9, Figure 3-10). These factors could influence both timing and survival.

Table 3-15. Group codes, descriptions, descriptive timing statistics and comparative statistics of steelhead release groups used for examining effects of origin on John Day Dam passage timing. Thin lines separate compared groups.

Release Group	Migration Year	Rear Type	Release Locations	Release Dates	Length (mm)	Median Detection Date	First Detections Date	Last Detection Date	Median Comparison P-Value
Natural Vs. Hatchery Groups									
STH 1	1999	N	All	All	All	17-May	1-Apr	27-Jun	0.684
STH 2	1999	H	All	All	All	18-May	18-Apr	21-Jun	
STH 3	2000	N	All	All	All	7-May	6-Apr	5-Jun	0.642
STH 4	2000	H	All	All	All	10-May	12-Apr	11-Jun	
STH 5	2001	N	All	All	All	6-May	31-Mar	27-Jun	0.00
STH 6	2001	H	All	All	All	21-May	12-Apr	14-Jul	
STH 7	2002	N	All	All	All	1-May	3-Apr	5-Jun	0.002
STH 8	2002	H	All	All	All	17-May	19-Apr	16-Jun	
STH 9	1999	N	Three Mile Dam	3/1-6/30	All	17-May	1-Apr	22-Jun	0.298
STH 27	1999	H	Three Mile Dam	4/20-6/2	All	20-May	23-Apr	14-Jun	
STH 54	2000	N	Imeques Acc. Pond	4/1-5/31	All	3-May	11-Apr	5-Jun	0.338
STH 55	2000	H	Bonifer Acc. Pond	4/10-4/12	All	9-May	15-Apr	6-Jun	
STH 49	2001	N	Three Mile Dam	4/1-6/30	All	22-May	10-May	26-Jun	0.332
STH 29	2001	H	ODFW Trap and Three Mile Dam	5/1-5/31	All	20-May	11-May	9-Jun	
STH 52	2001	N	CTUIR Mainstem Trap	3/1-5/31	All	2-May	31-Mar	1-Jun	0.00
STH 53	2001	H	Bonifer Acc. Pond	4/3-4/7	All	20-May	18-Apr	3-Jul	

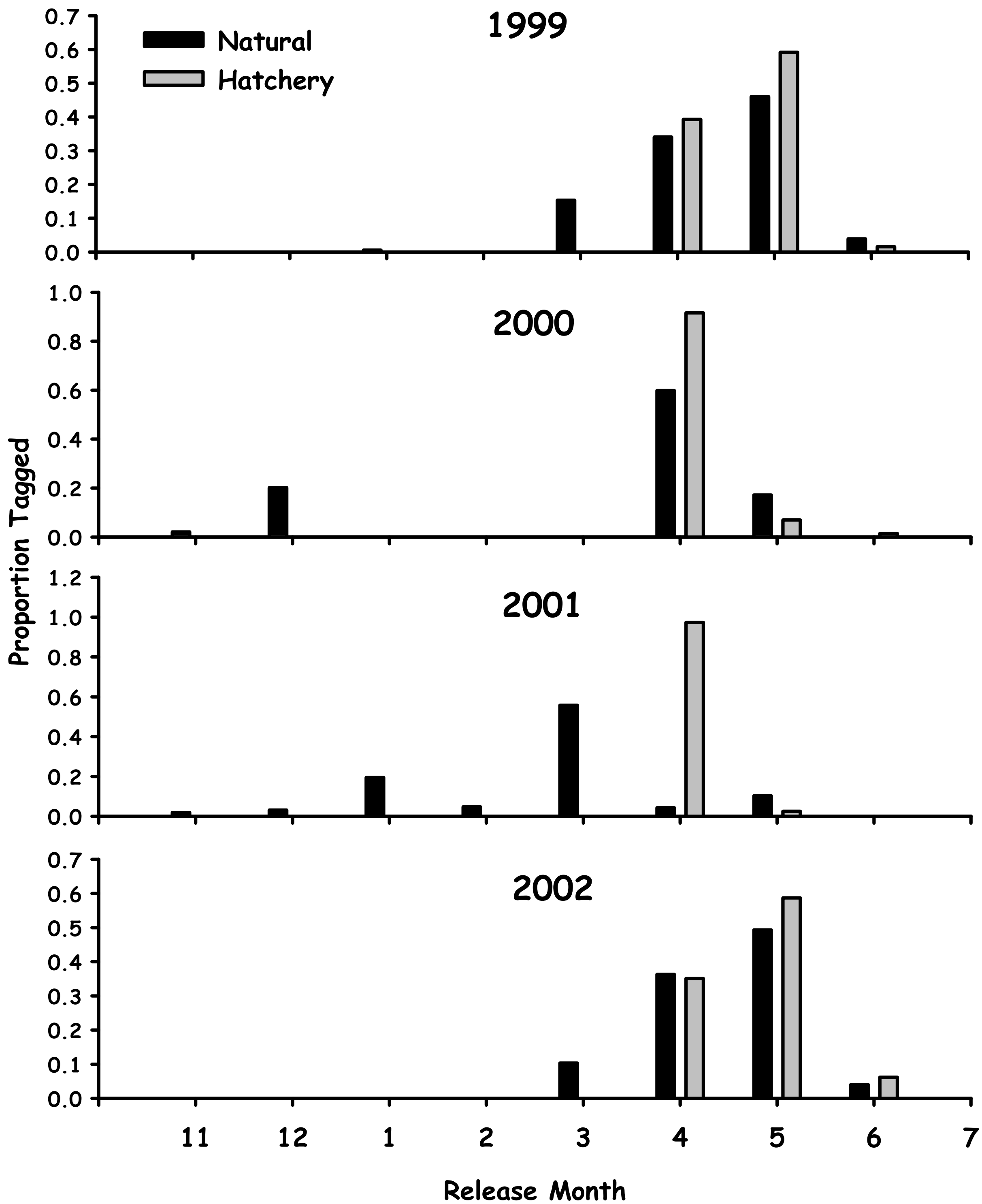


Figure 3-9. Proportion of natural and hatchery steelhead tagged by month in the Umatilla Basin for each migration year analyzed.

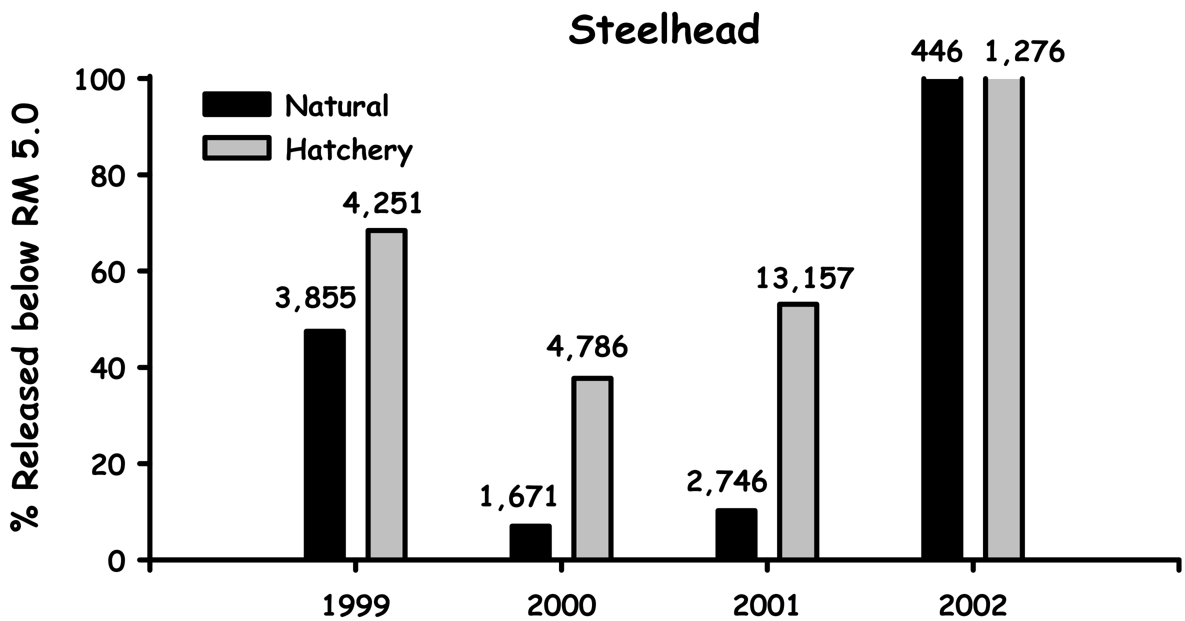


Figure 3-10. Proportion of natural and hatchery steelhead released in the lower five miles of the Umatilla River by year. Steelhead not released in the lower five miles were generally released at RM 40.0 or higher.

Significant differences of median passage date were found in 3 of the 8 comparisons. No significant differences were found in comparisons in migration year 1999 and 2000 release groups. Significant differences were found in 3 of 4 comparisons utilizing release groups in 2001 and 2002 (Table 3-15). In all three comparisons where differences were significant, median detection dates for natural fish were earlier than hatchery fish median detection dates (Table 3-15).

We also calculated dates where 10%, 50%, and 90% of the release group had passed John Day Dam. In the same comparison groups as above, 50% of natural steelhead passed before hatchery steelhead in 4 of 8 instances, and in all instances where median passage dates were significantly different. Again, passage timing did not differ between hatchery and natural steelhead in 1999 and 2000, but in 2001 and 2002 natural fish tended to pass John Day Dam earlier (Table 3-16, Figure 3-11).

Table 3-16. Group codes, descriptions, and 10th, 50th, and 90th percentile dates of expanded detections past John Day Dam steelhead groups used for examining effects of origin on John Day passage timing. Thin lines separate compared groups.

Release Group	Migr. Year	Rear Type	Release Location	Rel. Date	Length (mm)	# of Detections	Date Passed 10th	Date Passed 50th	Date Passed 90th	Days between 10th and 90th
Natural Vs. Hatchery Groups										
STH 1	1999	N	All	All	All	626	4/24	5/23	6/6	43
STH 2	1999	H	All	All	All	673	4/24	5/22	6/5	42
STH 3	2000	N	All	All	All	95	4/19	5/24	6/1	43
STH 4	2000	H	All	All	All	197	4/25	5/18	6/4	40
STH 5	2001	N	All	All	All	220	4/24	5/14	6/4	41
STH 6	2001	H	All	All	All	788	5/6	5/23	6/9	34
STH 7	2002	N	All	All	All	83	4/17	5/14	5/29	42
STH 8	2002	H	All	All	All	102	5/8	5/23	6/2	25
STH 9	1999	N	Three Mile Dam	3/1-6/30	All	462	4/24	5/23	6/5	42
STH 27	1999	H	Three Mile Dam	4/20-6/2	All	369	5/4	5/26	6/6	33
STH 54	2000	N	CTUIR Mainstem Trap	4/1-5/31	All	63	4/19	5/24	5/28	39
STH 55	2000	H	Bonifer Acc. Pond	4/10-4/12	All	30	4/28	5/14	5/26	28
STH 49	2001	N	Three Mile Dam	4/1-6/30	All	27	5/13	5/27	6/8	26
STH 29	2001	H	ODFW Trap & Three Mile Dam	5/1-5/31	All	77	5/13	5/26	6/1	19
STH 52	2001	N	CTUIR Mainstem Trap	3/1-5/31	All	92	4/21	5/10	5/29	38
STH 53	2001	H	Bonifer Acc. Pond	4/3-4/7	All	64	5/8	5/29	6/20	43

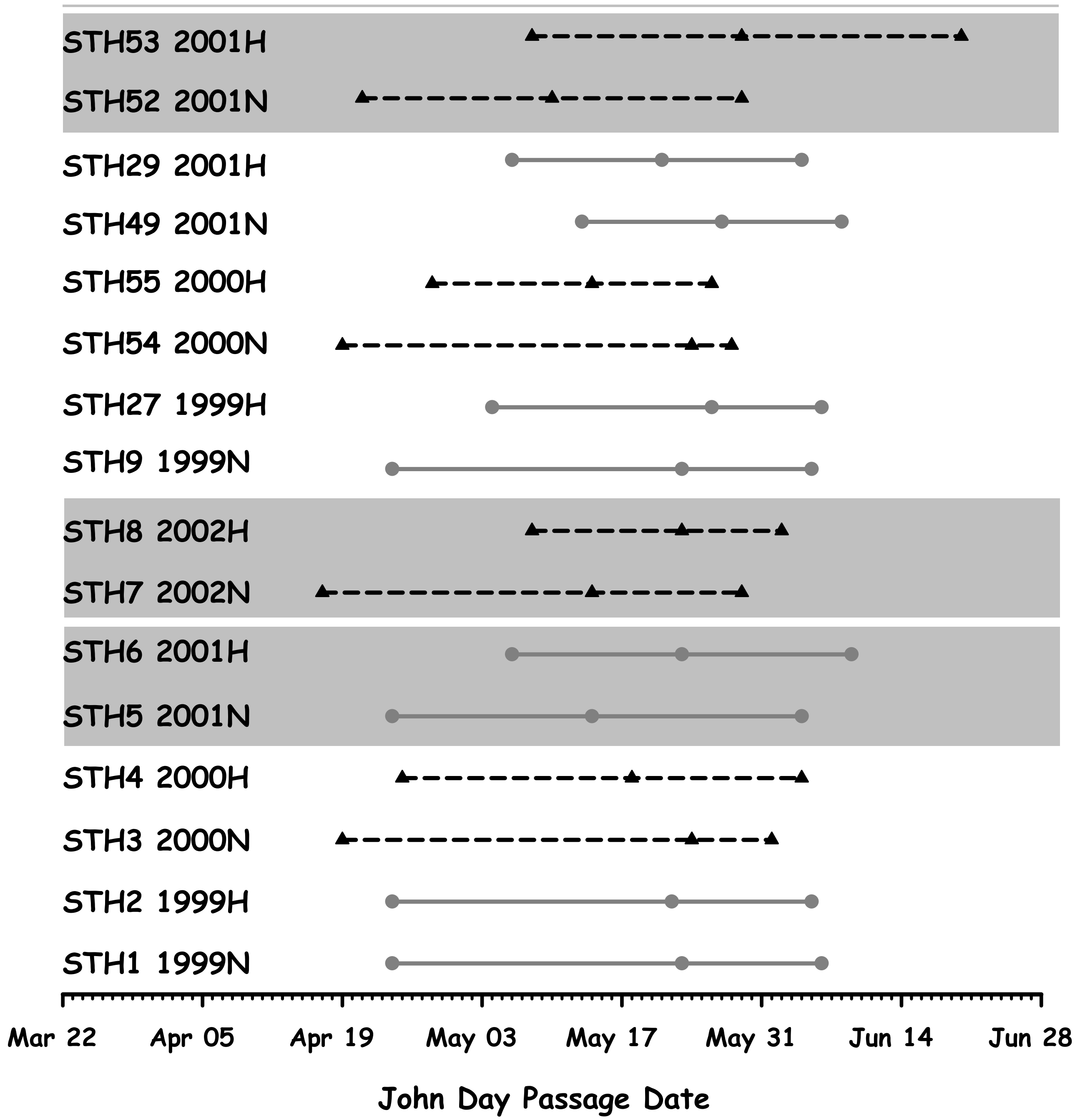


Figure 3-11. 10th, 50th, and 90th percentile dates of expanded detections past John Day Dam for natural and hatchery steelhead PIT tagged and released in the Umatilla Basin. Different colors and patterns of lines indicate different paired comparisons. Groups highlighted in gray indicate significant differences in median passage date. See Table 3-15 for complete descriptions of release groups.

Effects of Release Year on Timing

Natural steelhead passed John Day Dam progressively earlier in each successive year of tagging (Table 3-17, Table 3-18). We defined six releases to make two comparisons of passage timing between years. The first group consisted of a comparison of all naturally released fish in each year 1999-2002. The Kruskal-Wallis test identified significant differences between median passage dates of these four groups (Table 3-17). The median passage dates in 2000-2002 ranged from May 1 to May 7, as compared to a median passage date of May 17 in 1999 (Table 3-18). The 50th percentile dates were similar in 1999 and 2000 (May 23 & 24), but were later than those in 2001 and 2002 (May 14) (Table 3-18, Figure 3-12).

Table 3-17. Group codes, descriptions, descriptive timing statistics and comparative statistics of steelhead release groups used for examining effects of year on John Day Dam passage timing. Thin lines separate compared groups.

Release Group	Migration Year	Rear Type	Release Locations	Release Dates	Length (mm)	Median Detection Date	First Detections Date	Last Detection Date	Median Comparison P-Value
Between Years									
STH 1	1999	N	All	All	All	17-May	1-Apr	27-Jun	0.004
STH 3	2000	N	All	All	All	7-May	6-Apr	5-Jun	
STH 5	2001	N	All	All	All	6-May	31-Mar	27-Jun	
STH 7	2002	N	All	All	All	1-May	3-Apr	5-Jun	
STH 9	1999	N	Three Mile Dam	3/1-6/30	All	17-May	1-Apr	22-Jun	0.117
STH 49	2001	N	Three Mile Dam	4/1-6/30	All	22-May	10-May	26-Jun	

Table 3-18. Group codes, descriptions, and 10th, 50th, and 90th percentile dates of expanded detections past John Day Dam of steelhead groups used for examining effects of year on John Day Dam passage timing. Thin lines separate compared groups.

Release Group	Migr. Year	Rear Type	Release Location	Rel. Date	Length (mm)	# of Detections	Date Passed 10th	Date Passed 50th	Date Passed 90th	Days between 10th and 90th
Between Years										
STH 1	1999	N	All	All	All	626	4/24	5/23	6/6	43
STH 3	2000	N	All	All	All	95	4/19	5/24	6/1	43
STH 5	2001	N	All	All	All	220	4/24	5/14	6/4	41
STH 7	2002	N	All	All	All	83	4/17	5/14	5/29	42
STH 9	1999	N	Three Mile Dam	3/1-6/30	All	462	4/24	5/23	6/5	42
STH 49	2001	N	Three Mile Dam	4/1-6/30	All	27	5/13	5/27	6/8	26

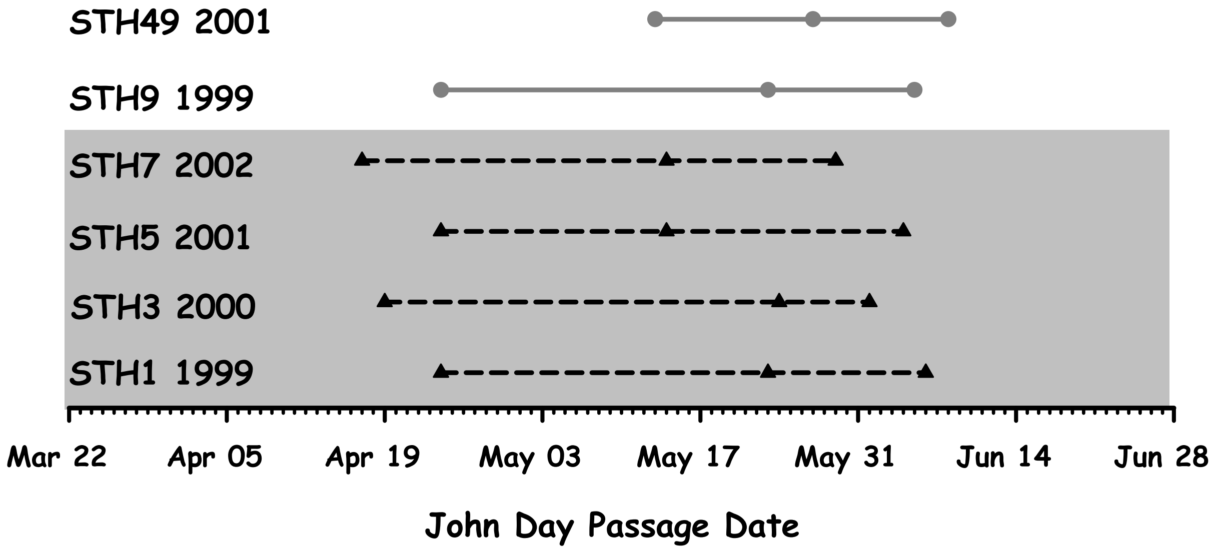


Figure 3-12. 10th, 50th, and 90th percentile dates of expanded detections past John Day Dam for natural steelhead PIT tagged and released in the Umatilla Basin. Different colors and patterns of lines indicate different comparison groups. Groups highlighted in gray indicate significant differences in median passage date. See Table 3-18 for complete descriptions of the release groups.

In the second comparison, we compared timing of fish released at Three Mile Dam in 1999 and 2001. These were the only groups that could be defined that would allow such a paired comparison. Median passage dates were May 17, and May 22 respectively, and the difference was not significant (Table 3-17). It is of note that 18% of fish tagged in the 1999 group were tagged in March and April as opposed to only 1% in the 2001 release group. This difference in release dates can partially account for earlier passage dates in the 1999 group.

Effects of Release Location on Timing

We found that release location had no statistically significant effect on passage timing at John Day Dam for steelhead. We identified six release groups to make three comparisons of passage timing of natural steelhead released at different locations in the Umatilla Basin. In each comparison, the migration year was the same in both release groups.

In two of the three comparisons there was no significant difference between the median passage dates of the two release groups (Table 3-19). In the first comparison, we looked at differences in 1999 from fish released at RM 3.7 and fish released at RM 78.9 (Meacham Cr.). The second comparison with no significant difference was between Meacham Cr. (RM 78.9) and the Umatilla River (RM 81) in 2001. The dates at which 50 percent of the fish in the release group had passed John Day Dam were similar between both groups (Table 3-20, Figure 3-13).

Table 3-19. Group codes, descriptions, descriptive timing statistics and comparative statistics of steelhead release groups used to examine the effects of release location on John Day Dam passage timing. Thin lines separate compared groups.

Release Group	Migration Year	Rear Type	Release Locations	Release Dates	Length (mm)	Median Detection Date	First Detections Date	Last Detection Date	Median Comparison P-Value
Release Location Groups									
STH 19	1999	N	Meacham Cr. Trap	All	All	26-May	20-Apr	27-Jun	0.130
STH 20	1999	N	Three Mile Dam	All	All	18-May	1-Apr	15-Jun	
STH 21	2001	N	Meacham Cr. Trap	11/1-3/31	All	5-May	31-Mar	27-Jun	0.346
STH 22	2001	N	CTUIR Mainstem Trap	All	All	1-May	31-Mar	1-Jun	
STH 52	2001	N	CTUIR Mainstem Trap	3/1-5/31	All	2-May	31-Mar	1-Jun	0.001
STH 49	2001	N	Three Mile Dam	4/1-6/30	All	22-May	10-May	26-Jun	

Table 3-20. Group codes, descriptions, and 10th, 50th, and 90th percentile dates of expanded detections past John Day Dam of steelhead groups used to examine the effects of release location on timing. Thin lines separate compared groups.

Release Group	Migr. Year	Rear Type	Release Location	Rel. Date	Length (mm)	# of Detections	Date Passed 10th	Date Passed 50th	Date Passed 90th	Days between 10th and 90th
Release Location Groups										
STH 19	1999	N	Meacham Trap	All	All	114	4/22	5/21	6/8	47
STH 20	1999	N	Three Mile Dam	All	All	411	4/26	5/23	6/5	40
STH 21	2001	N	Meacham Trap	11/1-3/31	All	64	4/24	5/11	5/23	29
STH 22	2001	N	CTUIR Mainstem Trap	All	All	97	4/19	5/10	5/29	40
STH 52	2001	N	CTUIR Mainstem Trap	3/1-5/31	All	92	4/21	5/10	5/29	38
STH 49	2001	N	Three Mile Dam	4/1-6/30	All	27	5/13	5/27	6/8	26

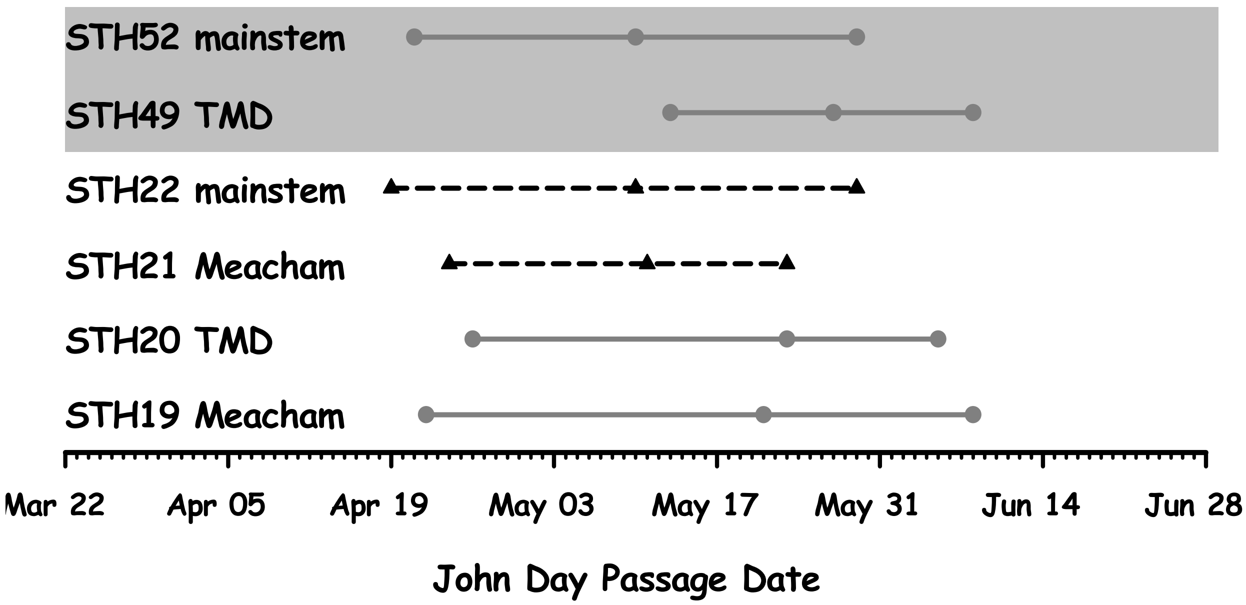


Figure 3-13. 10th, 50th, and 90th percentile dates of expanded detections past John Day Dam for natural steelhead PIT tagged and released in the Umatilla Basin. Different colors and patterns of lines indicate different comparison groups. Groups highlighted in gray indicate significant differences in median passage date. See Table 3-20 for complete description of the release groups. TMD= Three Mile Dam

There was a significant difference in timing of arrival at John Day Dam between the West Extension Canal (RM 3.7) and releases at the CTUIR screw trap on the Umatilla River (RM 81) in 2001 (Table 3-19). The significance of this comparison is weakened, because the tagging of natural steelhead at the West Extension Canal occurred almost exclusively in May. Tagging at the mainstem screw trap was primarily in March through April, and the median John Day Dam passage date for this group (May 2) marked the beginning of the tagging period at the West Extension Canal.

Effects of Size at Tagging on Timing

Smaller steelhead passed John Day Dam later in the season in one of two release groups analyzed. We compared length frequency distributions diagrams of natural steelhead released in Meacham Creek in the spring of 2001 that passed John Day Dam during early, mid and late portions of the outmigration season, as determined by dates when 33% and 67% of the release group had passed John Day Dam.

Steelhead passing in the middle of the season were shorter than those that passed earlier, and steelhead passing towards the end of the season were shorter than both those that passed early and or in the middle of the season. The dominant length group of the early passing steelhead was 130-140mm, compared to 120-130mm for the middle group, and 100-120 mm for the late group (Figure 3-14).

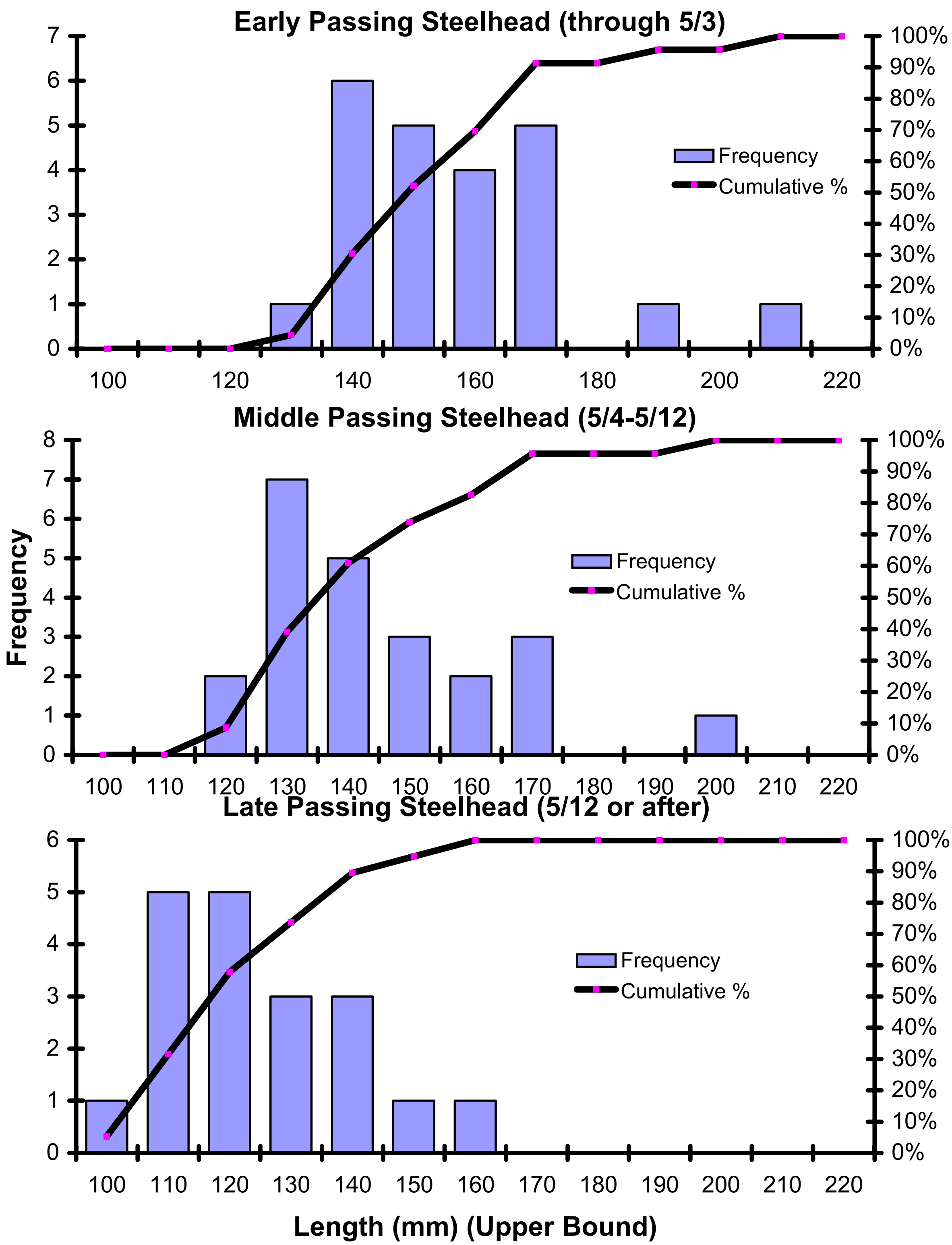


Figure 3-14. Length frequency distribution diagrams of steelhead released in Meacham Creek in the spring of 2001 that passed John Day Dam early in the outmigration season, in the middle of the season, and late in the season.

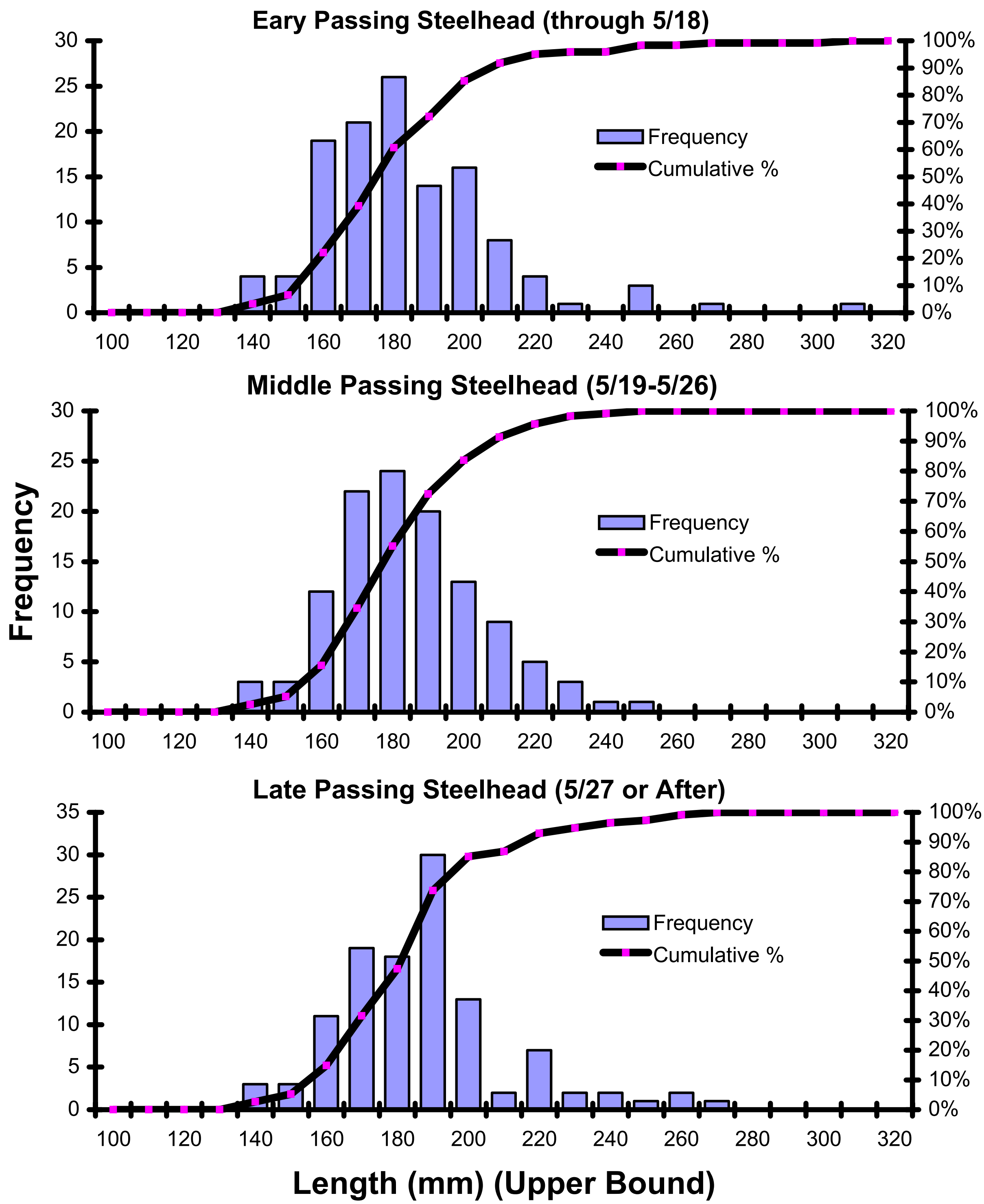


Figure 3-15. Length frequency distribution diagrams of steelhead released at Three Mile Dam in the spring of 1999 that passed John Day Dam early in the outmigration season, in the middle of the season, and late in the season.

We conducted a similar analysis using steelhead released in the spring of 1999 at Three Mile Dam. Steelhead were larger in 1999 than in 2001, and there was no distinction between length frequency distributions of fish passing early, in the middle, or late in the season. The dominant length group for the early and middle passing steelhead was 170-180mm compared to 180-190mm for the late season group (Figure 3-15).

Steelhead Survival

We compared survival to John Day Dam among the same release groups as we did with passage timing. However, we added some groups to examine the effects of capture method on survival

Effects of Origin on Survival

Natural steelhead survived better to John Day Dam than hatchery steelhead in all eight comparisons between the two origins. Four comparisons included all fish released within a year, and the other four held certain variables constant such as release location and release date. In all eight comparisons, survival rates were significantly different (P<0.001), and natural fish had higher survival rates (Table 3-21).

Table 3-21. Group codes, descriptions, estimated survival rate and comparative statistics of steelhead release groups used to examine the effects of origin on survival to John Day Dam. Thin lines separate compared groups.

Release Group	Migration Year	Rear Type	Release Locations	Release Dates	Length (mm)	Number Released	Estimated Survivors to JDD	Estimated Survival Rate	Survival Comparison P-Value
Natural Vs. Hatchery Groups									
STH 1	1999	N	All	All	All	3,855	1,990	0.516	<0.001
STH 2	1999	H	All	All	All	4,251	2,159	0.508	
STH 3	2000	N	All	All	All	1,671	650	0.389	<0.001
STH 4	2000	H	All	All	All	4,786	1,413	0.295	
STH 5	2001	N	All	All	All	2,746	464	0.169	<0.001
STH 6	2001	H	All	All	All	13,157	1,962	0.149	
STH 7	2002	N	All	All	All	446	489	1.096	<0.001
STH 8	2002	H	All	All	All	1,276	1,108	0.869	
STH 9	1999	N	Three Mile Dam	3/1-6/30	All	1,830	1,427	0.780	<0.001
STH 27	1999	H	Three Mile Dam	4/20-6/2	All	1,508	1,102	0.731	
STH 54	2000	N	Imeques Acc. Pond	4/1-5/31	All	822	409	0.498	<0.001
STH 55	2000	H	Bonifer Acc. Pond	4/10-4/12	All	822	207	0.252	
STH 49	2001	N	Three Mile Dam	4/1-6/30	All	281	99	0.354	<0.001
STH 29	2001	H	ODFW Trap and Three Mile Dam	5/1-5/31	All	329	77	0.235	
STH 52	2001	N	CTUIR Mainstem Trap	3/1-5/31	All	813	162	0.200	<0.001
STH 53	2001	H	Bonifer Acc. Pond	4/3-4/7	All	2,047	182	0.089	

Survival rates between the two rearing types were most similar in 1999. In a comparison of all releases, 51.6% of natural fish survived to John Dam compared to 50.8% of hatchery fish. When only fish released at Three Mile Dam were included, the margin was slightly larger (78% to 73.1%) (Table 3-21).

When comparing all fish of each origin released in 2000 natural fish survived at 38.9% compared to 29.5% for hatchery fish. Of fish released in similar upriver location (Imeques Acclimation Pond and Bonifer Acclimation Pond) natural fish survived better again at 49.8% to 25.2% (Table 3-21).

Survival rates were lower for both groups in 2001, but natural fish maintained a survival advantage. For all releases, natural fish survived at 16.9% compared to 14.9% for hatchery fish. When comparing fish released in the lower five miles of the Umatilla River, natural fish survived better again at 35.4% to 23.5% (Table 3-21). Natural fish survived better among upstream releases as well. Among releases at the CTUIR mainstem trap (RM 81) and Bonifer Acclimation Pond (RM 81.3), natural fish survived at 20% compared to 8.9% for hatchery fish (Table 3-21). The greatest proportion of expanded detections of steelhead that passed John Day Dam one year after tagging occurred in 2001 (Table 3-14). This indicates that actual survival rates of both natural and hatchery fish during migration are somewhat higher than reported for 2001. However, natural fish had a greater proportion of their number released that migrated a year later than hatchery fish. Among steelhead from all releases, which survived to John Day Dam in 2001, we estimated that 3.9% of natural fish passed John Day Dam one year after release as compared to 0.6% of hatchery survivors (Table 3-14). This means that the calculated survival rate of natural fish was reduced more by fish that reared an additional year, so the survival advantage during migration only was greater than our calculated values.

Estimated survival rates in 2002 were unrealistically high indicating that estimates of detection probability were biased low. Survival rates for natural fish exceeded 100% (Table 3-21). Still, estimates showed that natural fish out-survived hatchery fish in 2002. In 2002, all natural and hatchery PIT-tagged steelhead were released at Three Mile Dam. Natural fish survived 22% better than hatchery fish (Table 3-21).

Effects of Release Year on Survival

In a comparison between years of all natural steelhead released, the highest survival rate was in 2002, followed by 1999, then 2000, and finally 2001. However, differences between years in distribution of release location, release date, and tagging methods preclude putting much confidence in this comparison. We compared natural steelhead released at Three Mile Dam in 1999 and 2001. The survival rates were significantly different with a survival of 78% in 1999 compared to 35.4% in 2001 (Table 3-22).

Table 3-22. Group codes, descriptions, estimated survival rate and comparative statistics of steelhead release groups used to examine the effects of release year on survival to John Day Dam. Thin lines separate compared groups.

Release Group	Migration Year	Rear Type	Release Locations	Release Dates	Length (mm)	Number Released	Estimated Survivors to JDD	Estimated Survival Rate	Survival Comparison P-Value
Between Years									
STH 1	1999	N	All	All	All	3,855	1,990	0.516	NA
STH 3	2000	N	All	All	All	1,671	650	0.389	
STH 5	2001	N	All	All	All	2,746	464	0.169	
STH 7	2002	N	All	All	All	446	489	1.096	
STH 9	1999	N	Three Mile Dam	3/1-6/30	All	1,830	1,427	0.780	<0.001
STH 49	2001	N	Three Mile Dam	4/1-6/30	All	281	99	0.354	

Effects of Release Location on Survival

Downstream release groups had higher survival rates to John Day Dam than groups released higher in the basin. We made three comparisons of the effects of release location on survival to John Day Dam. In two instances, we compared a downstream group to an upstream group. The group released farther downstream survived better than the upstream release group in both instances (Table 3-23). In 1999 steelhead released at Three Mile Dam (RM 3.7) survived at 78.2% compared to 40% for fish released at Meacham Creek (RM 78.9). In 2001, fish released at Three Mile Dam (RM 3.7) survived at 35.4% compared to 20% for fish released in the Umatilla River (RM 82.2). The differences in survivals to John Day Dam between upstream and downstream groups indicate that survival in the Umatilla River from Meacham Creek to Three Mile Dam was 50-60% in 1999 and 2001.

Table 3-23. Group codes, descriptions, estimated survival rate and comparative statistics of steelhead release groups used to examine the effects of release location on survival to John Day Dam. Thin lines separate compared groups.

Release Group	Migration Year	Rear Type	Release Locations	Release Dates	Length (mm)	Number Released	Estimated Survivors to JDD	Estimated Survival Rate	Survival Comparison P-Value
Release Location Groups									
STH 19	1999	N	Meacham Cr. Trap	All	All	1,016	406	0.400	<0.001
STH 20	1999	N	Three Mile Dam	All	All	1,605	1,255	0.782	
STH 21	2001	N	Meacham Cr. Trap	11/1-3/31	All	989	120	0.121	<0.001
STH 22	2001	N	CTUIR Mainstem Trap	All	All	898	169	0.189	
STH 52	2001	N	CTUIR Mainstem Trap	3/1-5/31	All	813	162	0.200	<0.001
STH 49	2001	N	Three Mile Dam	4/1-6/30	All	281	99	0.354	

The third comparison examined locations of similar distance from the mouth, but in different parts of the basin. Steelhead released in Meacham Creek (RM 78.9) survived worse than steelhead released in the mainstem Umatilla River (RM 81) (12.1% to 18.9%) (Table 3-23). However, the Meacham Creek group had a significant proportion (15%) of their detections passing John Day Dam a year later than expected (Table 3-14).

Effects of Capture Method on Survival

Fish captured via electrofishing generally survived with less success than those captured via screw trap. The ability to make comparisons between capture methods was compromised by the nature of the release data. PIT tagging activities were not specifically designed to evaluate the effects of release location, and thus clean comparisons were not available. Specifically, fish were not captured by electrofishing in the same locations as those captured by screw trap, and releases via electrofishing were made in small numbers in numerous locations. However, all of these locations were in the upper basin, and all were between 48 and 78 miles from the mouth of the Umatilla River. We estimated a survival rate for steelhead captured via electrofishing by pooling all of the electrofish capture locations. We compared this estimate to survival rates of steelhead captured by screw traps in the upper Umatilla Basin in the same time period. We did not compare the survival rates statistically because of the caveats regarding the electrofish survival rate.

We made two comparisons between steelhead captured via electrofishing, and those captured via screw trap. We pooled electrofished releases from Buckaroo Creek, Birch Creek, East Fork Birch Creek, West Fork Birch Creek, Pearson Creek, and Squaw Creek in the spring of 1999. We compared these releases to fish captured via the CTUIR mainstem screw trap and released at Imeques Acclimation Pond (RM 80) and those captured at the Meacham Creek (RM 78.9) trap. Survival was 9% for the electrofish release group and 49% for the screw trap group (Table 3-24).

Table 3-24. Descriptions and estimated survival rates of steelhead release groups used to examine the effects of capture method on survival to John Day Dam. Thin lines separate compared groups.

Migration Year	Rear Type	Capture Method	Release Locations	Release Dates	Length (mm)	Number Released	Estimated Survivors to JDD	Estimated Survival Rate
Capture Method Groups								
1999	N	Electrofish	All	3/1-4/30	All	703	63	0.09
1999	N	Screw trap	Imeques Acc. Pond & Meacham Cr. Trap	3/1-4/30	All	861	420	0.49
2001	N	Electrofish	All	1/1-1/31	All	532	74	0.14
2001	N	Screw trap	CTUIR Mainstem Trap & Imeques Acc. Pond	1/1-1/31	All	1664	241	0.15

A second similar comparison was made between steelhead released in January, 2001. In this comparison electrofished steelhead were pooled from East Fork Birch Creek, West Fork Birch Creek, and Squaw Creek. The trapped fish were captured in the CTUIR mainstem trap and at Meacham Creek. The electrofish group survival rate was similar to 1999 at 14%. The trap group survival rate was lower than in 1999 and similar to that of the electrofish group at 15% (Table 3-24). However, 7% of the expanded detections from the screw trap group did not outmigrate until one year after expected, and artificially deflated the group's survival rate.

The final comparison in 2000 that was ineffective, but illustrated that fish tagged via screw trapping and those trapped via electrofishing may be in different stages of rearing. The electrofish releases were pooled from East Fork Birch Creek, West Fork Birch Creek, Cottonwood Creek, Pearson Creek, Squaw Creek, and 36 fish released at Imeques Acclimation Pond. All of the screw trapped fish were captured in the CTUIR mainstem trap (RM 81) and released at Imeques Acclimation Pond m (RM 80). A comparison of survival rates was not appropriate because 12% of the expanded detections of the electrofish group did not outmigrate until 2001. In addition, only 9 fish were detected from this released group.

The comparisons between electrofish group and trap group need to be viewed with caution. First, to obtain a reasonable release group size of fish captured via electrofishing, it was necessary to pool data from locations up to 45 miles apart. Second, fish captured via screw trap are actively migrating, whereas the fish captured via electrofishing may include fish that are migrating. This was illustrated by the 2000 electrofish group where 12% of the expanded detections represented fish that reared one full extra year in fresh water. Chilcote et al. (1984) found that survival of parr to smolt the next was 35% in the Kalama River, Washington. If we assume this is similar to the Umatilla River, then we would estimate that 35% of the steelhead captured via electrofishing in 2000 did not migrate that spring.

Effect of Size at Tagging on Survival

Larger steelhead survived with more success than smaller steelhead in one of two release groups analyzed. We analyzed data from locations where there was enough releases of multiple size classes of steelhead in a short time frame. We examined length frequency distribution diagrams of steelhead released in Meacham Creek in the spring of 2001 that were detected at either Three Mile Dam, John Day Dam, or Bonneville Dam, and compared them to the length frequency distribution of all the fish released in that group. Twenty-nine percent of steelhead released in Meacham Creek that survived to detection in the spring of 2001 were 120mm or shorter compared to 45% of those released. This indicates that the shorter fish released in Meacham Creek were less likely than larger fish to survive to detection facilities downstream. We conducted a similar analysis using steelhead released in the spring of 1999 at Three Mile Dam. There was no distinction in length frequency distributions between fish that survived to detection and those that were released. The dominant size group of fish released and detected was 170-180mm.

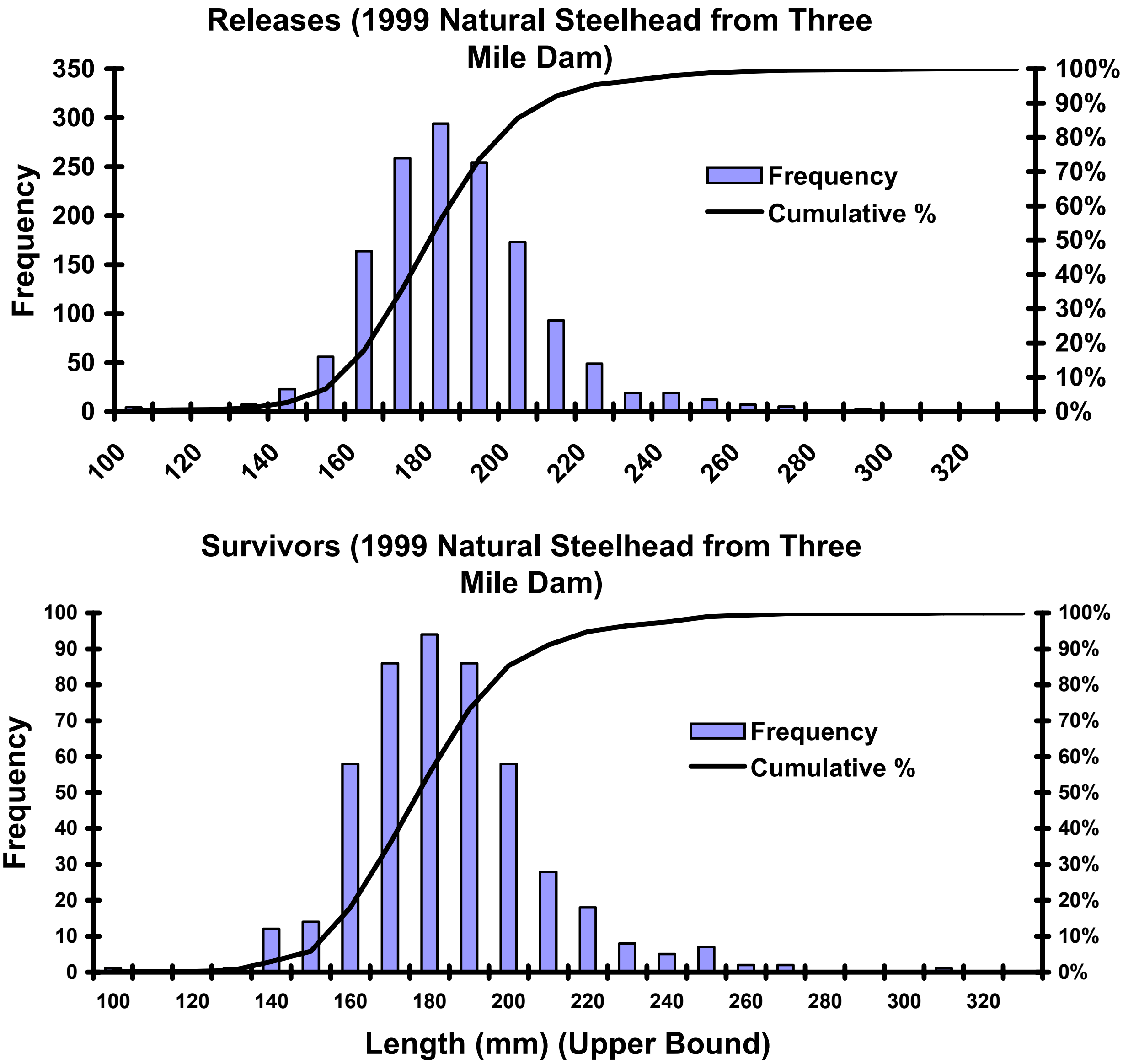


Figure 3-16. Length frequency distribution diagrams of steelhead released from Meacham Creek in the spring of 2001 and those that survived to detection.

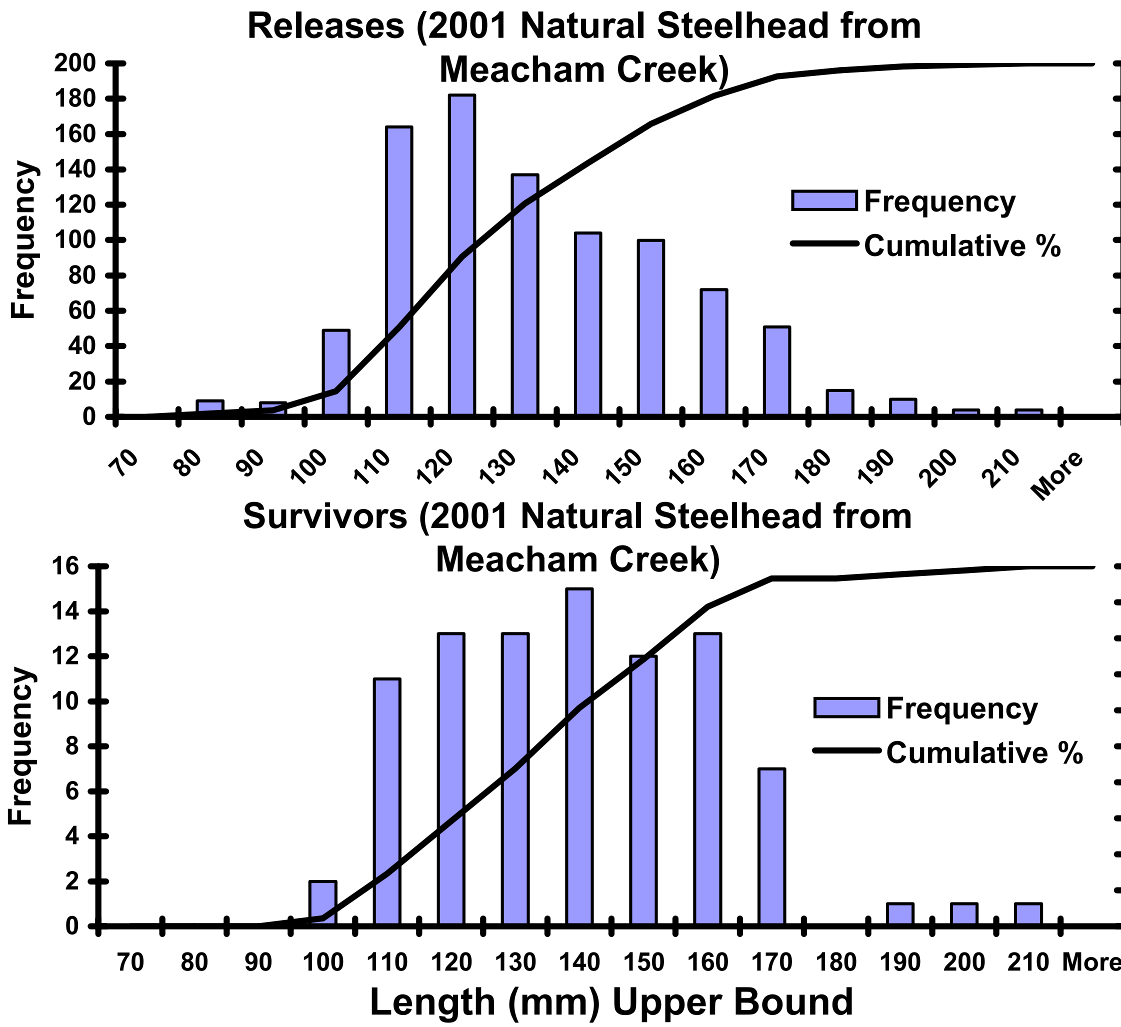
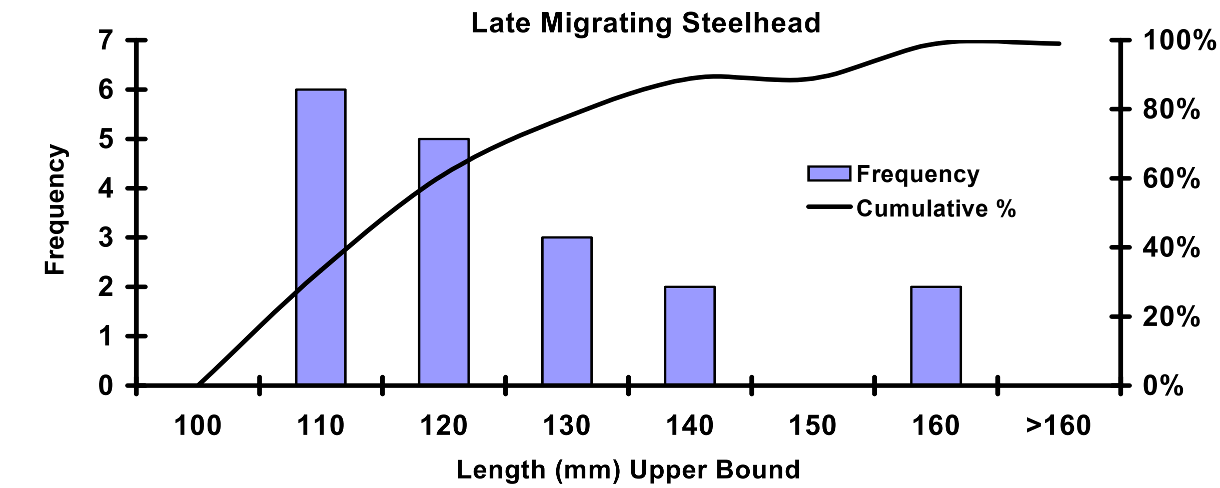


Figure 3-17. Length frequency distribution diagrams of steelhead released from Three Mile Dam in the spring of 1999 and those that survived to detection.

Characteristics of Steelhead Rearing an Extra Year

Eighteen steelhead were detected at Three Mile Dam, John Day Dam or Bonneville Dam one year after they were tagged. Eleven of these detections were in 2001 and the remainder were in 2002. We found that steelhead that outmigrated a year later than other fish tagged in any given year tended to be shorter than average for their release group. Sixteen of the eighteen fish detected a year after tagging were tagged in Meacham Creek or Birch Creek or one of its tributaries.

We compared the length frequency distributions of the late migrating steelhead to their counterparts in their release groups. We examined releases of steelhead expected to migrate in 2000 and 2001 from Meacham Creek and Birch Creek and its tributaries. The late migrating steelhead generally represented the smaller length groups of the entire release. Eighty-nine percent of late migrating fish were less than 140mm, compared to 64% for all fish tagged. The dominant length group for the late migrating fish was 100-110mm compared to 110-120mm for the released fish (Figure 3-18).



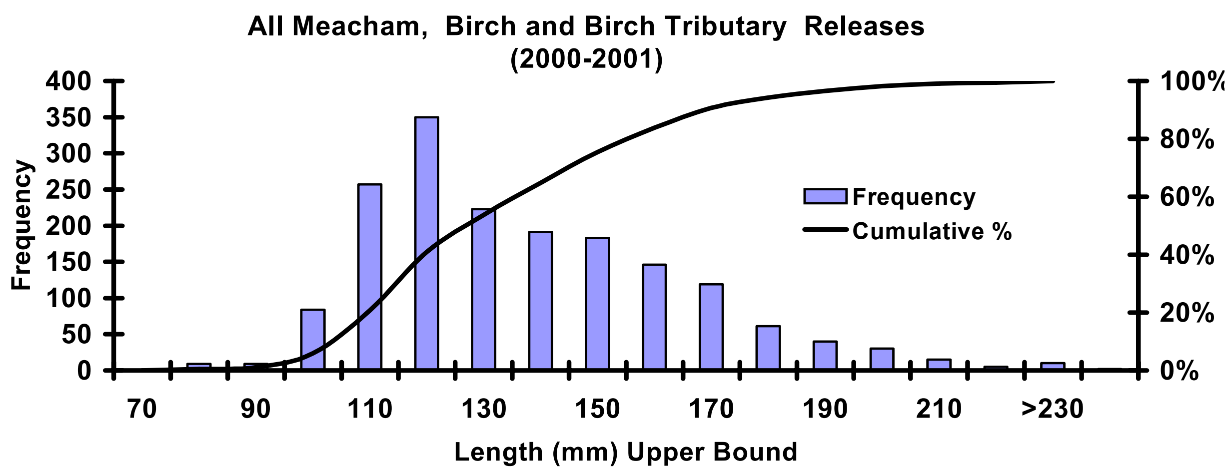


Figure 3-18. Length frequency distributions of steelhead detected one year after the expected migration year (top) and all fish released in the locations where the late migrating steelhead primarily came from (bottom).

It is possible that handling at Three Mile Dam influenced the migration behavior of some fish. One of the late migrating fish was captured and tagged at Three Mile Dam on May 18, 2000. This fish was recycled upstream (at approximately RM 5.0) and reared another year in the Umatilla system before being detected at Three Mile Dam on March 17, 2001, and again at John Day Dam on April 2, 2001. This fish was 155mm long upon release.

Chinook

Chinook Timing

We found that Chinook tended to pass John Day Dam in mid May. We also examined the effects of origin, release date, release location and length on timing, to see how these factors influenced passage timing at John Day Dam. Detections were only sufficient for analysis in 1999 and 2001 for comparisons. Median detection dates among these release groups ranged from April 21 to May 19 (Table 3-25).

Table 3-25. Group codes, descriptions, descriptive timing statistics and comparative statistics of Chinook release groups used to examine the effects of origin on John Day Dam passage timing. Thin lines separate compared groups.

Release Group	Migration Year	Rear Type	Release Location	Release Dates	Length (mm)	Median Detection Date	First Detection Date	Last Detection Date	Median Comparison P-Value
Natural Vs. Hatchery Groups									
CHK1	1999	N	All	All	All	10-May	19-Apr	31-May	0.000
CHK2	1999	H	All	All	All	26-Apr	1-Apr	22-May	
CHK4	2001	N	All	All	All	19-May	13-Apr	29-Jul	0.005
CHK5	2001	H	All	All	All	8-May	30-Mar	25-Jun	
CHK7	1999	N	Three Mile Dam & ODFW Trap	3/1-5/31	All	10-May	22-Apr	30-May	0.000
CHK8	1999	H	Three Mile Dam & ODFW Trap	All	All	21-Apr	1-Apr	22-May	
CHK9	2001	N	CTUIR Mainstem Trap & Meacham Cr.	3/1-4/30	All	18-May	29-Apr	29-Jun	0.004
CHK10	2001	H	Imeques Acc. Pond	All	All	8-May	30-Mar	25-Jun	

Effects of Origin on Timing

Hatchery Chinook passed John Day Dam earlier than natural fish in both 1999 and 2001. We defined 8 release groups to compare passage timing of natural and hatchery Chinook. In each comparison, the migration year was the same in both release groups. In two of the comparisons, we compared timing for all releases of natural and hatchery Chinook within that year. In the other two comparisons, we held other factors including sample location, sample method, and release date constant because tagging season and locations were not consistent between hatchery and natural Chinook. Hatchery Chinook were generally tagged later in the season and lower in the watershed (Figure 3-19, Figure 3-20). These factors could influence both timing and survival.

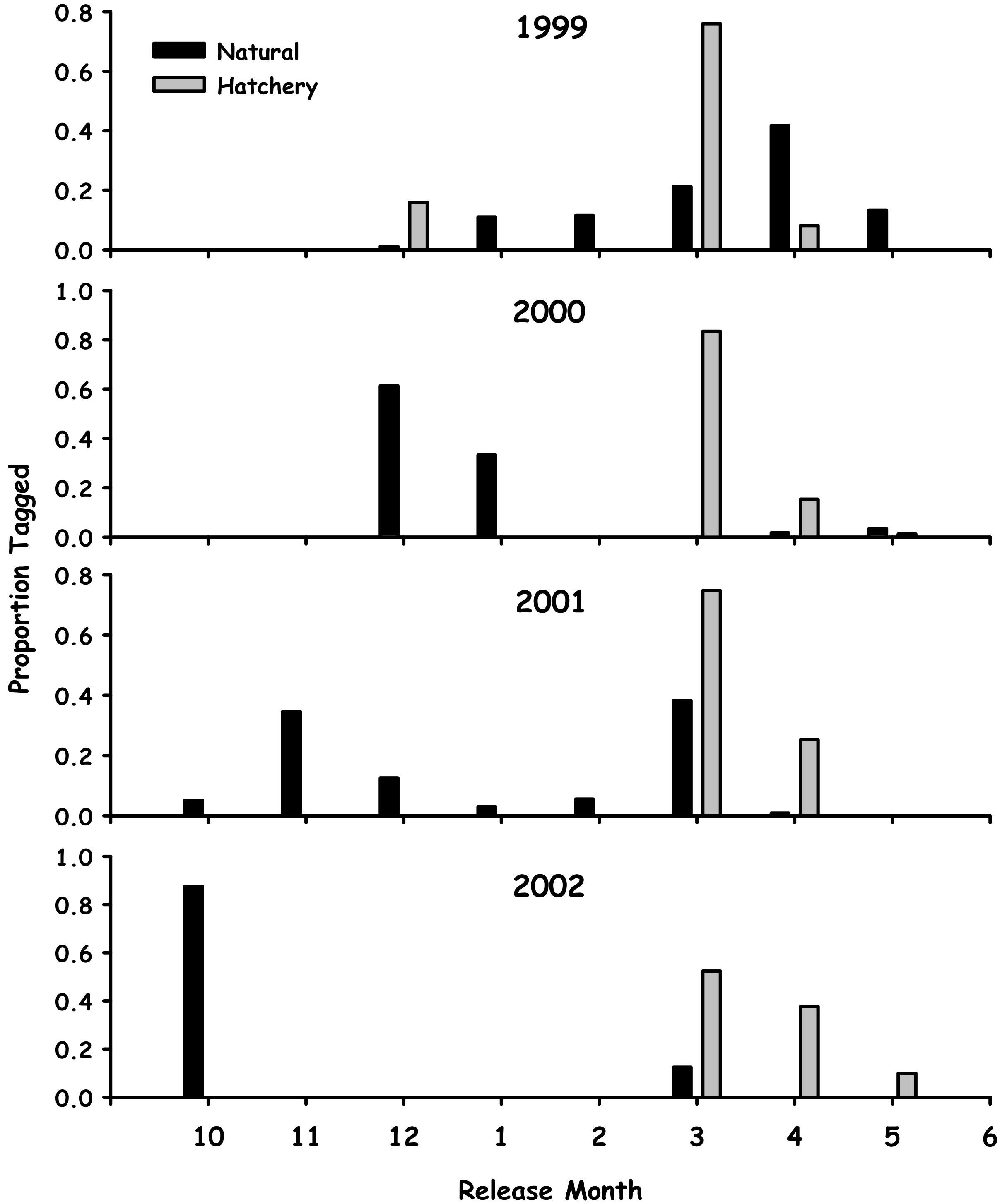


Figure 3-19. Proportion of natural and hatchery Chinook tagged by month in the Umatilla Basin for each migration year analyzed.

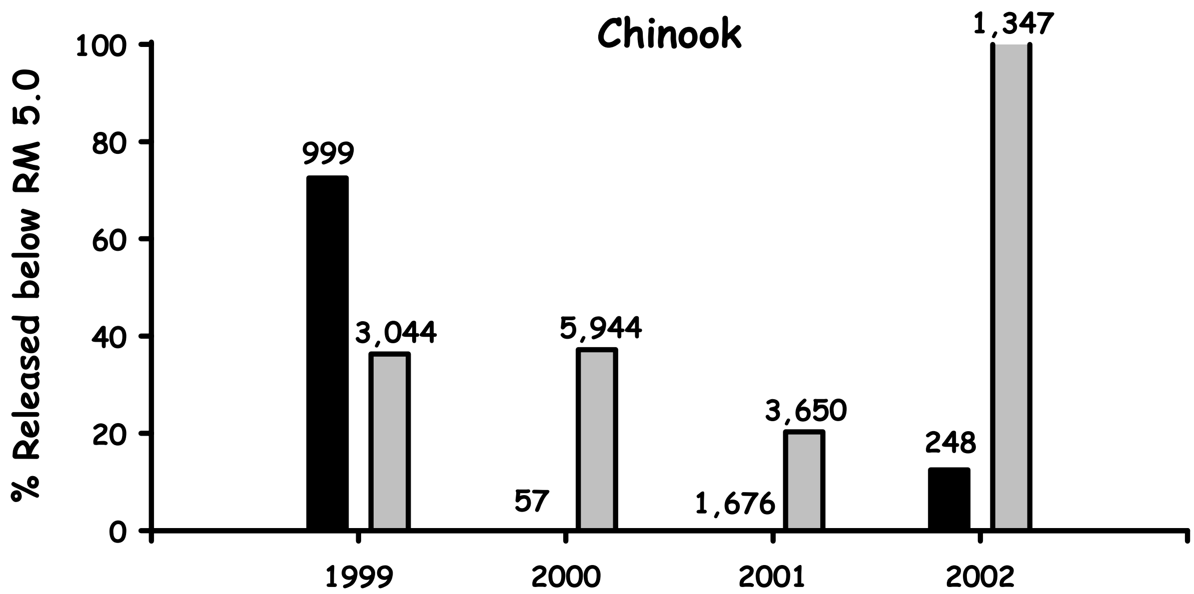


Figure 3-20. Proportion of natural (black) and hatchery (grey) Chinook tagged in the lower five miles of the Umatilla River by year. Chinook not tagged in the lower five miles were generally released at RM 40.0 or higher.

Significant differences of median passage date were found in all four comparisons of natural vs. hatchery groups (Table 3-25). In the first comparison using all releases of natural and hatchery fish in 1999, median detection rates were April 26 for hatchery fish, and May 10 for natural fish. Natural fish were later again in 2001 with a median John Day Dam passage date of May 19, compared to May 8 for hatchery fish (Table 3-25). Comparisons limited to specific release locations yielded similar results with hatchery fish passing John Day Dam first in both 1999 and 2001 (Table 3-25, Figure 3-21). The 1999 comparison was made between groups released at Three Mile Dam and the ODFW screw trap. In the 2001 comparison, natural fish were released at the CTUIR mainstem trap and the Meacham Creek trap. Hatchery fish were released at the Imeques Acclimation Pond.

Comparison of 50th percentile dates showed similar results to comparisons of median passage dates, but the difference between natural and hatchery was not as pronounced in comparisons of 2001 releases (Table 3-26). When examining all releases, the difference in median dates in 2001 was 11 days, compared to just 3 days difference in the 50th percentile dates. In three of the four comparisons, the natural run had a shorter travel time than the hatchery run. Only in the 1999 comparison of releases in the lower river did the natural fish have longer travel time (25 days to 21 days) (Table 3-26, Figure 3-21).

Table 3-26. Group codes, descriptions, and 10th, 50th, and 90th percentile dates of expanded detections of steelhead groups passing John Day Dam used to examine the effects of origin on timing. Thin lines separate compared groups.

Release Group	Migr. Year	Rear Type	Release Location	Rel. Date	Length (mm)	# of Detections	Date Passed 10th	Date Passed 50th	Date Passed 90th	Days between 10th and 90th
Natural Vs. Hatchery Groups										
CHK1	1999	N	All	All	All	181	4/25	5/9	5/21	26
CHK2	1999	H	All	All	All	325	4/13	4/24	5/12	29
CHK4	2001	N	All	All	All	177	5/9	5/18	6/1	23
CHK5	2001	H	All	All	All	756	4/9	5/15	5/28	49
CHK7	1999	N	Three Mile Dam & ODFW Trap	3/1-5/31	All	134	4/26	5/9	5/21	25
CHK8	1999	H	Three Mile Dam & ODFW Trap	All	All	104	4/9	4/21	4/30	21
CHK9	2001	N	CTUIR Mainstem Trap & Meacham Cr.	3/1-4/30	All	89	5/10	5/18	6/1	22
CHK10	2001	H	Imeques Acc. Pond	All	All	561	4/20	5/14	5/27	37

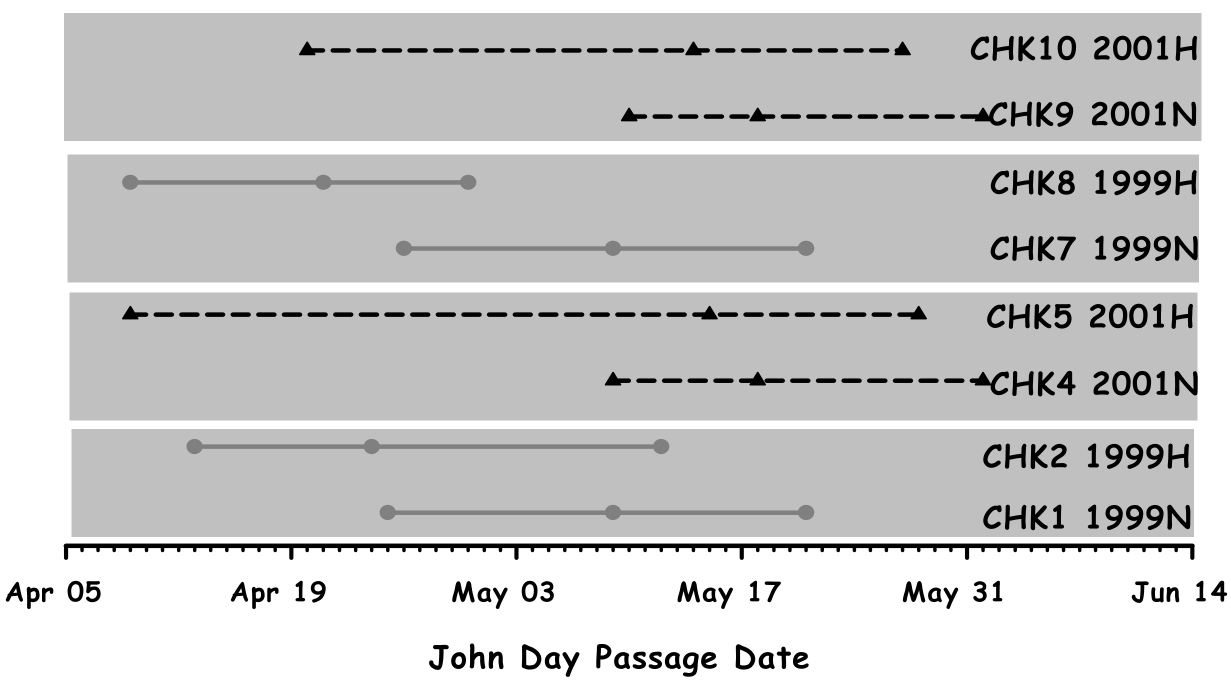


Figure 3-21. 10th, 50th, and 90th percentile dates of expanded detections past John Day Dam for natural Chinook tagged and released in the Umatilla Basin. Different colors and patterns of lines indicate different comparison groups. Groups highlighted in gray indicate significant differences in median passage date. See Table 3-26 for complete description of release groups.

Effect of Release Year on Timing

Peak passage for natural fish in both 1999 and 2001 was in mid May. Median passage dates were significantly different with passage taking place earlier in 1999 (May 10) than in 2001 (May 19) (Table 3-27). The 50th percentile date was earlier in 1999 as well (May 9 vs. May 18) (Table 3-28, Figure 3-22).

Table 3-27. Group codes, descriptions, descriptive timing statistics and comparative statistics of Chinook release groups used to examine the effects of year on John Day Dam passage timing.

Release Group	Migration Year	Rear Type	Release Location	Release Dates	Length (mm)	Median Detection Date	First Detection Date	Last Detection Date	Median Comparison P-Value
Between Year Groups									
CHK1	1999	N	All	All	All	10-May	19-Apr	31-May	0.006
CHK4	2001	N	All	All	All	19-May	13-Apr	29-Jul	

Table 3-28. Group codes, descriptions, and 10th, 50th, and 90th percentile dates of expanded detections of steelhead groups passing John Day Dam steelhead groups used to examine the effects of year on timing.

Release Group	Migr. Year	Rear Type	Release Location	Rel. Date	Length (mm)	# of Detections	Date Passed 10th	Date Passed 50th	Date Passed 90th	Days between 10th and 90th
Between Year Groups										
CHK1	1999	N	All	All	All	181	4/25	5/9	5/21	26
CHK4	2001	N	All	All	All	177	5/9	5/18	6/1	23

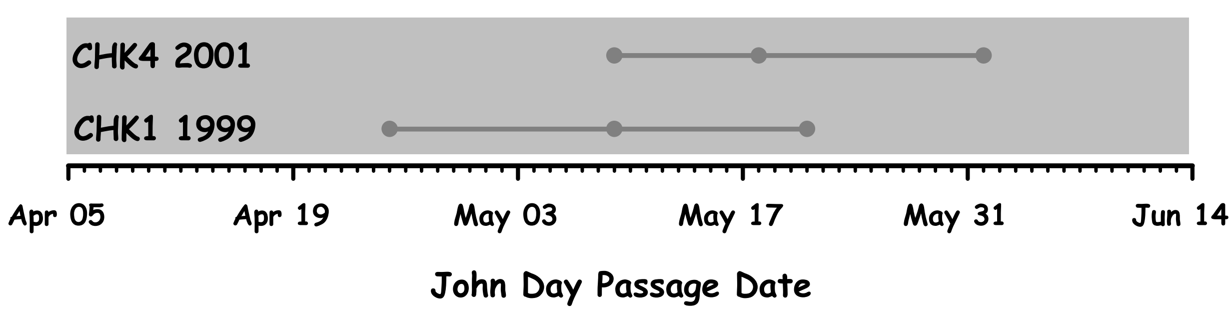


Figure 3-22. 10th, 50th, and 90th percentile dates of expanded detections past John Day Dam for natural Chinook tagged and released in the Umatilla Basin. See Table 3-28 for complete description of the release groups

Effects of Release Season on Timing

We found that release season did not influence passage timing at John Day Dam. We were able to establish one comparison of the effects of the release season on passage timing. For the purposes of this comparison, we pooled Chinook released at two release locations because of the similarity in distance from the mouth of the Umatilla and advantage of larger sample size. The first location was the CTUIR mainstem trap at RM 81, and the other location was Meacham Creek at RM 78.9. The first release group was PIT tagged and released between October 1, 2000 and December 31, 2000. The second release group was PIT tagged and released between March 1, 2001 and April 31, 2001. We found that the median dates past John Day Dam were not significantly different between groups in either comparison, and that 50th percentile dates were similar (Table 3-29, Table 3-30).

Table 3-29. Group codes, descriptions, descriptive timing statistics and comparative statistics of Chinook release groups used to examine the effects of release season on John Day Dam passage timing.

Release Group	Migration Year	Rear Type	Release Location	Release Dates	Length (mm)	Median Detection Date	First Detection Date	Last Detection Date	Median Comparison P-Value
Tagging Season Groups									
CHK11	2001	N	CTUIR Mainstem Trap & Meacham Cr.	10/1-12/31	All	15-May	13-Apr	29-Jul	0.222
CHK12	2001	N	CTUIR Mainstem Trap & Meacham Cr.	3/1-4/30	All	18-May	29-Apr	29-Jun	

Table 3-30. Group codes, descriptions, and 10th, 50th, and 90th percentile dates of expanded detections past John Day Dam of Chinook groups used to examine the effects of release season on timing.

Release Group	Migr. Year	Rear Type	Release Location	Rel. Date	Length (mm)	# of Detections	Date Passed 10th	Date Passed 50th	Date Passed 90th	Days between 10th and 90th
Tagging Season Groups										
CHK11	2001	N	CTUIR Mainstem Trap & Meacham Cr.	10/1-12/31	All	70	5/5	5/16	6/1	27
CHK12	2001	N	CTUIR Mainstem Trap & Meacham Cr.	3/1-4/30	All	89	5/10	5/18	5/30	20

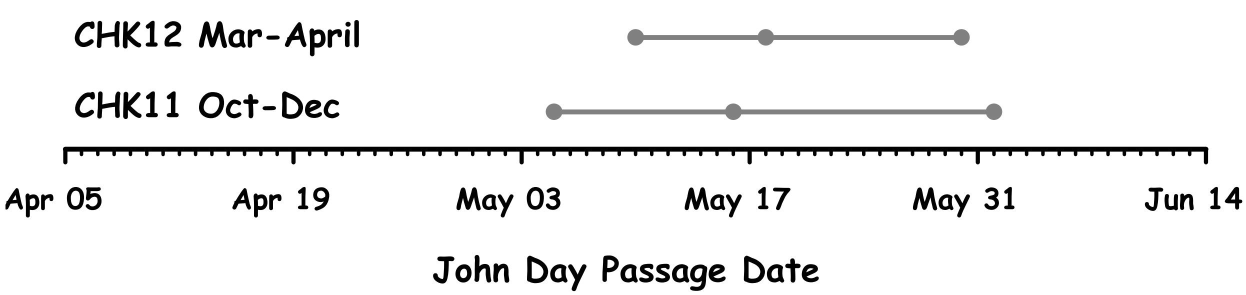


Figure 3-23. 10th, 50th, and 90th percentile dates of expanded detections past John Day Dam for natural Chinook PIT tagged and released in the Umatilla Basin. See Table 3-30 for complete description of the release groups.

Effects of Release Location on Timing

Because of a general lack of data, we were able to make only one comparison of the effects of release location for natural Chinook. We compared Chinook PIT tagged and released in 1999 in the lower river at the ODFW screw trap (RM 1.2) or Three Mile Dam (RM 3.7) to Chinook released at the Imeques Acclimation Pond (RM 80). Chinook were released at the lower river locations between March 1 and May 31, and releases at Imeques Acclimation Pond were made in January through April.

The median passage date of both groups was May 10 (Table 3-31). The 50th percentile date was May 10 for the Imeques Acclimation Pond group, and was May 9 for the lower river group (Table 3-32, Figure 3-24).

Table 3-31. Group codes, descriptions, descriptive timing statistics and comparative statistics of Chinook release groups used to examine the effects of release location on John Day Dam passage timing.

Release Group	Migration Year	Rear Type	Release Location	Release Dates	Length (mm)	Median Detection Date	First Detection Date	Last Detection Date	Median Comparison P-Value
Release Location Groups									
CHK7	1999	N	Three Mile Dam & ODFW Trap	3/1-5/31	All	10-May	22-Apr	30-May	0.646
CHK19	1999	N	Imeques Acc. Pond	All	All	10-May	21-Apr	31-May	

Table 3-32. Group codes, descriptions, and 10th, 50th, and 90th percentile dates of expanded detections past John Day Dam of Chinook groups used to examine the effects of release location on timing.

Release Group	Migr. Year	Rear Type	Release Location	Rel. Date	Length (mm)	# of Detections	Date Passed 10th	Date Passed 50th	Date Passed 90th	Days between 10th and 90th
Release Location Groups										
CHK7	1999	N	Three Mile Dam & ODFW Trap	3/1-5/31	All	134	4/26	5/9	5/21	25
CHK19	1999	N	Imeques Acc. Pond	All	All	29	4/25	5/10	5/18	23

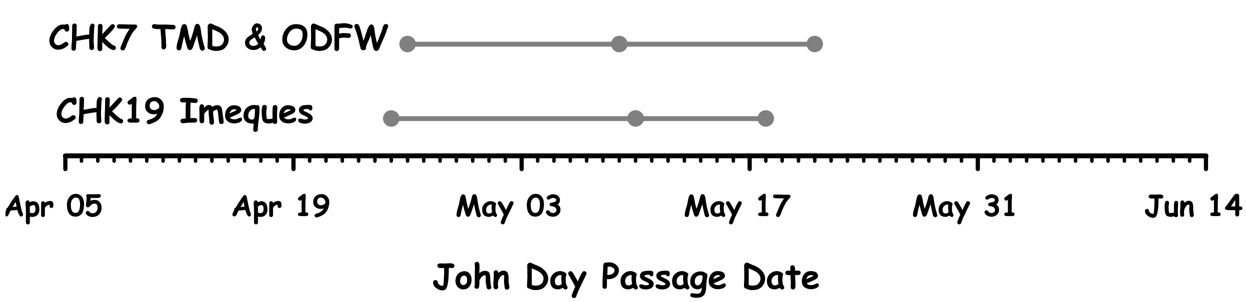


Figure 3-24. 10th, 50th, and 90th percentile dates of expanded detections past John Day Dam for natural Chinook PIT tagged and released in the Umatilla Basin. See Table 3-32 for complete description of the release groups.

Effects of Size at Tagging on Timing

Smaller Chinook passed John Day Dam later in the season than larger fish. We looked at three release groups, and the results were similar in all three. We examined length frequency distributions of Chinook released in Meacham Creek (RM 78.9) and in the Umatilla River (RM 80 and 81) in the fall of 2000 that passed John Day Dam in the early, middle, and late portion of the season, dates of 33% and 67% passage at John Day Dam.

Chinook passing in the middle of the season were shorter than those that passed earlier, and Chinook passing towards the end of the season were shorter than both those passing early and in the middle of the season (Figure 3-25). The dominant length of the early and middle passing Chinook was 90-95mm, compared to 85-90mm for the late group. Thirty percent of the early group was 90mm or smaller compared to 42% and 62% respectively for the middle and late groups. We conducted the same analysis using Chinook released in the spring of 2001 at a similar location. The results were the same with a larger proportion of the run being comprised of smaller fish that migrated later (Figure 3-26). Thirty-four percent of the early group was 90mm or smaller compared to 35% and 50% respectively for the middle and late groups.

The final analysis showed slightly different results using fish released at Three Mile Dam and the Umatilla River at RM 1.2 in 1999. We found that the smallest fish passed in the middle of the season. Distributions of the early and late group were similar to each other. The difference between the middle group and the early and late groups was minor.

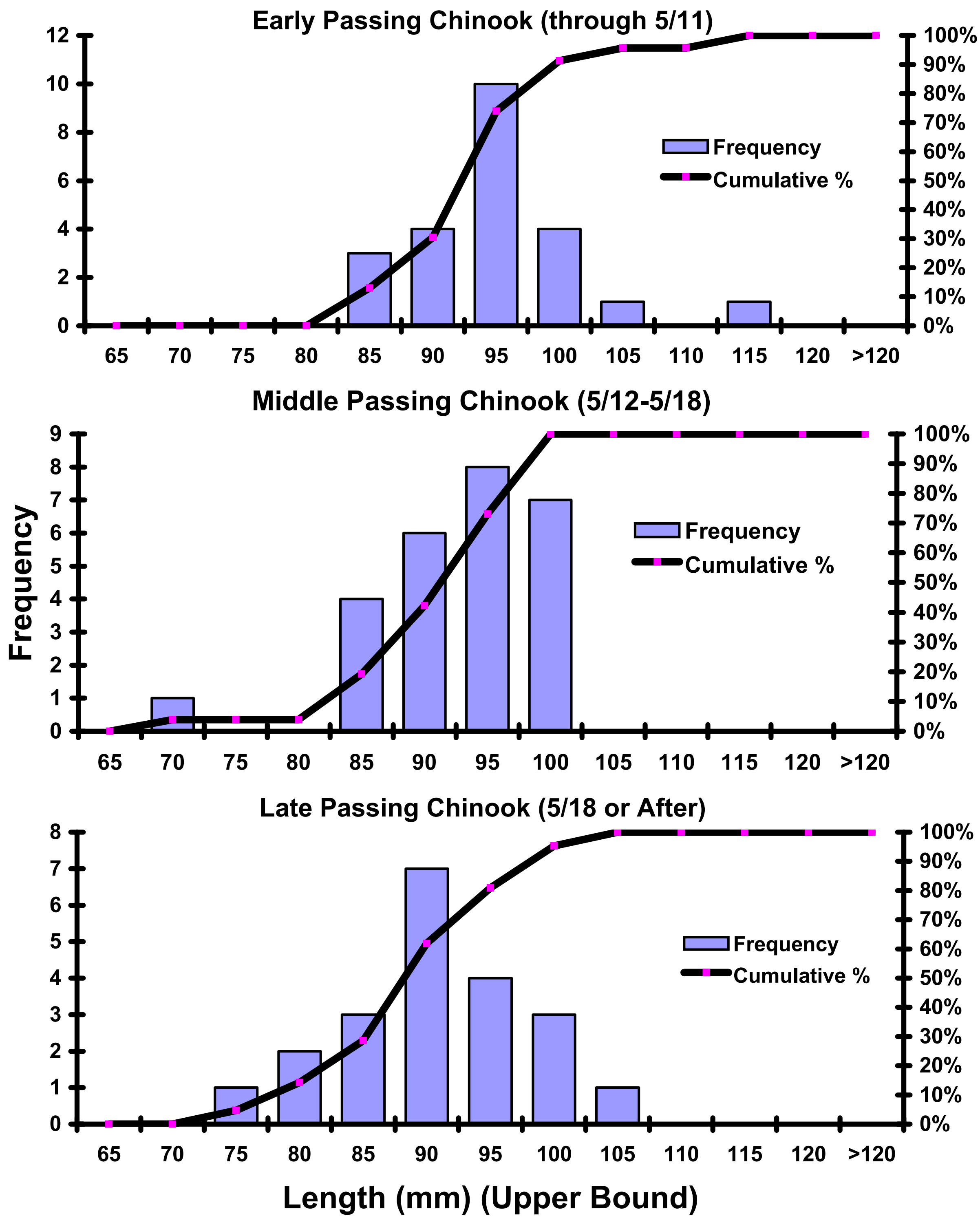


Figure 3-25. Length frequency distribution diagrams of Chinook released in Meacham Creek and the Umatilla River (RM 80 and 81) in the fall of 2000 passing John Day Dam early in the outmigration season, in the middle of the season, and late in the season.

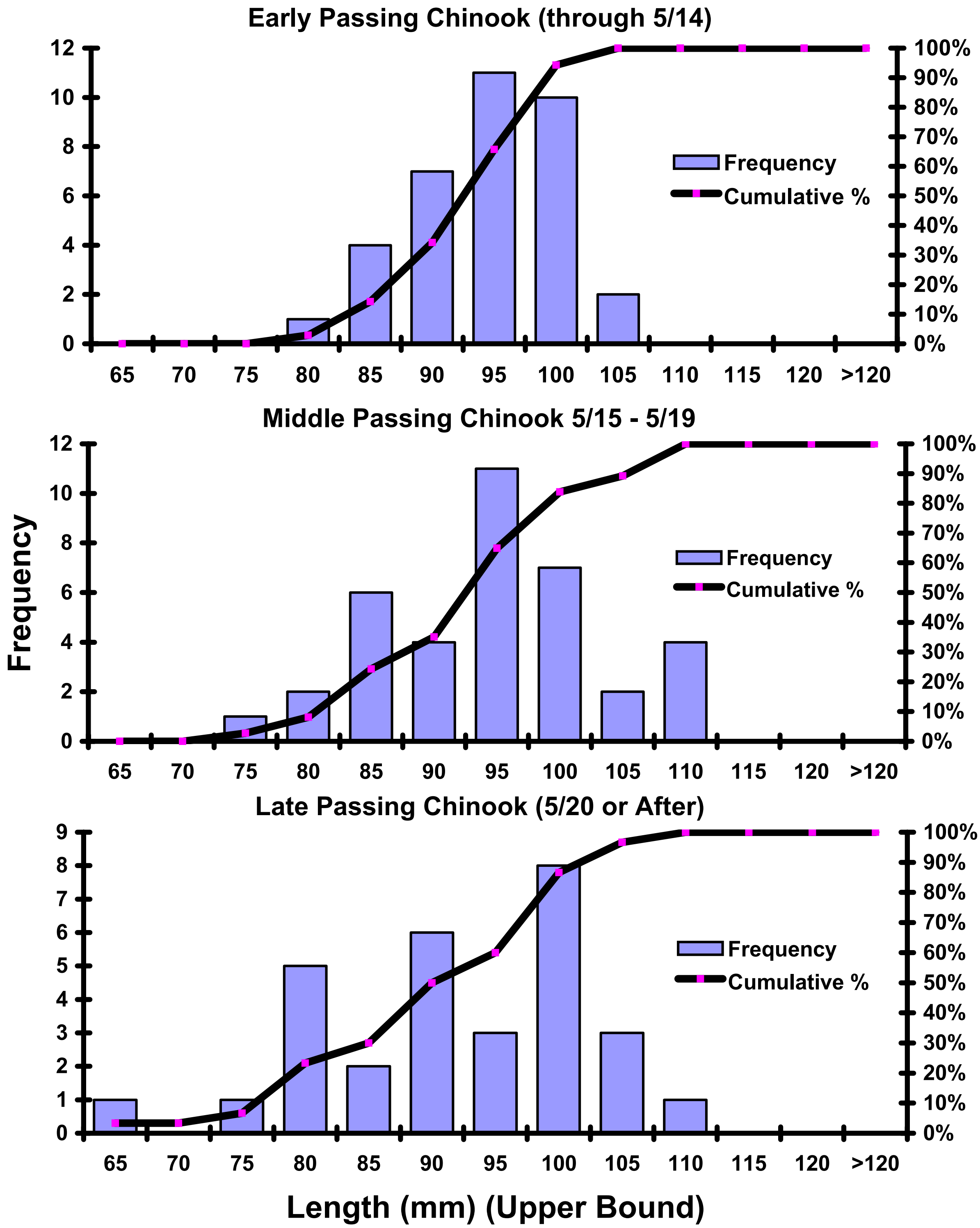


Figure 3-26. Length frequency distribution diagrams of Chinook released at in Meacham Creek and the Umatilla River (RM 80 and 81) in the spring of 2001 passing John Day Dam early in the outmigration season, in the middle of the season, and late in the season.

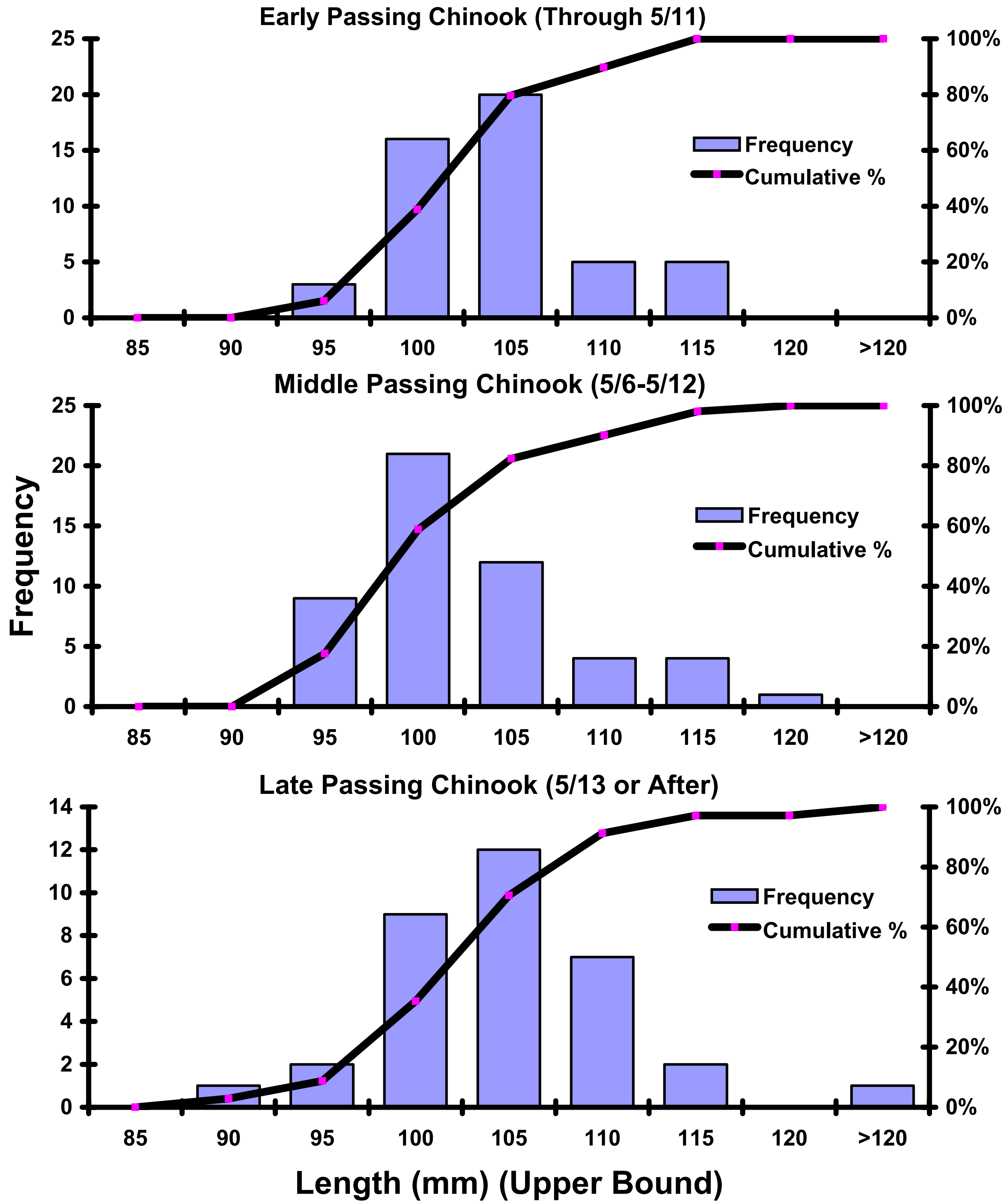


Figure 3-27. Length frequency distribution diagrams of Chinook released at Three Mile Dam and the Umatilla River (RM 1.2) in 1999 passing John Day Dam early in the outmigration season, in the middle of the season, and late in the season.

Chinook Survival

We compared survival to John Day Dam among the same release groups used to evaluate possible differences in migration timing.

Effects of Origin on Survival

We compared survival to John Day Dam of natural and hatchery Chinook for migration years 1999 and 2001. Two comparisons included all fish released within a year, and the other two held release location and release date constant. In all four comparisons survival rates were significantly different (P<0.001) (Table 3-33). In both 1999 comparisons, natural Chinook survived better, and in both 2001 comparisons hatchery Chinook survived better (Table 3-33).

In a comparison of all hatchery and natural releases in 1999, natural Chinook survived at 76.8% compared to 40% for hatchery Chinook. When release location was limited to the lower four miles of the river and release date was held constant, natural fish outsurvived hatchery fish 85.8% to 36.6% (Table 3-33).

When comparing all releases in 2001, hatchery Chinook survived at 43% compared to 25.3% for natural fish. When release locations were near RM 80, and release date was held constant, hatchery Chinook still survived better at 39% to 33.4% (Table 3-33).

Table 3-33. Group codes, descriptions, estimated survival rate and comparative statistics of Chinook release groups used to examine the effects of origin on survival to John Day Dam. Thin lines separate compared groups.

Release Group	Migration Year	Rear Type	Release Location	Release Dates	Length (mm)	Number Released	Estimated Survivors to JDD	Estimated Survival Rate	Survival Comparison P-Value
Natural Vs. Hatchery Groups									
CHK1	1999	N	All	All	All	999	767	0.768	<0.001
CHK2	1999	H	All	All	All	3044	1216	0.400	
CHK4	2001	N	All	All	All	1676	423	0.253	<0.001
CHK5	2001	H	All	All	All	3650	1569	0.430	
CHK7	1999	N	Three Mile Dam & ODFW Trap	3/1-5/31	All	653	560	0.858	<0.001
CHK8	1999	H	Three Mile Dam & ODFW Trap	All	All	1104	404	0.366	
CHK9	2001	N	CTUIR Mainstem Trap & Meacham Cr.	3/1-4/30	All	656	219	0.334	<0.001
CHK10	2001	H	Imeques Acc. Pond	All	All	2911	1134	0.390	

Effects of Release Year on Survival

Survival of natural Chinook was significantly higher in 1999 than in 2001 (76.8% to 25.3%) (Table 3-34).

Table 3-34. Group codes, descriptions, estimated survival rate and comparative statistics of Chinook release groups used to examine the effects of origin on survival to John Day Dam.

Release Group	Migration Year	Rear Type	Release Location	Release Dates	Length (mm)	Number Released	Estimated Survivors to JDD	Estimated Survival Rate	Survival Comparison P-Value
Between Year Groups									
CHK1	1999	N	All	All	All	999	767	0.768	<0.001
CHK4	2001	N	All	All	All	1676	423	0.253	

Effects of Release Season on Survival

Chinook tagged in the spring had a higher survival rate to John Day Dam than fish tagged in the fall. When comparing Chinook released at either the CTUIR mainstem trap of the Meacham Creek trap in the fall (10/1-12/31) to Chinook released in the spring (3/1-4/30), we found that survival of the spring release was significantly higher (33.4%-15.9%) (Table 3-35). We did not estimate overwinter survival by comparing these groups, because the two groups did not overwinter in the same reaches. The fish used in this comparison were captured via screw trap. Fish captured in the fall were migrating out of Meacham Creek and the upper Umatilla River to overwinter below the traps. Fish captured in the spring remained above the traps through winter.

Table 3-35. Group codes, descriptions, estimated survival rate and comparative statistics of Chinook release groups used to examine the effects of release season on survival to John Day Dam.

Release Group	Migration Year	Rear Type	Release Location	Release Dates	Length (mm)	Number Released	Estimated Survivors to JDD	Estimated Survival Rate	Survival Comparison P-Value
Release Season									
CHK11	2001	N	CTUIR Mainstem Trap & Meacham Cr.	10/1-12/31	All	875	139	0.159	<0.001
CHK12	2001	N	CTUIR Mainstem Trap & Meacham Cr.	3/1-4/30	All	656	219	0.334	

Effects of Release Location on Survival

Available data enabled us to make one comparison to examine the effects of release location on survival. In the spring of 1999, Chinook released below RM 4.0 survived at 85.8% compared to 58.2% for Chinook released the same spring at the Imeques Acclimation Pond (RM 80) (Table 3-36). Differences in survival rates to John Day Dam between upstream and downstream groups indicate that survival in the Umatilla River from Imeques Acclimation Pond to Three Mile Dam was 67% in 1999.

Table 3-36. Group codes, descriptions, estimated survival rate and comparative statistics of Chinook release groups used to examine the effects of release location on survival to John Day Dam.

Release Group	Migration Year	Rear Type	Release Location	Release Dates	Length (mm)	Number Released	Estimated Survivors to JDD	Estimated Survival Rate	Survival Comparison P-Value
Release Location Groups									
CHK7	1999	N	Three Mile Dam & ODFW Trap	3/1-5/31	All	653	560	0.858	<0.001
CHK19	1999	N	Imeques Acc. Pond	All	All	227	132	0.582	

Effects of Size at Tagging on Survival

Larger Chinook did not exhibit different survival rates than smaller fish in two release groups in the upper river, but did in a release group in the lower river. We examined length frequency distributions of Chinook released in Meacham Creek and the Umatilla River (RM 80 and 81) in the fall of 2000 that were detected at either Three Mile Dam, John Day Dam or Bonneville Dam, and compared them to the length frequency distribution of all the fish released in the same group. We conducted the same analysis using releases from the same location in the spring of 2001. The survivors were comprised of a slightly greater proportion of small fish and large fish, but less moderate sized fish than the release group (Figure 3-28, Figure 3-29).

We conducted a similar analysis using Chinook released in 1999 at Three Mile Dam and the Umatilla River at RM 1.2. Larger fish survived to detection at higher rates than smaller fish. Sixty percent of Chinook released from these locations were less than 95mm compared to only 9% of the Chinook that survived to detection.

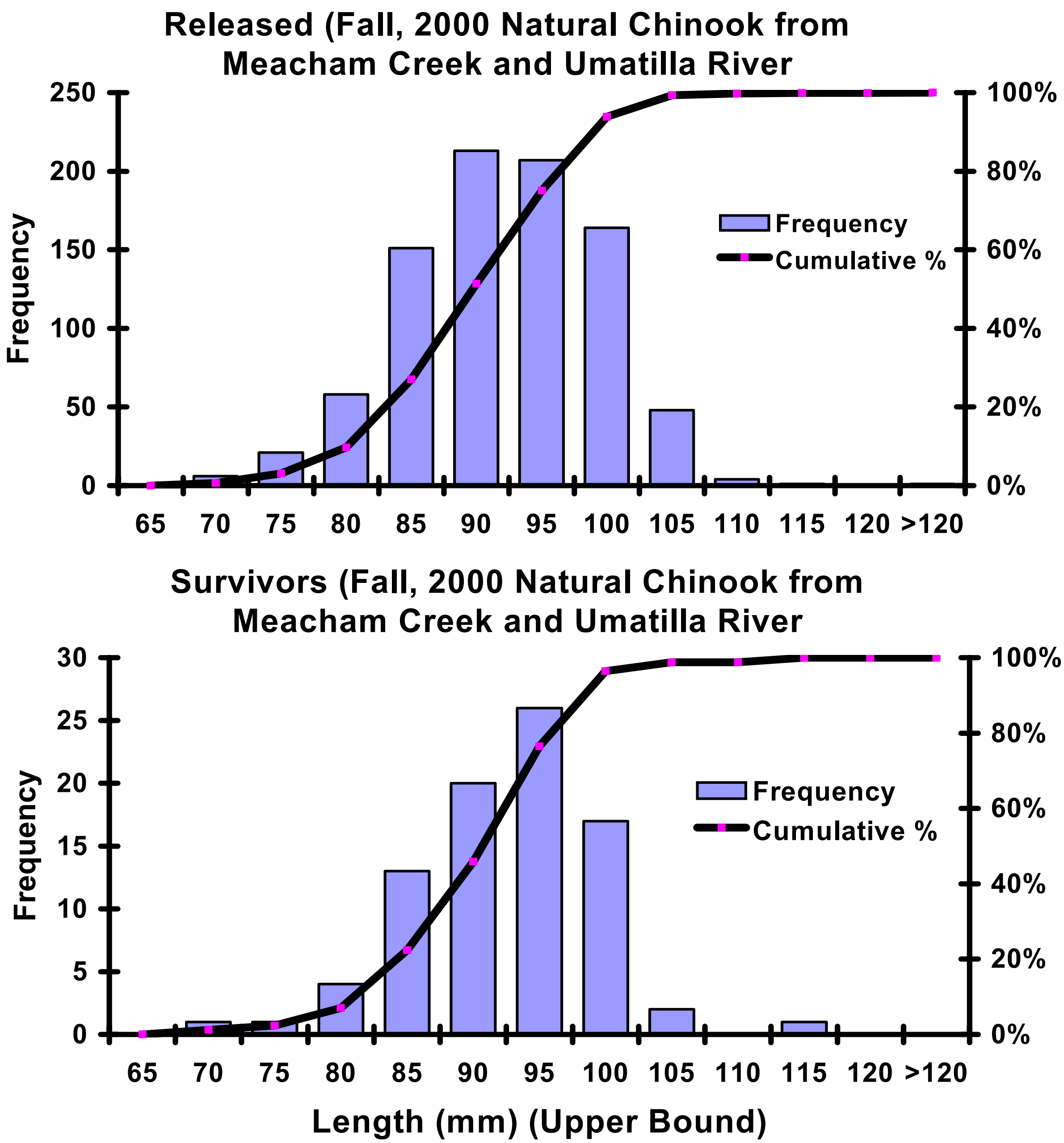


Figure 3-28. Length frequency distributions of Chinook released from Meacham Creek and the Umatilla River (RM 80 and 81) in the fall of 2000 and those that survived to detection.

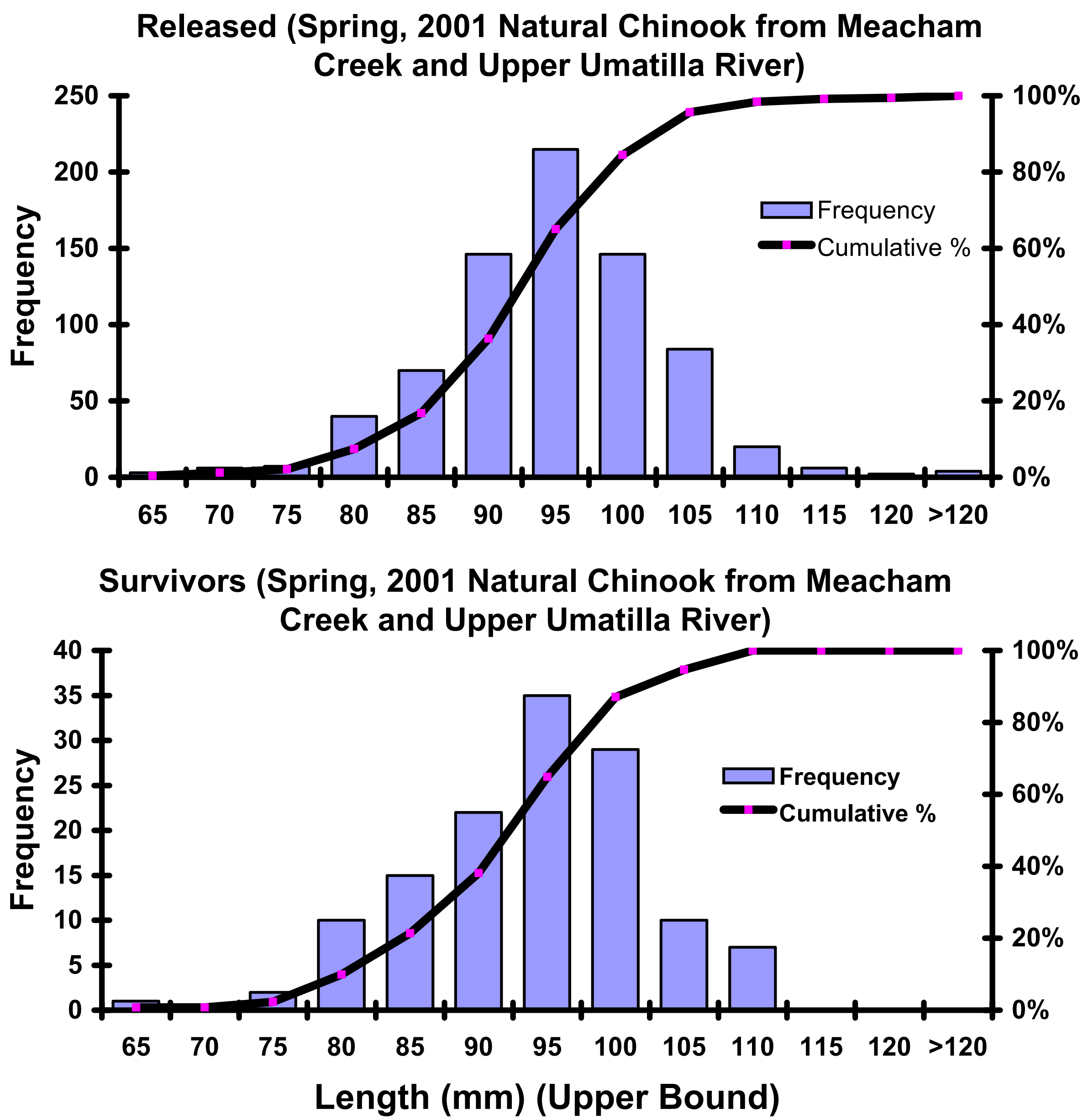


Figure 3-29. Length frequency distributions of Chinook released from Meacham Creek and the Umatilla River (RM 80 and 81) in the spring of 2001 and those that survived to detection

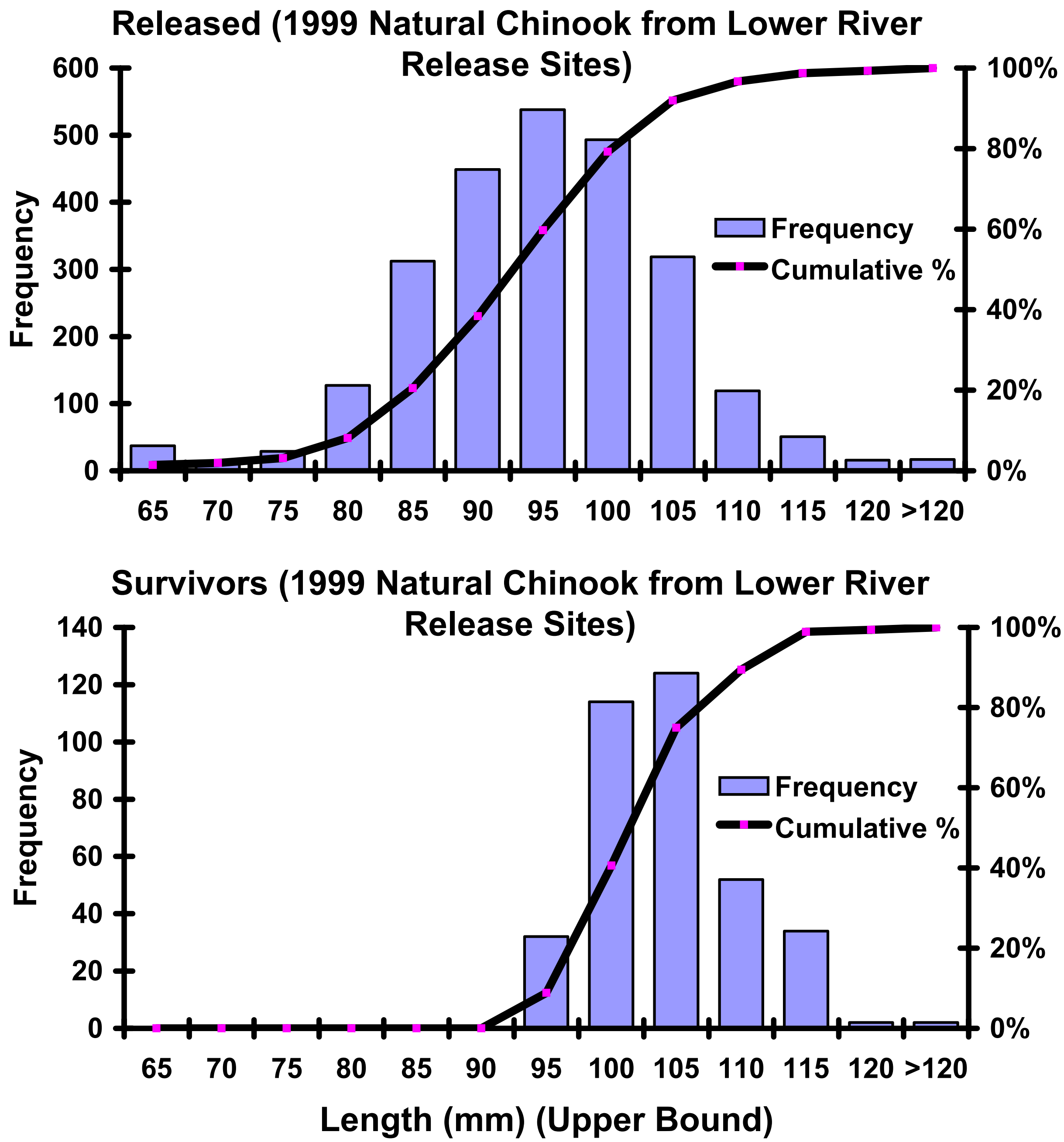


Figure 3-30. Length frequency distributions of Chinook released from Three Mile Dam and the Umatilla River in 1999 and those that survived to detection.

Coho

There were not sufficient detections at John Day Dam of coho released in the Umatilla Basin for comparison among release groups. Only one group met the minimum number of detections we required to estimate timing and survival. In 2000, 12 coho were detected at John Day Dam from 536 PIT-tagged natural coho in the Umatilla Basin. The median John Day Dam passage date of these detections was May 21. The 10^{th}, 50^{th}, and 90^{th} percentile dates were April 20, June 1, and June 5 respectively. The survival rate of this group was 17.5% $\pm$ 11.1(α = 0.05).

Inter-Species comparisons

Inter-Species Timing

Passage at John Day Dam peaked in mid-May for both steelhead and Chinook. We compared all releases of natural steelhead to all releases of natural Chinook in 1999. Both species began their run at nearly the same time. Ten percent of steelhead passing John Day Dam in the season had passed on April 24, and the same percent of Chinook passed on April 25. The migration season of the steelhead was more prolonged. The time between the 10th and 90th percentile dates was 43 days for steelhead as compared to 26 for Chinook. Both the median and 50th percentile dates were earlier for Chinook (May 10 and May 9) than for steelhead (May 17 and May 23) (Figure 3-31).
Results were different in comparing all releases of steelhead and Chinook in 2001. While Chinook maintained a shorter migration period (23 days to 41 days), their median and 50th percentile dates were later than steelhead. The median steelhead passage date was May 6, compared to May 19 for Chinook. The 50th percentile date was May 14 for steelhead and May 18 for Chinook (Figure 3-31).

We compared coho to steelhead in 2000. The duration of passage was similar for the two species at 43 days for steelhead and 46 for coho. Steelhead peak passage was earlier with a median passage date of May 7, compared to May 21 for coho, and a 50th percentile date of May 24 for steelhead as compared to June 1st for coho (Figure 3-31). This comparison is weakened somewhat by the fact that the coho passage timing is based on only 12 detections at John Day Dam.

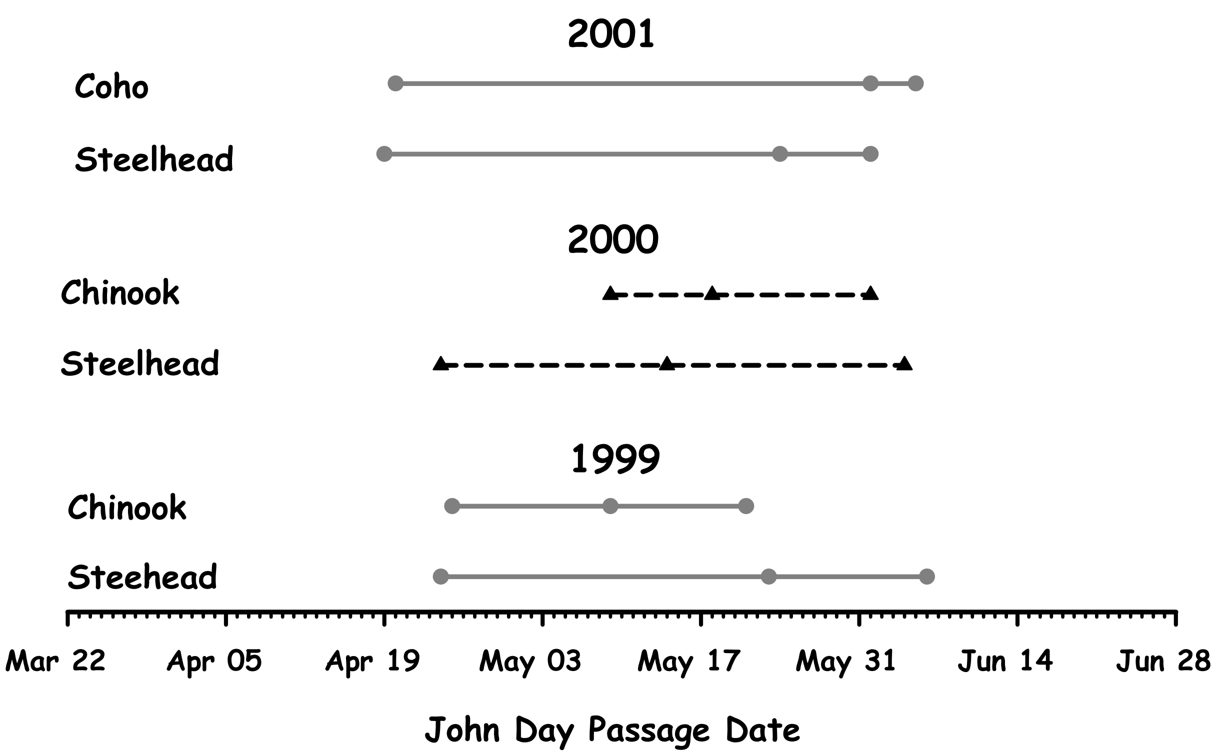


Figure 3-31. 10th, 50th, and 90th percentile dates of expanded detections past John Day Dam for natural steelhead, Chinook and coho for all fish released within each year to John Day Dam.

Inter-Species Survival

We compared survival rates between species where sample size and conditions permitted. Using all releases in 1999 and 2001, Chinook survived at a higher rate than steelhead. Chinook survival in 1999 was 76.8% compared to 51.6% for steelhead, and was 40% in 2001 compared to 16.9% for steelhead (Figure 3-32). Chinook survived at 85.8% compared to 78% for steelhead when we only compared groups released at Three Mile Dam of 78.9). For releases at RM 80-81 of the Umatilla River, the survival rate of Chinook was 33.4% compared to just 12.1% for steelhead (Figure 3-32).

In 2000, accounting for all releases, steelhead survived at 38.9% compared to an all release survival rate of coho of 17.5%. The coho survival is suspect because of a low number of detections at John Day Dam (Figure 3-32).

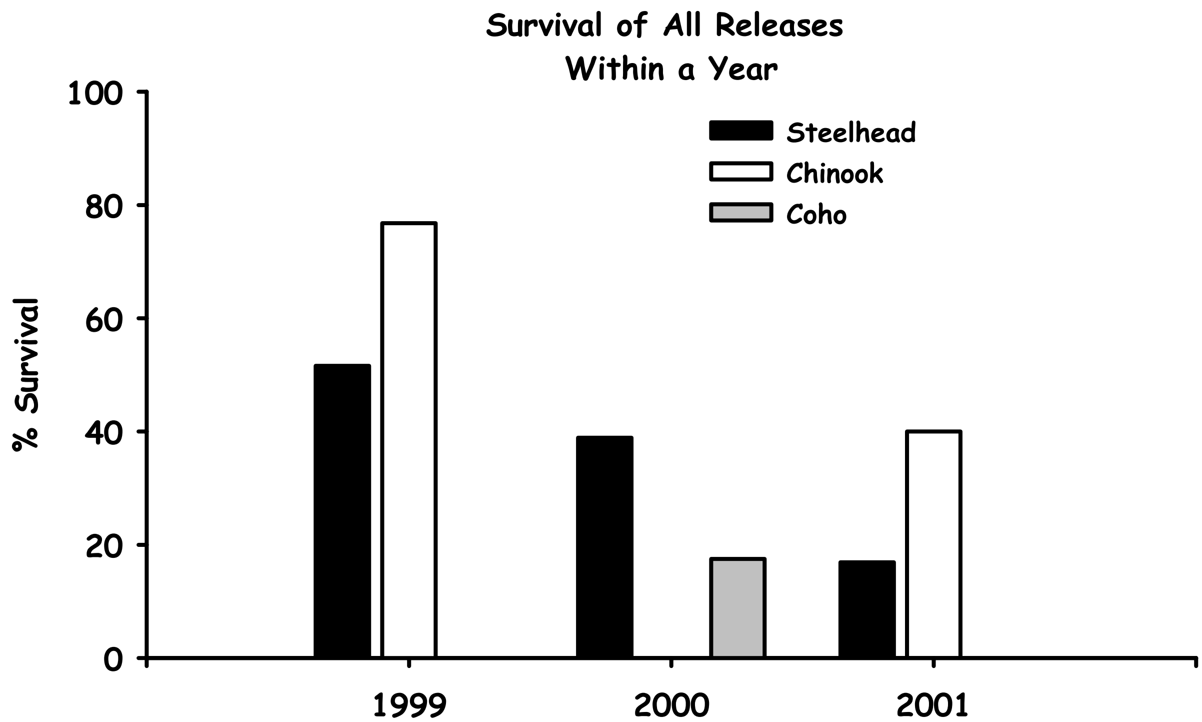


Figure 3-32. Survival rates of steelhead, Chinook and coho for all fish released within each year to John Day Dam.

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This was a BPA funded project and we would like to thank Jay Marcotte and Johnathan McCloud and other BPA personnel for their contributions. We appreciate the assistance of the following individuals. Their actions were critical for the success of the project. S. P. Cramer and Associates: Caryn Ackerman; CTUIR Administration: Michael J. Farrow, Gary James, Michelle Thompson, Julie Burke, Celeste Reeves; CTUIR Fisheries Staff: David Thompson, James Marsh, David Wolf, Brian Conner; ODFW Staff: Tim Bailey, Shannon Jewet, Susanne Knapp, Tara White; CRITFC: Dave Marvin

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APPENDIX A

Detection Efficiency Estimate Methods

A critical component of using PIT tag detections to estimate survival of release groups from one point to another is computing the detection efficiency of the detection point that represents the downstream end of the stream reach over which survival is to be estimated. In this report, the downstream detection point is John Day Dam. PIT-tagged fish passing a dam may do so either by way of the fish bypass system, spillway or through the turbines. Because not all PIT-tagged fish are directed into the bypass system, not all PIT-tagged fish are susceptible to detection. The proportion of fish subject to detection may change from day to day, as environmental conditions change at the dam, especially proportion of flow spilled. By examining detections of PIT-tagged fish at Bonneville Dam downstream, it is possible to come up with a day by day estimate of the proportion of PIT-tagged fish detected vs. not detected as they passed each dam. This proportion (termed "detection efficiency" or "detection probability") is used to expand actual counts of PIT-tagged fish, to arrive at an estimate of the total number of fish arriving at the dam at a particular date. The fundamental concepts used in calculating detection efficiencies were developed by Cramer et al. (1995) and have undergone substantial refinement in later efforts by S. P. Cramer & Associates and by Neeley (2002). The basic formulas for estimating detection efficiency and survival, however, remain the same today as when they were first developed. The detection efficiency is divided directly into actual daily counts of PIT tag detections to arrive at an expanded count (Equation 1). Estimates of survival from release points in the Umatilla Basin to John Day Dam are thus highly influenced by the estimate of detection efficiency.

Equation 1:

$$\text{Detection Efficiency} = \frac{\#\ \text{Bonneville Dam detections previously detected at John Day Dam}}{\text{total Bonneville Dam detections}}$$

$$\text{Release Point - to - John Day Dam Survival} = \left(\frac{\#\ \text{PIT tags detected at John Day Dam}}{\text{detection efficiency}}\right) \Big/ \#\ \text{fish released}$$

Early efforts used median travel time between the John Day Dam and the Bonneville Dam, rather than the full distribution of travel times, to identify arrivals at Bonneville Dam corresponding to a given passage date at John Day Dam. This method necessitated making the assumption that all fish traveling from John Day Dam to Bonneville Dam did so in the same amount of time. However, travel times vary among fish, and over the course of the migration season. While substantial effort was made in earlier studies to stratify travel times into discrete time periods where patterns existed, the inherent variability of fish migration behavior meant that some error necessarily occurred at this step. Neeley (2002) refined the analysis to look at the temporal distribution of downstream detections from each day of John Day Dam detection, so that all real data are used. This method uses a cross tabulation of arrival dates at John Day Dam and corresponding arrival times at Bonneville Dam. We have adopted Neely's cross tabulation method because we believe it is an improvement on earlier methods, in that the true temporal distribution of fish traveling from John Day Dam to downstream Bonneville Dam is incorporated into the detection efficiency estimates, rather than relying on estimates of median travel time that do not capture the full range of the data. The distribution of travel times to downstream detection locations is then reflected in the expanded daily estimates of fish passing John Day Dam.

The methods for the cross tabulation exercise and incorporation into detection efficiency estimates are as follows. Joint John Day Dam and Bonneville Dam detections were cross-tabulated by John Day Dam date detection and Bonneville's date of detection. Within Bonneville Dam's detection date, the relative distribution of joint counts over John Day Dam detection dates was estimated. The resulting relative distribution frequencies were then multiplied by the total Bonneville Dam detections to obtain estimates of Bonneville Dam total detections for a given date. Once this was done for each Bonneville Dam detection date, the estimated total Bonneville Dam detections allocated to each John Day Dam detection date were summed. This gave the estimated total Bonneville Dam detections that passed John Day Dam on the given John Day Dam date. The total joint detections on a given John Day Dam date were then divided by this total, giving an estimated John Day Dam detection efficiency for that date. Appendix Table 3-1-4 depict the method for cross tabulation and estimation of detection efficiency. Values represented in the tables are examples used to illustrate the methods involved.

Appendix Table 3-1**.** Joint John Day Dam and Bonneville Dam counts by John Day Dam and Bonneville Dam dates. Numbers presented are examples to illustrate the concept.

JDD Date (Julian)	n(JDD Date, BON Date [(n(JDD,BON)]							
	BON Site Date (Julian)							
	97	98	99	100	101	**102**	103	Total
93	0	0	0	0	0	**0**	0	**0 (93,x)**
94	0	3(94,98)	5(94,99)	5 (94,100)	6 (94,101)	**0**	0	**19 (94,x)**
95	0	0	3(95,99)	10(95,100)	12 (95,101)	**5 (95,102)**	0	**30 (95,x)**
96	0	0	0	5 (96,100)	5 (94,101)	**10 (96,102)**	5 (96,103)	**25 (96,x)**
97	0	0	0	0	0	**15 (97,102)**	5 (97,103)	**20 (97,x)**
98	0	0	0	0	0	**5 (98,102)**	2 (98,103)	**7 (98,x)**
99	0	0	0	0	0	**0**	0	**0 (99,x)**
100	0	0	0	0	0	**0**	0	**0 (200,x)**
Total	0 (x,97)	3 (x,98)	8 (x,99)	20 (x,100)	23 (x,101)	**35 (x,102)**	12 (x,103)	

Appendix Table 3-2. For each Bonneville Dam date, the distribution of John Day Dam contributions is estimated. Numbers presented are examples to illustrate the concept.

JDD Date Julian	p(JDD,BON) = n(JDD,BON)/(n(BON)				
	BON Date (Julian)				
	…	100	101	**102**	103
93	…	0	0	**0**	0
94	…	0.625	0.25	**0**	0
95	…	0.375	0.50	**p = (5/35) = .143**	0
96	…	0	0.25	**p = (10/35) = .286**	0.417
97	…	0	0	**p = (15/35) = .429**	0.417
98	…	0	0	**p = (5/35) = .143**	0.167
99	…	0	0	**0**	0
100	…	0	0	**0**	0
Total	1	1	1	**1**	1

Appendix Table 3-3. Daily Bonneville Dam counts [N(BON)] are allocated over John Day Dam dates using distributions from

JDD Date Julian	N'(JDD,BON) = p(JDD,BON)*N(BON)					JDD Date Total N' (JDD,X)
	BON Date (Julian)					
	…	100	101	**102**	103	
BON Detections	…	15(100)	50(101)	**100(102)**	50(103)	
93	…	0	0	**0**	0	**0**
94	…	9.38	12.5	**0**	0	**21.88**
95	…	5.63	25	**N' = (.143*100) = 14.3**	0	**44.93**
96	…	0	12.5	**N' = (.286*100) = 28.6**	20.9	**62**
97	…	0	0	**N' = (.429*100) = 42.9**	20.9	**63.8**
98	…	0	0	**N' = (.143*100) = 14.3**	8.4	**22.7**
99	…	0	0	**0**	0	**0**
100	…	0	0	**0**	0	**0**
Total	…	15	50	**100**	50	215.31

Appendix Table 3-4. Daily John Day Dam joint detections (Appendix Table 3-1) and total and total detections are used to compute John Day Dam daily detection rates. Numbers used are examples to illustrate the concept.

JDD Date (Julian)	Table 1 n Total	Table 3 N' Total	Estimated Detection Rate: DR = n/N'
93	0	0	**--**
94	19	21.88	**0.868**
95	30	44.93	**0.668**
96	25	62	**0.403**
97	20	63.8	**0.313**
98	7	22.7	**0.308**
99	0	0	**--**
100	0	0	**--**

In order to assemble the largest possible data set from which to calculate detection efficiencies, we used all Columbia Basin PIT-tagged fish originating upstream of the Umatilla River in addition to those from the Umatilla Basin. All these fish are intermingled and experience similar conditions at John Day Dam, because fish originating upstream from the mouth of the Umatilla join with Umatilla origin fish at the head of John Day Dam pool and travel together for a distance of over 75 miles before encountering John Day Dam.

We estimated daily detection efficiencies at John Day Dam for 1999 – 2002, and then aggregated over periods of homogeneous detection efficiency at the dam. We attempted to aggregate over periods resulting in large enough sample sizes to provide useful confidence bounds on our estimates, while also keeping the period short enough that collection efficiencies would be relatively homogeneous within the period. We set the dividing dates between periods of similar detection probability according to two criteria in decreasing priority: (1) the number of PIT tags detected at both John Day Dam and Bonneville Dam (dual detections) was at least 15 for the period, and (2) there was no trend of change in daily estimates of detection probability within the period

APPENDIX B

Appendix Table 3-5. Daily joint John Day Dam to Bonneville Dam (Chinook)

1999			2000			2001			2002		
John Day Dam Date	Dual Detections	Detect.. Rate	John Day Dam Date	Dual Detections	Detect. Rate	John Day Dam Date	Dual Detections	Detect. Rate	John Day Dam Date	Dual Detections	Detect. Rate
4/1/1999	1	1.00	4/3/2000	2	0.21	4/7/2001	1	0.70	4/3/2002	1	1.00
4/8/1999	1	1.00	4/4/2000	3	0.50	4/9/2001	1	1.00	4/6/2002	1	1.00
4/9/1999	2	0.50	4/5/2000	4	0.47	4/13/2001	2	0.58	4/14/2002	1	0.13
4/10/1999	1	0.67	4/6/2000	8	0.51	4/20/2001	1	1.00	4/17/2002	3	0.24
4/11/1999	2	0.31	4/7/2000	5	0.58	4/21/2001	1	0.56	4/18/2002	6	0.34
4/12/1999	1	0.33	4/8/2000	8	0.68	4/22/2001	3	0.52	4/19/2002	12	0.37
4/14/1999	1	0.50	4/9/2000	3	0.61	4/23/2001	6	0.54	4/20/2002	5	0.25
4/15/1999	2	0.25	4/10/2000	11	0.68	4/24/2001	7	0.59	4/21/2002	9	0.22
4/16/1999	3	0.21	4/11/2000	4	0.58	4/25/2001	9	0.57	4/22/2002	15	0.31
4/17/1999	1	0.50	4/12/2000	10	0.61	4/26/2001	3	0.67	4/23/2002	31	0.34
4/18/1999	2	0.15	4/13/2000	9	0.58	4/27/2001	14	0.60	4/24/2002	29	0.28
4/19/1999	5	0.27	4/14/2000	23	0.62	4/28/2001	35	0.60	4/25/2002	15	0.29
4/20/1999	5	0.21	4/15/2000	14	0.55	4/29/2001	78	0.59	4/26/2002	17	0.24
4/21/1999	11	0.26	4/16/2000	13	0.46	4/30/2001	144	0.60	4/27/2002	44	0.24
4/22/1999	17	0.33	4/17/2000	5	0.35	5/1/2001	82	0.61	4/28/2002	34	0.22
4/23/1999	19	0.34	4/18/2000	13	0.38	5/2/2001	32	0.61	4/29/2002	24	0.20
4/24/1999	16	0.33	4/19/2000	8	0.33	5/3/2001	23	0.60	4/30/2002	31	0.20
4/25/1999	25	0.16	4/20/2000	15	0.31	5/4/2001	15	0.60	5/1/2002	65	0.25
4/26/1999	26	0.33	4/21/2000	13	0.31	5/5/2001	24	0.57	5/2/2002	105	0.29
4/27/1999	19	0.35	4/22/2000	9	0.27	5/6/2001	21	0.58	5/3/2002	123	0.33
4/28/1999	38	0.35	4/23/2000	11	0.28	5/7/2001	15	0.56	5/4/2002	80	0.31
4/29/1999	53	0.22	4/24/2000	20	0.30	5/8/2001	8	0.59	5/5/2002	96	0.31
4/30/1999	19	0.07	4/25/2000	31	0.32	5/9/2001	11	0.67	5/6/2002	125	0.32
5/3/1999	63	0.23	4/26/2000	22	0.30	5/10/2001	29	0.64	5/7/2002	153	0.33
5/4/1999	134	0.31	4/27/2000	8	0.32	5/11/2001	28	0.57	5/8/2002	280	0.34
5/5/1999	124	0.29	4/28/2000	12	0.32	5/12/2001	22	0.48	5/9/2002	202	0.26
5/6/1999	141	0.28	4/29/2000	30	0.35	5/13/2001	42	0.47	5/10/2002	96	0.14
5/7/1999	122	0.23	4/30/2000	38	0.37	5/14/2001	36	0.52	5/11/2002	93	0.12
5/8/1999	76	0.18	5/1/2000	55	0.36	5/15/2001	43	0.56	5/12/2002	85	0.13
5/9/1999	98	0.21	5/2/2000	63	0.32	5/16/2001	149	0.57	5/13/2002	116	0.16
5/10/1999	175	0.31	5/3/2000	65	0.33	5/17/2001	77	0.57	5/14/2002	372	0.32
5/11/1999	133	0.36	5/4/2000	77	0.26	5/18/2001	132	0.57	5/15/2002	894	0.35
5/12/1999	196	0.30	5/5/2000	39	0.21	5/19/2001	98	0.54	5/16/2002	536	0.28
5/13/1999	93	0.22	5/6/2000	44	0.17	5/20/2001	54	0.53	5/17/2002	686	0.24
5/14/1999	76	0.18	5/7/2000	24	0.18	5/21/2001	67	0.54	5/18/2002	472	0.16
5/15/1999	84	0.19	5/8/2000	40	0.17	5/22/2001	48	0.44	5/19/2002	272	0.10
5/16/1999	162	0.28	5/9/2000	82	0.16	5/23/2001	55	0.39	5/20/2002	275	0.11
5/17/1999	337	0.35	5/10/2000	46	0.11	5/24/2001	130	0.63	5/21/2002	267	0.15
5/18/1999	344	0.30	5/11/2000	41	0.07	5/25/2001	156	0.29	5/22/2002	590	0.23
5/19/1999	147	0.23	5/12/2000	28	0.07	5/26/2001	43	0.08	5/23/2002	711	0.28
5/20/1999	101	0.18	5/13/2000	20	0.06	5/27/2001	16	0.04	5/24/2002	775	0.22
5/21/1999	92	0.17	5/14/2000	25	0.07	5/28/2001	11	0.05	5/25/2002	537	0.17
5/22/1999	122	0.21	5/15/2000	49	0.08	5/29/2001	77	0.13	5/26/2002	139	0.13
5/23/1999	155	0.22	5/16/2000	17	0.04	5/30/2001	163	0.24	5/27/2002	101	0.15
5/24/1999	111	0.17	5/17/2000	10	0.04	5/31/2001	123	0.25	5/28/2002	598	0.24
5/25/1999	108	0.16	5/18/2000	5	0.03	6/1/2001	282	0.21	5/29/2002	559	0.32

1999		
John Day Dam Date	Dual Detections	Detect.. Rate
5/26/1999	90	0.15
5/27/1999	96	0.14
5/28/1999	101	0.13
5/29/1999	88	0.12
5/30/1999	84	0.13
5/31/1999	56	0.18
6/1/1999	65	0.23
6/2/1999	63	0.29
6/3/1999	31	0.32
6/4/1999	18	0.31
6/5/1999	8	0.40
6/6/1999	26	0.38
6/7/1999	13	0.39
6/8/1999	8	0.27
6/9/1999	3	0.17
6/10/1999	9	0.43
6/11/1999	6	0.34
6/12/1999	7	0.23
6/13/1999	1	0.17
6/14/1999	2	0.33
6/16/1999	3	0.17
6/17/1999	9	0.24
6/18/1999	10	0.28
6/19/1999	12	0.26
6/20/1999	5	0.35
6/21/1999	16	0.37
6/22/1999	8	0.38
6/23/1999	5	0.29
6/24/1999	10	0.36
6/25/1999	9	0.50
6/26/1999	5	0.29
6/27/1999	4	0.26
6/28/1999	7	0.30
6/29/1999	3	0.15
6/30/1999	3	0.07
7/1/1999	3	0.16
7/2/1999	2	0.14
7/4/1999	1	0.14
7/5/1999	2	0.20
7/6/1999	2	0.33
7/8/1999	2	0.09
7/12/1999	1	0.13
7/15/1999	1	0.14
7/16/1999	1	0.10
7/19/1999	1	0.13
7/24/1999	1	0.50
7/26/1999	2	0.36
7/28/1999	1	0.22

2000		
John Day Dam Date	Dual Detections	Detect. Rate
5/19/2000	13	0.03
5/20/2000	11	0.03
5/21/2000	20	0.03
5/22/2000	25	0.03
5/23/2000	22	0.03
5/24/2000	12	0.03
5/25/2000	5	0.02
5/26/2000	6	0.03
5/27/2000	10	0.05
5/28/2000	20	0.03
5/29/2000	6	0.02
5/30/2000	9	0.02
5/31/2000	10	0.04
6/1/2000	2	0.02
6/3/2000	1	0.07
6/4/2000	12	0.08
6/5/2000	8	0.08
6/6/2000	1	0.11
6/8/2000	2	0.11
6/10/2000	1	0.02
6/11/2000	1	0.01
6/13/2000	1	0.05
6/14/2000	2	0.05
6/15/2000	1	0.05
6/17/2000	1	0.08
6/19/2000	1	0.09
6/21/2000	1	0.40
6/25/2000	1	0.40
6/28/2000	1	0.50

2001		
John Day Dam Date	Dual Detections	Detect. Rate
6/2/2001	95	0.14
6/3/2001	69	0.13
6/4/2001	94	0.19
6/5/2001	52	0.26
6/6/2001	45	0.34
6/7/2001	36	0.41
6/8/2001	41	0.45
6/9/2001	140	0.41
6/10/2001	40	0.31
6/11/2001	10	0.21
6/12/2001	35	0.29
6/13/2001	10	0.22
6/14/2001	12	0.28
6/15/2001	19	0.35
6/16/2001	11	0.46
6/17/2001	1	0.55
6/18/2001	9	0.67
6/19/2001	13	0.72
6/20/2001	44	0.85
6/21/2001	25	0.77
6/22/2001	26	0.75
6/23/2001	6	0.74
6/24/2001	12	0.58
6/25/2001	4	0.47
6/26/2001	6	0.59
6/27/2001	12	0.70
6/28/2001	8	0.79
6/29/2001	5	0.82
6/30/2001	2	0.83
7/1/2001	2	0.80
7/2/2001	1	0.67
7/3/2001	3	0.60
7/4/2001	6	0.67
7/6/2001	1	1.00
7/8/2001	1	1.00
7/10/2001	1	0.50
7/11/2001	1	1.00
7/28/2001	1	1.00
8/8/2001	1	1.00
9/2/2001	1	1.00
9/5/2001	1	1.00

2002		
John Day Dam Date	Dual Detections	Detect. Rate
5/30/2002	447	0.38
5/31/2002	270	0.40
6/1/2002	255	0.31
6/2/2002	137	0.23
6/3/2002	40	0.16
6/4/2002	48	0.18
6/5/2002	34	0.20
6/6/2002	30	0.17
6/7/2002	17	0.13
6/8/2002	38	0.17
6/9/2002	42	0.28
6/10/2002	42	0.28
6/11/2002	35	0.22
6/12/2002	21	0.22
6/13/2002	23	0.25
6/14/2002	25	0.38
6/15/2002	12	0.27
6/16/2002	5	0.23
6/17/2002	7	0.27
6/18/2002	4	0.30
6/19/2002	2	0.33
6/20/2002	6	0.44
6/21/2002	5	0.50
6/22/2002	8	0.46
6/23/2002	2	0.43
6/24/2002	2	0.11
6/25/2002	1	0.22
6/26/2002	2	0.08
6/27/2002	1	0.25
6/28/2002	5	0.28
6/29/2002	3	0.21
7/2/2002	3	0.29
7/3/2002	2	0.31
7/11/2002	5	0.42
7/12/2002	10	0.45
7/13/2002	12	0.34
7/15/2002	1	0.33
7/17/2002	2	0.36
7/18/2002	1	0.40
7/22/2002	1	1.00
7/23/2002	2	0.71
7/24/2002	3	0.72

Appendix Table 3-6. John Day Dam - Bonneville Dam (Steelhead)

1999			2000			2001			2002		
John Day Dam Date	Dual Detections	Detect. Rate	John Day Dam Date	Dual Detections	Detect.t Rate	John Day Dam Date	Dual Detections	Detect. Rate	John Day Dam Date	Dual Detections	Detect. Rate
4/11/1999	1	0.50	4/8/2000	1	1.00	4/1/2001	1	1.00	3/23/2002	.	1.00
4/13/1999	1	0.50	4/10/2000	1	1.00	4/9/2001	1	1.00	4/3/2002	5	0.83
4/16/1999	3	0.36	4/11/2000	3	0.51	4/13/2001	1	1.00	4/4/2002	2	1.00
4/17/1999	6	0.23	4/12/2000	4	0.75	4/16/2001	1	1.00	4/5/2002	1	1.00
4/18/1999	3	0.07	4/13/2000	7	0.64	4/18/2001	1	1.00	4/8/2002	1	1.00
4/19/1999	4	0.31	4/14/2000	6	0.32	4/19/2001	4	0.94	4/9/2002	1	1.00
4/20/1999	8	0.24	4/15/2000	10	0.39	4/21/2001	1	0.50	4/10/2002	1	1.00
4/21/1999	7	0.28	4/16/2000	6	0.44	4/24/2001	4	0.84	4/12/2002	1	0.60
4/22/1999	19	0.31	4/17/2000	8	0.41	4/25/2001	2	1.00	4/13/2002	1	0.60
4/23/1999	13	0.14	4/18/2000	18	0.36	4/26/2001	4	0.61	4/14/2002	2	0.35
4/24/1999	16	0.29	4/19/2000	25	0.28	4/27/2001	1	0.72	4/15/2002	5	0.50
4/25/1999	30	0.23	4/20/2000	17	0.22	4/28/2001	2	0.79	4/16/2002	3	0.38
4/26/1999	17	0.21	4/21/2000	17	0.23	4/29/2001	7	0.75	4/17/2002	4	0.34
4/27/1999	26	0.20	4/22/2000	36	0.28	4/30/2001	14	0.81	4/18/2002	12	0.53
4/28/1999	39	0.20	4/23/2000	49	0.29	5/1/2001	23	0.73	4/19/2002	3	0.35
4/29/1999	75	0.11	4/24/2000	77	0.26	5/2/2001	10	0.70	4/20/2002	10	0.32
4/30/1999	32	0.14	4/25/2000	151	0.27	5/3/2001	5	0.61	4/21/2002	16	0.40
5/3/1999	89	0.26	4/26/2000	183	0.26	5/4/2001	8	0.55	4/22/2002	18	0.22
5/4/1999	251	0.29	4/27/2000	73	0.25	5/5/2001	6	0.55	4/23/2002	7	0.09
5/5/1999	291	0.27	4/28/2000	97	0.24	5/6/2001	9	0.64	4/24/2002	12	0.20
5/6/1999	222	0.29	4/29/2000	134	0.25	5/7/2001	16	0.61	4/25/2002	15	0.29
5/7/1999	246	0.29	4/30/2000	128	0.26	5/8/2001	3	0.64	4/26/2002	6	0.24
5/8/1999	196	0.28	5/1/2000	161	0.27	5/9/2001	5	0.54	4/27/2002	5	0.14
5/9/1999	218	0.28	5/2/2000	164	0.26	5/10/2001	5	0.51	4/28/2002	22	0.10
5/10/1999	392	0.29	5/3/2000	156	0.24	5/11/2001	29	0.67	4/29/2002	23	0.08
5/11/1999	277	0.29	5/4/2000	145	0.22	5/12/2001	49	0.73	4/30/2002	12	0.10
5/12/1999	223	0.29	5/5/2000	94	0.21	5/13/2001	10	0.71	5/1/2002	31	0.19
5/13/1999	276	0.29	5/6/2000	62	0.19	5/14/2001	12	0.72	5/2/2002	43	0.27
5/14/1999	239	0.30	5/7/2000	82	0.17	5/15/2001	10	0.69	5/3/2002	80	0.24
5/15/1999	266	0.30	5/8/2000	73	0.16	5/16/2001	15	0.64	5/4/2002	19	0.22
5/16/1999	187	0.29	5/9/2000	102	0.16	5/17/2001	21	0.65	5/5/2002	22	0.21
5/17/1999	317	0.30	5/10/2000	76	0.15	5/18/2001	12	0.48	5/6/2002	7	0.11
5/18/1999	282	0.28	5/11/2000	67	0.14	5/19/2001	13	0.54	5/7/2002	9	0.11
5/19/1999	320	0.28	5/12/2000	67	0.14	5/20/2001	29	0.72	5/8/2002	33	0.11
5/20/1999	302	0.30	5/13/2000	76	0.14	5/21/2001	48	0.71	5/9/2002	16	0.09
5/21/1999	340	0.34	5/14/2000	57	0.15	5/22/2001	27	0.62	5/10/2002	11	0.12
5/22/1999	352	0.35	5/15/2000	81	0.14	5/23/2001	39	0.62	5/11/2002	15	0.15
5/23/1999	340	0.37	5/16/2000	49	0.14	5/24/2001	23	0.60	5/12/2002	14	0.20
5/24/1999	234	0.39	5/17/2000	49	0.13	5/25/2001	8	0.28	5/13/2002	7	0.15
5/25/1999	223	0.41	5/18/2000	29	0.10	5/26/2001	10	0.10	5/14/2002	5	0.12
5/26/1999	317	0.41	5/19/2000	19	0.10	5/27/2001	3	0.10	5/15/2002	15	0.12
5/27/1999	273	0.40	5/20/2000	16	0.08	5/28/2001	4	0.12	5/16/2002	13	0.08
5/28/1999	288	0.39	5/21/2000	40	0.10	5/29/2001	6	0.10	5/17/2002	15	0.08
5/29/1999	399	0.37	5/22/2000	27	0.10	5/30/2001	15	0.14	5/18/2002	20	0.14
5/30/1999	547	0.40	5/23/2000	47	0.08	5/31/2001	16	0.13	5/19/2002	38	0.20
5/31/1999	333	0.35	5/24/2000	28	0.07	6/1/2001	18	0.15	5/20/2002	21	0.22

1999		
John Day Dam Date	Dual Detections	Detect. Rate
6/1/1999	381	0.33
6/2/1999	305	0.31
6/3/1999	123	0.35
6/4/1999	63	0.41
6/5/1999	57	0.45
6/6/1999	43	0.44
6/7/1999	38	0.36
6/8/1999	25	0.28
6/9/1999	4	0.19
6/10/1999	4	0.17
6/11/1999	6	0.26
6/12/1999	6	0.28
6/13/1999	5	0.27
6/14/1999	2	0.26
6/15/1999	4	0.19
6/16/1999	3	0.35
6/17/1999	16	0.29
6/18/1999	14	0.29
6/19/1999	8	0.25
6/20/1999	4	0.25
6/21/1999	8	0.46
6/22/1999	9	0.47
6/23/1999	8	0.42
6/24/1999	12	0.34
6/25/1999	7	0.45
6/26/1999	3	0.50
6/27/1999	10	0.26
6/28/1999	4	0.20
6/29/1999	4	0.27
6/30/1999	7	0.26
7/1/1999	4	0.18
7/2/1999	3	0.16
7/3/1999	2	0.03
7/4/1999	1	0.08
7/6/1999	1	0.07
7/8/1999	2	0.09
7/12/1999	1	0.14
7/15/1999	1	0.14
7/16/1999	1	0.10
7/19/1999	1	0.13
7/24/1999	1	0.50
7/26/1999	1	0.22
7/28/1999	1	0.22

2000		
John Day Dam Date	Dual Detections	Detect.t Rate
5/25/2000	9	0.06
5/26/2000	11	0.08
5/27/2000	10	0.07
5/28/2000	16	0.10
5/29/2000	15	0.06
5/30/2000	8	0.06
5/31/2000	9	0.07
6/1/2000	1	0.10
6/2/2000	5	0.05
6/3/2000	5	0.05
6/4/2000	20	0.07
6/5/2000	8	0.08
6/6/2000	2	0.05
6/7/2000	2	0.06
6/8/2000	1	0.06
6/9/2000	3	0.07
6/12/2000	1	0.02
6/16/2000	1	0.33
6/25/2000	1	0.50
6/28/2000	1	1.00

2001		
John Day Dam Date	Dual Detections	Detect. Rate
6/2/2001	4	0.07
6/3/2001	2	0.13
6/4/2001	5	0.13
6/6/2001	6	0.09
6/7/2001	1	0.06
6/8/2001	5	0.17
6/9/2001	6	0.06
6/11/2001	2	0.05
6/12/2001	2	0.12
6/13/2001	1	0.09
6/14/2001	3	0.10
6/15/2001	2	0.11
6/16/2001	1	0.11
6/19/2001	1	0.14
6/21/2001	4	0.17
6/22/2001	2	0.32
6/23/2001	2	0.30
6/24/2001	1	0.09
6/25/2001	1	0.08
6/26/2001	2	0.36
6/27/2001	6	0.41
6/28/2001	2	0.40
6/30/2001	1	0.50
7/3/2001	1	0.40
7/4/2001	3	0.29
7/18/2001	1	1.00
7/29/2001	1	1.00

2002		
John Day Dam Date	Dual Detections	Detect. Rate
5/21/2002	14	0.24
5/22/2002	18	0.17
5/23/2002	12	0.07
5/24/2002	18	0.05
5/25/2002	16	0.04
5/27/2002	13	0.08
5/28/2002	59	0.20
5/29/2002	76	0.18
5/30/2002	22	0.07
5/31/2002	11	0.05
6/1/2002	14	0.06
6/2/2002	7	0.08
6/3/2002	8	0.02
6/4/2002	6	0.02
6/5/2002	5	0.02
6/6/2002	4	0.03
6/7/2002	7	0.05
6/8/2002	31	0.10
6/9/2002	21	0.13
6/10/2002	23	0.17
6/11/2002	17	0.25
6/12/2002	37	0.32
6/13/2002	38	0.32
6/14/2002	12	0.27
6/15/2002	6	0.26
6/16/2002	2	0.29
6/17/2002	1	0.04
6/19/2002	2	0.07
6/20/2002	5	0.12
6/22/2002	1	0.08
6/24/2002	1	0.13
6/25/2002	2	0.22
6/26/2002	2	0.22
6/27/2002	1	0.13
6/28/2002	2	0.08
6/29/2002	3	0.08
7/2/2002	1	0.17
7/11/2002	5	0.40
7/12/2002	9	0.40
7/13/2002	8	0.31
7/15/2002	1	0.50
7/17/2002	2	0.50
7/18/2002	1	0.50
7/23/2002	1	1.00

Appendix Table 3-7. John Day Dam - Bonneville Dam (Coho)

John Day Dam Date	Dual Detections	Detect. Rate
4/22/1999	1	0.07
4/27/1999	1	0.10
4/29/1999	4	0.11
5/3/1999	1	0.06
5/4/1999	2	0.13
5/5/1999	4	0.10
5/6/1999	1	0.10
5/7/1999	3	0.12
5/8/1999	3	0.07
5/9/1999	2	0.20
5/10/1999	3	0.20
5/11/1999	4	0.17
5/12/1999	6	0.12
5/13/1999	1	0.13
5/14/1999	3	0.07
5/15/1999	2	0.10
5/16/1999	6	0.17
5/17/1999	7	0.21
5/18/1999	11	0.18
5/19/1999	10	0.16
5/20/1999	11	0.16
5/21/1999	6	0.15
5/22/1999	4	0.10
5/23/1999	7	0.10
5/24/1999	4	0.12
5/25/1999	10	0.12
5/26/1999	15	0.14
5/27/1999	15	0.17
5/28/1999	16	0.20
5/29/1999	31	0.21
5/30/1999	39	0.32
5/31/1999	37	0.36
6/1/1999	40	0.39
6/2/1999	51	0.44
6/3/1999	20	0.46
6/4/1999	18	0.50
6/5/1999	18	0.46
6/6/1999	16	0.65
6/7/1999	15	0.49
6/8/1999	11	0.44
6/9/1999	3	0.34
6/10/1999	3	0.38
6/11/1999	8	0.37
6/12/1999	5	0.29
6/13/1999	5	0.40
6/14/1999	2	0.27

John Day Dam Date	Dual Detections	Detect. Rate
4/10/2000	1	1.00
4/13/2000	1	1.00
4/18/2000	1	0.50
4/24/2000	2	0.67
4/27/2000	2	0.17
4/28/2000	1	0.20
5/2/2000	1	0.40
5/3/2000	1	0.40
5/4/2000	3	0.21
5/6/2000	4	0.36
5/8/2000	3	0.38
5/9/2000	2	0.20
5/11/2000	1	0.08
5/13/2000	2	0.33
5/14/2000	1	0.33
5/15/2000	1	0.21
5/16/2000	3	0.12
5/20/2000	1	0.20
5/22/2000	2	0.25
5/23/2000	5	0.17
5/24/2000	2	0.12
5/25/2000	2	0.17
5/27/2000	1	0.04
5/29/2000	4	0.05
5/30/2000	2	0.04
5/31/2000	2	0.04
6/2/2000	1	0.07
6/3/2000	6	0.18
6/4/2000	11	0.21
6/5/2000	10	0.18
6/6/2000	1	0.07
6/7/2000	2	0.22
6/9/2000	3	0.06
6/12/2000	1	0.02
6/14/2000	2	0.07
6/16/2000	1	0.07
6/25/2000	1	0.50
6/28/2000	1	0.33

John Day Dam Date	Dual Detections	Detect. Rate
4/9/2001	1	1.00
4/19/2001	1	1.00
5/1/2001	2	1.00
5/6/2001	1	1.00
5/11/2001	1	0.75
5/12/2001	1	0.14
5/13/2001	1	0.50
5/14/2001	1	0.67
5/15/2001	3	0.55
5/16/2001	3	0.43
5/17/2001	3	0.43
5/18/2001	1	0.14
5/19/2001	1	0.75
5/20/2001	5	0.54
5/21/2001	3	0.41
5/22/2001	4	0.33
5/23/2001	6	0.21
5/24/2001	1	0.43
5/25/2001	1	0.17
5/26/2001	1	0.20
5/28/2001	1	0.04
5/29/2001	1	0.04
5/30/2001	6	0.16
5/31/2001	9	0.18
6/1/2001	14	0.17
6/2/2001	2	0.13
6/3/2001	5	0.18
6/4/2001	3	0.23
6/5/2001	2	0.15
6/6/2001	3	0.26
6/7/2001	1	0.29
6/8/2001	2	0.14
6/9/2001	5	0.18
6/11/2001	2	0.09
6/14/2001	1	0.10
6/15/2001	1	0.33
6/16/2001	1	0.33
6/18/2001	1	0.50
6/19/2001	1	0.20
6/20/2001	13	0.30
6/21/2001	5	0.57
6/22/2001	4	0.64
6/24/2001	1	0.33
6/26/2001	3	0.43
6/27/2001	3	0.57
6/28/2001	3	0.44

John Day Dam Date	Dual Detections	Detect. Rate
4/3/2002	1	1.00
4/17/2002	2	0.50
4/18/2002	1	1.00
4/21/2002	1	1.00
4/23/2002	1	0.33
4/27/2002	1	0.25
4/29/2002	1	0.17
4/30/2002	1	0.25
5/1/2002	1	0.50
5/3/2002	3	0.50
5/5/2002	1	0.25
5/6/2002	1	0.25
5/7/2002	1	0.50
5/8/2002	6	0.30
5/9/2002	3	0.28
5/10/2002	2	0.30
5/11/2002	1	0.30
5/13/2002	1	0.14
5/14/2002	1	0.33
5/16/2002	2	0.11
5/17/2002	1	0.14
5/18/2002	2	0.09
5/19/2002	3	0.09
5/20/2002	1	0.09
5/21/2002	2	0.10
5/22/2002	2	0.22
5/23/2002	2	0.22
5/24/2002	1	0.03
5/26/2002	1	0.05
5/27/2002	6	0.10
5/28/2002	19	0.15
5/29/2002	18	0.15
5/30/2002	19	0.15
5/31/2002	17	0.13
6/1/2002	40	0.15
6/2/2002	36	0.14
6/3/2002	34	0.13
6/4/2002	24	0.13
6/5/2002	13	0.13
6/6/2002	6	0.09
6/7/2002	16	0.11
6/8/2002	27	0.17
6/9/2002	18	0.22
6/10/2002	14	0.20
6/11/2002	15	0.19
6/12/2002	23	0.22

John Day Dam Date	Dual Detections	Detect. Rate
6/15/1999	1	0.38
6/16/1999	12	0.37
6/17/1999	14	0.38
6/18/1999	27	0.42
6/19/1999	30	0.48
6/20/1999	29	0.58
6/21/1999	34	0.65
6/22/1999	19	0.64
6/23/1999	12	0.47
6/24/1999	9	0.31
6/25/1999	5	0.49
6/26/1999	3	0.52
6/27/1999	2	0.18
6/28/1999	4	0.16
6/29/1999	7	0.15
7/1/1999	2	0.10
7/2/1999	2	0.28
7/6/1999	1	0.11
7/8/1999	2	0.10
7/12/1999	1	0.14
7/15/1999	1	0.14
7/16/1999	2	0.20
7/19/1999	1	0.13
7/24/1999	1	0.50
7/26/1999	1	0.22
7/28/1999	1	0.22

John Day Dam Date	Dual Detections	Detect. Rate

John Day Dam Date	Dual Detections	Detect. Rate
6/29/2001	2	0.31
6/30/2001	2	0.67
7/4/2001	2	0.57
7/14/2001	1	1.00
7/18/2001	1	0.50
7/20/2001	1	1.00
7/23/2001	1	0.50
7/24/2001	1	1.00
7/27/2001	4	1.00
7/30/2001	2	1.00
8/4/2001	1	1.00
8/6/2001	1	0.50
8/8/2001	1	1.00
8/10/2001	1	0.50
8/16/2001	1	0.50
9/2/2001	1	1.00
9/5/2001	1	1.00

John Day Dam Date	Dual Detections	Detect. Rate
6/13/2002	22	0.28
6/14/2002	25	0.33
6/15/2002	13	0.30
6/16/2002	10	0.28
6/17/2002	10	0.33
6/18/2002	11	0.39
6/19/2002	6	0.31
6/20/2002	3	0.22
6/21/2002	7	0.26
6/22/2002	10	0.37
6/23/2002	4	0.23
6/24/2002	1	0.13
6/25/2002	1	0.10
6/28/2002	2	0.17
6/29/2002	1	0.14
7/2/2002	1	0.50
7/11/2002	5	0.40
7/12/2002	9	0.40
7/13/2002	8	0.32
7/15/2002	1	0.50
7/17/2002	2	0.50
7/18/2002	1	0.50
7/23/2002	1	1.00

Chapter Four: Adult Returns and Spawning Surveys

The Umatilla Basin Natural Production Monitoring and Evaluation Project

Progress Report
1999-2002

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INTRODUCTION

The Umatilla Basin Natural Production Monitoring and Evaluation Project (UBNPME) was funded by Bonneville Power Administration (BPA) as directed by section 4(h) of the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (P. L. 96-501). This project is in accordance with and pursuant to measures 4.2A, 4.3C.1, 7.1A.2, 7.1C.3, 7.1C.4 and 7.1D.2 of the Northwest Power Planning Council's (NPPC) Columbia River Basin Fish and Wildlife Program (NPPC 1994). Work was conducted by the Fisheries Program of the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) under the Umatilla Basin Natural Production Monitoring and Evaluation Project. This report and associated data will be available through http://www.umatilla.nsn.us (CTUIR website).

Objectives and Tasks
This chapter summarizes the adult returns of salmon and steelhead to the Umatilla River Basin, as well as spawning surveys, harvest monitoring, and age and growth data collected during monitoring efforts from September 30, 1998 through December 31, 2002.

Spawning Surveys
Objective C, Objective 3 in the 1999 and 2000 SOW and Objective 1 in the 2001 and 2002 SOW.
Monitor spawning activities of hatchery and natural adult spring Chinook, and summer steelhead in the Umatilla River Basin. Summarize spawning survey data collected to date and evaluate improved sampling design and protocol developed by ODFW and recommended by the ISRP.

Task C.1 Develop a long term plan to monitor the natural spawning of summer steelhead, spring Chinook salmon, fall Chinook salmon and coho salmon in the Umatilla River Basin (see Chapter Six).

Task C.2 Estimate final disposition of adult returns enumerated at Three Mile Falls Dam and conduct spawning surveys for summer steelhead and spring Chinook to maintain trend data. Document the number and location of redds and examine carcasses in index sites as conditions allow.

Task C.3 Estimate survival to spawning and total egg deposition by species and reach. Collect and record length, sex, pre and post-spawn mortality data, coded wire tags, marks, fin clips, kidney samples and scales from the appropriate carcasses examined on the spawning grounds.

Task C.4 Digitize and summarize data, report findings and discuss management implications.

Harvest monitoring
Objective D, Objective 4 in the 1999-2002 SOW. Estimate tribal harvest of adult salmon and steelhead returning to the Umatilla River Basin using an improved sampling design and protocol as recommended by the ISRP.

Task D.1 Design stratified-random roving creel surveys and telephone surveys. Design must be flexible to allow for large variations in angler effort as well as seasons and locations of the fisheries.

Task D.2 Implement stratified-random roving creel surveys and telephone surveys depending on the seasons and locations of the fisheries. Telephone surveys may include direct contact if randomly selected individuals do not have telephones.

Task D.3 Digitize and summarize data, estimate harvest, and report findings (see disposition tables).

Age and growth

Objective E, Objective 6 in the 1999-2002 SOW. Determine age, growth and life history characteristics of salmon, steelhead and bull trout in the Umatilla River Basin.

Task E.1 Collect scale samples from juvenile and adult, salmon, steelhead and bull trout during trapping, electrofishing, artificial spawning and natural spawning surveys.

Task E.2 Mount and press adult scale samples. Place juvenile scales directly between labeled acetate sheets at the time of sampling.

Task E.3 Determine the proportion of unmarked adult spring Chinook salmon that are of hatchery and natural origin based on circuli counts from the scale focus to the first annuli.

Task E.4 Read scales and determine age and brood year as well as the years of freshwater and saltwater rearing of naturally produced adult salmon and steelhead and develop parent-progeny histories of wild steelhead.

Task E.5 Digitize and summarize data, report findings and discuss management implications.

SUMMER STEELHEAD

SUMMER STEELHEAD: EXECUTIVE SUMMARY

This report summarizes adult summer steelhead *(Oncorhynchus mykiss*) return data from entry into the trap or viewing window at Three Mile Dam, Umatilla River, through spawning. Because all summer steelhead adults entering the Umatilla River are enumerated by ocean age, gender and fin clip at Three Mile Dam, a fairly complete picture of return by run and brood year was completed. Although returns were at record high levels during the past three run years (1999-2000, 2000-2001, 2001-2002) only three brood years from 1988-1997 returned at levels greater than one returning adult per spawner.

The natural summer steelhead population of Umatilla River origin has been supplemented with a hatchery component that utilizes mostly natural brood. The natural and hatchery summer steelhead returning to the Umatilla River have similar timing of entry into the Umatilla River, are similar in size by ocean age, and are usually observed spawning together on the spawning grounds in the upper river, except that near the Minthorn and Bonifer acclimation sites hatchery females and males usually spawn together. In other areas it was unusual to observe paired hatchery spawners on redds.

Escapement enumeration of summer steelhead has been conducted in various reaches of the Umatilla River since 1988. There is a good correlation between females available to spawn and redds observed in the six index reaches (r=0.93). There is also a good correlation between redds per mile in index reaches and redds per mile in all areas surveyed (r=0.96). Conducting escapement surveys to monitor the health of summer steelhead populations in individual tributaries both on and off the Reservation was critical for developing land use and mitigation plans to aid in population recovery.

The ratio of natural summer steelhead adults returning to TMD divided by returns at Nursery Bridge (Walla Walla) and ratio of natural redds per mile in index reaches of the Umatilla River divided by redds per mile in index reaches of the John Day River indicated returns since 1995-1996 increased more rapidly in the Umatilla River than in the Walla Walla or John Day Rivers.

Although 15 years of high quality return data is available on Umatilla River adult summer steelhead, this is much too short a period of time to determine the status of the natural population. Since only three of 10 brood years have returned at greater than one adult per spawner, the population does not appear to be recovering even though natural returns have improved the last several years and 2002 was the largest natural escapement since enumeration of the total return began in 1988.

SUMMER STEELHEAD: METHODS

Enumeration of returning summer steelhead adults in the Umatilla River began in 1966 at Three Mile Dam (TMD). Adults were enumerated by electronic counter and/or mark recapture from 1966-1987. A trapping and handling facility at TMD has been operated since the 1987-1988 run year. The 1987-1988 run year was defined as the return of summer steelhead at TMD from August 1987 to July of 1988 and all fish would have spawned in February through June of 1988. In June and July of each run year a few summer steelhead were observed that would not spawn until the following year. Because of increased numbers observed during the last several years (always less than 10), these fish have been recorded in the following run year. From 1992 to 1999, adult summer steelhead were all captured, anesthetized with carbon dioxide and enumerated and categorized by gender, ocean age and fin clip (Zimmerman and Duke 1998). Since 2000, the adult return has been enumerated and categorized by a combination of capturing, anesthetizing and handling, alternating with video taping without capture (alternating approximately every 7-10 days). Adult summer steelhead enumerated from video tapes were apportioned (ocean age, sex, fin clip) by determining the percentage of the known fish in the immediate periods before and after video taping and using that percentage to expand the unknown fish from the video taping period (Dale Chess, ODFW, personal communication).

Adults enumerated at TMD were categorized as having spent one or two years in the ocean based on fork length. A fish 659 mm or less was assigned ocean age one and 660 mm or greater ocean age two. Adjustments to TMD fork length data vs. ocean age were necessary for both natural and hatchery summer steelhead because of an overall 6.3% error in ocean age of natural fish and a 7.0% error in ocean age of hatchery fish based only on length. All adjustments were done by return year because of annual variation in fork length versus age. The adjusted TMD fork length data vs. ocean age was then utilized to expand freshwater ages of natural adult summer steelhead as they spend from one to four years in freshwater. Freshwater ages were apportioned from annual samples collected during brood stock collection. Almost all hatchery summer steelhead adults spent one year in freshwater.

Summer steelhead adult scales were taken in the preferred area, two rows above the lateral line in a diagonal line between the posterior edge of the dorsal fin and the anterior edge of the anal fin on the left side of the fish. Additional scales were taken above and below the lateral line and on the right side of the fish in and near the preferred area because of the high degree of regeneration of summer steelhead scales in the Umatilla River. Scales were mounted on gum cards and pressed in cellulose acetate. Scales were examined under a microfiche reader at a magnification of 42x and/or 72x. Age designation utilized the European method; a fish returning in the 2000-2001 run year at age 2.2 was spawned and emerged from the gravel in 1996, migrated to the ocean in the spring of 1998, returned to freshwater in the summer or fall of 2000 and spawned in the spring of 2001 at total age 5.

Gender was determined by external sexual characteristics. Fin clips were observed and recorded and from 50 to 150 of the coded wire tagged returns from hatchery releases were sacrificed annually for research objectives. Estimates of Umatilla River hatchery summer steelhead harvest below TMD, based on coded wire tag recoveries, were provided by Oregon Department of Fish and Wildlife (Will Cameron, personal communication). Because of non retention in sport fisheries of summer steelhead with adipose fins, harvest of natural Umatilla summer steelhead occurred only in the Tribal gillnet fishery. Harvest for six brood years was insignificant (16-101) if similar to the hatchery estimates of harvest. Thus, harvest of natural summer steelhead below TMD was not considered in the development of brood tables. Natural returns to TMD were considered the total return.

Estimating harvest of summer steelhead by Tribal fishermen in the Umatilla River is an essential element in documenting the benefit of Umatilla River programs and with keeping harvest within management guidelines outlined in the Master Plan (CTUIR 1984). Harvest estimates are also important in estimating spawning escapement. Catch estimates are subtracted from the number of adults passing TMD or released above TMD.

The variability from year to year of the tribal angling seasons and locations often requires significant modifications of survey designs. In the past we employed a non-uniform probability roving creel surveys designed after Malvestuto (1983). However during 2001 and 2002 limitations in resources prevented adequate monitoring of the Tribal harvest of summer steelhead. We recommend additional monitoring to provide reasonable harvest estimates. The Tribal steelhead fisheries begin in October and extend through April. Fishing pressure has often been light and variable. Past steelhead creel surveys did not yield sufficient data to calculate angler effort, catch rates, and total harvest. Surveying anglers via telephone or direct off-stream interviews provided most of the information obtained about summer steelhead harvest in past years.

Spawning ground surveys were conducted in various reaches of the Umatilla River to enumerate summer steelhead redds from 1985-2002. Initially, large areas of many individual tributaries were surveyed to determine where and when summer steelhead spawned. Sections of six summer steelhead spawning tributaries (Squaw, Buckaroo, Camp, Boston Canyon, South Fork Umatilla and the North Fork Meacham Creeks) totaling 21.4 river miles were chosen as index reaches because of reasonable numbers of redds, generally good survey conditions and good access. Surveys were conducted every several weeks in index tributaries and at less frequent intervals or not at all in other areas because of poor survey conditions, access problems or low abundance. Surveyors wore baseball caps and polarized glasses to maximize fish observing capabilities. Redds were judged to be complete (and thus spawning successful) based on redd size and depth, location, and amount and size of rock moved. Redds were marked with flagging and the date, location, number and origin (natural or hatchery) of females and males on or near the redd and their spawning status were written with permanent marker on the flagging. Returning hatchery summer steelhead had at least an adipose fin clip, thus attempts were made to determine whether each fish observed on the spawning grounds had an adipose fin present or had an adipose fin clip. For each observed redd, the surveyor recorded on a data sheet the location, date the redd was first observed, sex, origin (natural or hatchery), and number of fish observed on or near the redd, fish sampled and spawning habitat type (riffle, tailout, glide). Carcasses sampled were measured from the middle of the eye to the hypural plate (MEHP) and tip of snout to fork of tail (fork length). Carcasses were cut open to determine the egg retention of females and spawning success of males. Tails of sampled fish were removed at the caudal peduncle to prevent resampling. Snouts of adipose plus left ventral clipped summer steelhead were removed behind the orbit to recover coded wire tags. Snouts were placed in plastic bags and given individual snout numbers. The snout number linked the snout with other biological data collected from the individual fish.

Various measures of estimating summer steelhead population abundance have occurred in the Mid-Columbia Region. Complete enumeration of adult returns occurred at Three Mile Dam on the Umatilla River and on the Walla Walla River at Nursery Bridge (radio telemetry indicated that all radio tagged fish used the ladder in 2002). Total escapement in the Touchet River has been estimated by expansion of spawning ground surveys and adding 20% to that figure for small tributaries which were not surveyed. Redds per mile data was available both in the Umatilla and John Day Subbasins. The redds per mile data in the Umatilla Subbasin was based on multiple surveys and the John Day data was based on one survey of each tributary at the conclusion of spawning activity.

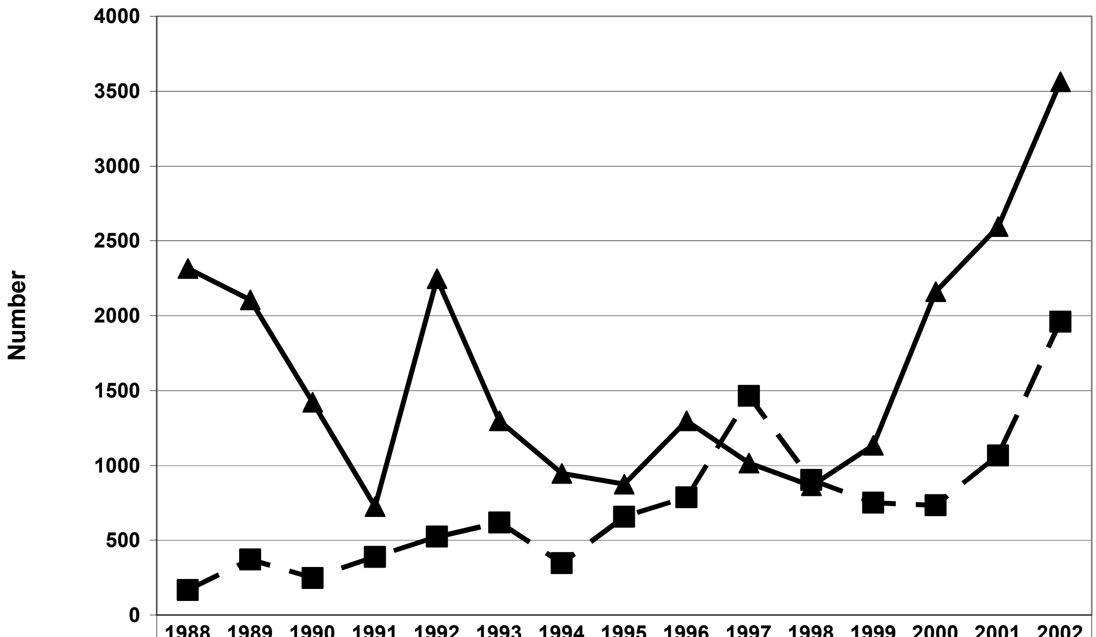
The estimated number of natural summer steelhead redds per mile in index reaches was calculated by determining the total number of redds per mile and multiplying by the percentage of natural versus hatchery summer steelhead available to spawn.

Approximately 50 natural female and 50 natural male and ten hatchery male summer steelhead were usually collected for brood stock annually for the Umatilla River summer steelhead supplementation program. A 3x3 spawning matrix was utilized when possible. Matrices were selected for natural x natural crosses. Hatchery males were used when necessary. Males were used only one time. Coded wire tags were read prior to spawning hatchery males because of non endemic summer steelhead entering the Umatilla River.

SUMMER STEELHEAD: RESULTS AND DISCUSSION

Summer Steelhead: Return to Three Mile Dam
The total return by run year of adult natural and hatchery summer steelhead to Three Mile Dam since reliable, comparable records were available in the 1987-1988 run year (Jim Phelps, retired ODFW area management biologist, personal communication) has varied between 1111 (1991) and 5520 (2002) and averaged 2368 adults. The natural component of the return to TMD has varied between 724 (1991) and 3562 (2002) and averaged 1637 (Figure 4-1). From 1988-2002 natural fish comprised from 40.9% to 93.3% (mean 68.8%) of the summer steelhead return to TMD (Figure 4-2). The return of hatchery summer steelhead to TMD has varied between 165 (1988) and 1958 (2002) and averaged 731 (Figure .4-1). Reconstruction of many aspects of the return by run year is in Table 4-1.

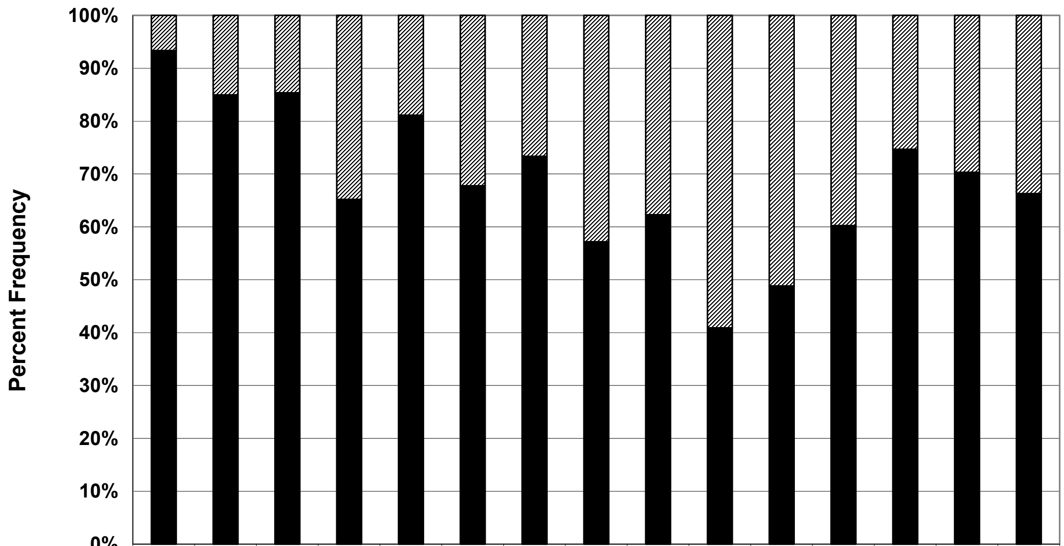
Total return of adult summer steelhead by brood year to TMD has varied between 842 (1991 brood) and 3677 (1996 brood) (Table 4-2). Total return to TMD of the natural component from the 1988-1997 broods has varied between 654 (1991 brood) and 3184 (1996 brood) and averaged 1512 (Figure 4-3). From 1987-1997 natural fish made up from 38.0% to 100.0% (mean 68.0%) of the return by brood year (Figure 4-4). Total return to TMD of hatchery adults from the 1989-1997 brood years varied between 188 (1991 brood) and 1610 (1994 brood) and averaged 829 (Figure 4-3).



	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Natural	2315	2104	1422	724	2247	1298	945	875	1296	1014	862	1135	2160	2596	3562
Hatchery	165	370	245	387	522	616	345	656	785	1463	903	751	732	1066	1958

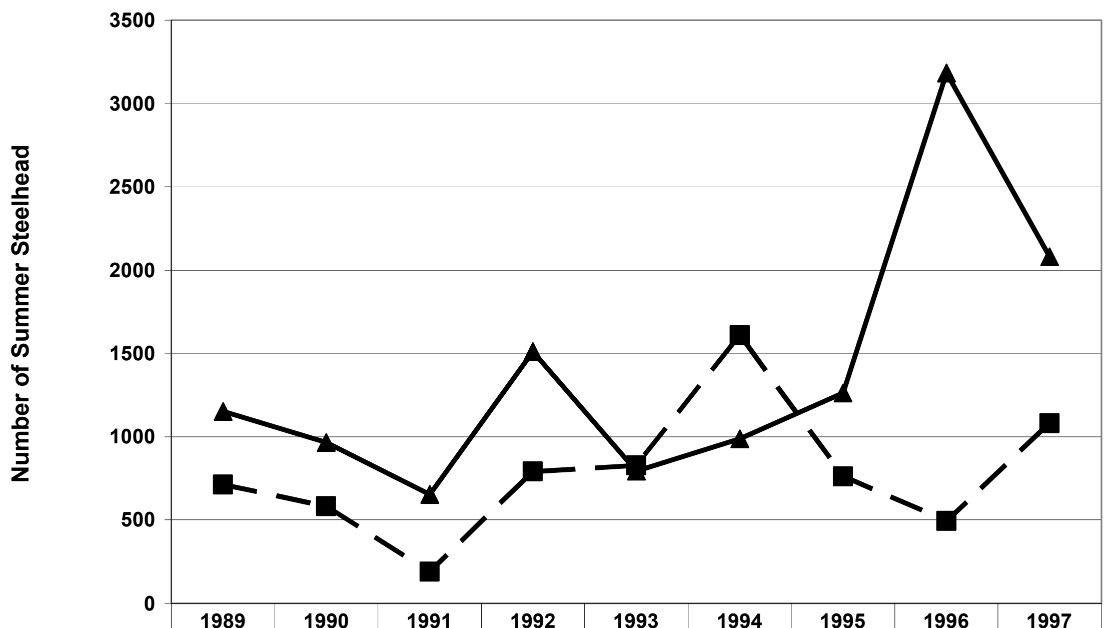
Return Year

Figure 4-1. Natural and hatchery return of summer steelhead to Three Mile Dam, Umatilla River, 1988-2002.



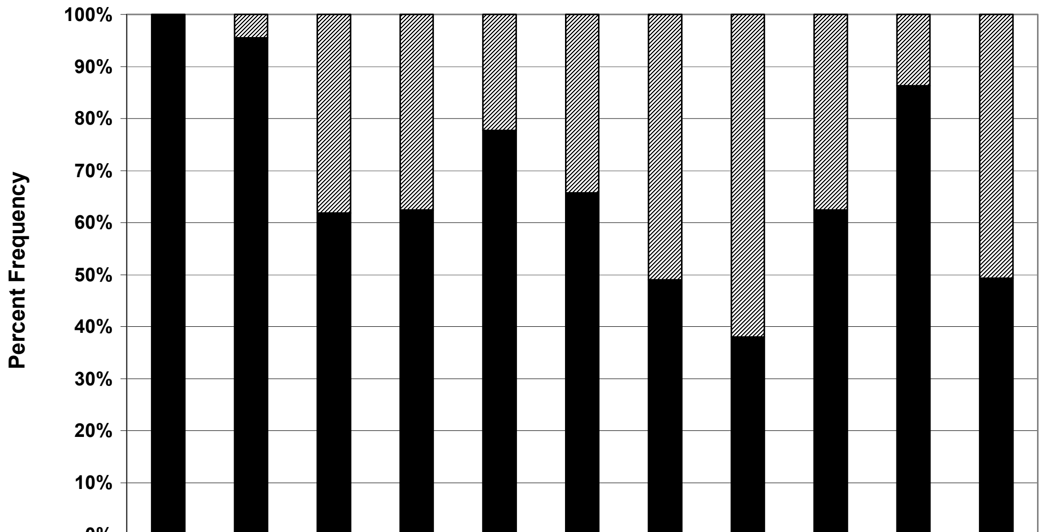
	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02
Hatchery	6.7	15	14.7	34.8	18.9	32.2	26.7	42.8	37.7	59.1	51.2	39.8	25.3	29.7	33.7
Natural	93.3	85	85.3	65.2	81.1	67.8	73.3	57.2	62.3	40.9	48.8	60.2	74.7	70.3	66.3

Figure 4-2. Natural and hatchery summer steelhead percent frequency at TMD, Umatilla River by return year 1988-2002.



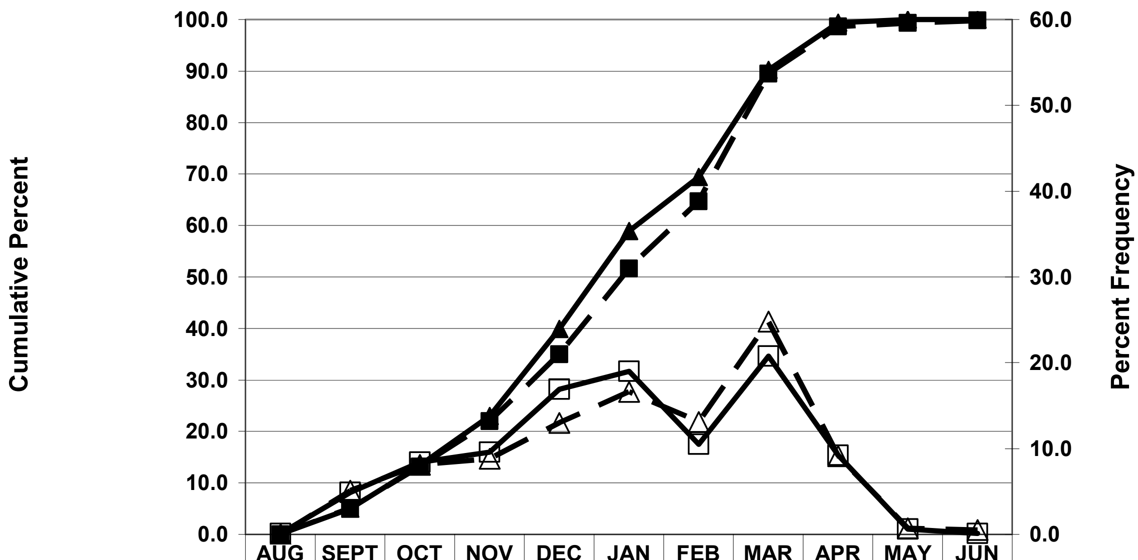
	1989	1990	1991	1992	1993	1994	1995	1996	1997
Natural	1152	965	654	1510	794	988	1262	3184	2080
Hatchery	713	582	188	790	827	1610	762	493	1080

Figure 4-3. Natural and hatchery summer steelhead return to TMD, Umatilla River by brood year, 1989-1997.



	87	88	89	90	91	92	93	94	95	96	97
Hatchery	0.0	4.5	38.2	37.6	22.3	34.3	51.0	62.0	37.6	13.7	50.7
Natural	100.0	95.5	61.8	62.4	77.7	65.7	49.0	38.0	62.4	86.3	49.3

Figure 4-4. Percent frequency of natural and hatchery summer steelhead returning to TMD, Umatilla River by brood year.



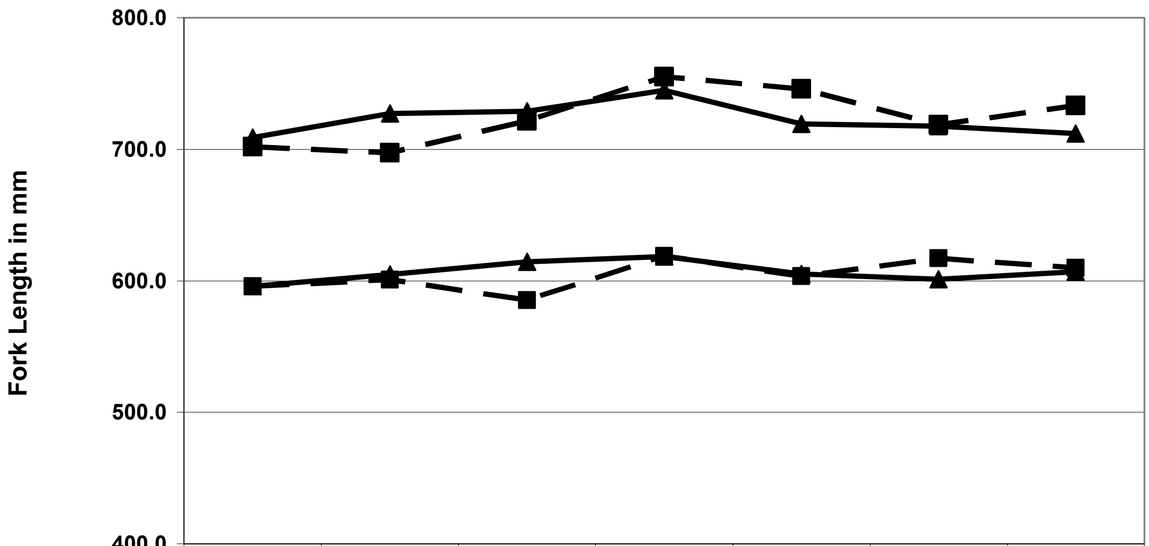
	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
Natural N=8282	0.1	5.0	13.4	23.0	39.9	58.9	69.4	90.2	99.4	100.0	100.0
Hatchery N=5630	0.0	5.1	13.2	22.0	35.0	51.6	64.7	89.5	98.6	99.3	99.8
NATURAL %	0.1	4.9	8.4	9.6	16.9	19.0	10.5	20.8	9.2	0.6	0.1
HATCHERY %	0.0	5.1	8.1	8.8	13.0	16.6	13.1	24.8	9.1	0.7	0.5

Figure 4-5. Adult summer steelhead time of entry to TMD, Umatilla River, 1994-2000 run years, cumulative and percent frequency.

Steelhead age summary tables and associated graphs used to reconstruct summer steelhead returns to TMD by brood year are in the Appendix Tables 4-A15 through 4-A17.

Timing of adult summer steelhead returning to TMD is similar for natural and hatchery summer steelhead (Figure 4-5). The return begins in late August and/or early September as water temperatures decrease, peaks during January and March and is mostly complete by the end of April.

Comparisons of fork length data between natural and hatchery summer steelhead were most appropriate by return year rather than by brood year. Mean size by return year compared natural and hatchery fish of the same year of outmigration and same ocean age but different freshwater ages, while brood year comparisons would compare different years of outmigration and different ocean ages. Mean fork length of natural summer steelhead adults age 2.1 varied between 596 mm and 618 mm and averaged 606.7 mm and hatchery summer steelhead adults age 1.1 varied between 585 mm and 619 mm and averaged 604.4 mm for the 1994-1995 through 1999-2000 run years (Figure 4-6). Mean fork length of natural summer steelhead adults age 2.2 varied between 709 mm and 744 mm and averaged 722.6 mm. Hatchery fish age 1.2 varied between 697 mm and 755 mm and averaged 724.8 mm for the same run years. Thus natural and hatchery summer steelhead adults were similar in fork length by ocean age.



	1994	1995	1996	1997	1998	1999	2000
Natural 2.1	596.0	604.7	614.4	618.5	605.1	601.3	606.8
Hatchery 1.1	596.0	600.8	585.1	618.8	603.4	617.1	609.9
Natural 2.2	708.8	727.1	728.7	744.9	719.2	717.4	712
Hatchery 1.2	701.9	697.4	721.4	755.0	745.7	718.7	733.3

Return Year

Figure 4-6. Mean fork length by return year of natural and hatchery summer steelhead adults for both one-ocean and two-ocean fish, Umatilla River, 1994-2000.

Table 4-1 Summer steelhead adult returns, disposition, harvest, and escapement for the Umatilla River 1987-2002

RUN YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Summer Steelhead (STS) Enumerated at TMD	2480	2474	1667	1111	2769	1914	1290	1531	2081	2477	1765	1886	2892	3662	5520
Natural STS Enumerated at Three Mile Dam (TMD)	2315	2104	1422	724	2247	1298	945	875	1296	1014	862	1135	2160	2596	3562
Hatchery STS Enumerated at TMD	165	370	245	387	522	616	345	656	785	1463	903	751	732	1066	1958
Hatchery STS Harvested below TMD						15	14	40	35	67	89	54	74	87	147
Estimated # of nonendemic STS strays to TMD						187	35	121	120	174	177	49	60		
Harvest or straying to other areas															
TMD+sport below TMD+other areas-%strays															
Natural Female STS Enumerated at TMD						942	688	645	922	742	593	774	1355	1776	2180
Hatchery Female STS Enumerated at TMD						364	251	342	447	720	529	478	377	643	965
Natural Male STS Enumerated at TMD						356	257	230	374	272	269	361	805	797	1382
Hatchery Male STS Enumerated at TMD						252	94	314	338	743	374	273	355	446	993
Natural STS Sacrificed or Mortalities at TMD	20	12	25	2	3	0	0	0	8	5	2	1	0	2	1
Hatchery STS Sacrificed or Mortalities at TMD	5	17	143	50	112	70	51	33	73	95	70	75	42	97	49
Natural STS Taken for Brood Stock	151	160	106	99	237	125	92	86	105	97	86	111	115	106	100
Natural STS Spawned	62	84	53	85	172	95	79	59	63	75	68	76			
Hatchery STS Taken for Brood Stock	0	0	0	103	95	91	42	68	26	10	30	15	15	10	10
Hatchery STS Spawned	0	0	0	42	0	3	17	22	21	3	21	4		7	
Natural Females Released above TMD	1436	1232			1193	878	641	602	863	687	549	718	1317	1721	2129
Natural Males Released above TMD	708	702			814	292	211	187	323	222	225	306	728	744	1332
Natural STS Released above TMD	2144	1934	1290	623	2007	1170	852	789	1186	909	774	1024	2045	2465	3461
Hatchery Females Released above TMD	114	216			161	266	183	289	376	669	475	427	351	583	939
Hatchery Males Released above TMD	46	137			154	188	69	266	305	689	328	234	324	399	960
Hatchery STS Released above TMD	160	353	102	234	315	454	252	555	681	1358	803	661	675	982	1899
Natural STS Harvested above TMD-CTUIR						5	5	5	0	0	5	5	0	0	*
Hatchery STS Harvested above TMD-CTUIR						25	20	20	39	33	33	39	99	84	*
Natural STS Harvested above TMD-ODFW								0	0	0	0	0		0	0
Hatchery STS Harvested above TMD-ODFW						22	5	21	25	24	12	47	4	3	57

Notes: We assumed that harvest was 50% females and 50% males. No adjustments made for hook and release mortality

Table 4-1 Continued

RUN YEAR	**1987 1988**	**1988 1989**	**1989 1990**	**1990 1991**	**1991 1992**	**1992 1993**	**1993 1994**	**1994 1995**	**1995 1996**	**1996 1997**	**1997 1998**	**1998 1999**	**1999 2000**	**2000 2001**	**2001 2002**
Natural Female STS Potentially Available to Spawn	1436*	1232*			1193*	875	638	599	863	687	547	715	1317	1721	2129
Hatchery Female STS Potentially Available to Spawn	114*	216*			161*	242	170	268	344	640	453	384	301	539	911
Total Female STS Potentially Available to Spawn	1550*	1448*			1354*	1117	808	862	1207	1327	1000	1099	1618	2260	3040
Natural Male STS Potentially Available to Spawn	708*	702*			814*	290	209	185	323	222	222	304	728	744	1332
Hatchery Male STS Potentially Available to Spawn	46*	137*			154*	165	57	246	273	661	306	191	273	356	931
Total Male STS Potentially Available to Spawn	754*														2263
Natural STS Potentially Available to Spawn	2144	1934	1290	623	2007	1165	847	784	1186	909	769	1019	2045	2465	3461
Hatchery STS Potentially Available to Spawn	160	353	102	234	315	407	227	514	617	1301	758	575	574	895	1842
Total STS Available to Spawn	2304	2287	1392	857	2322	1572	1074	1298	1803	2210	1527	1594	2619	3360	5303
STS Redds Observed in Index Reaches	138	77	HW	HW	135	HW	64	74	119	138	126	218	238	383	347
Total STS Redds Observed	275	128	HW	HW	300	HW	224	126	150	149	217	293	523	n/a	n/a
Index Reaches Miles Surveyed	18.5	20	HW	HW	21.4	HW	21.4	21.4	21.4	21.4	21.4	21.4	21.4	21.4	19.4
Total Redds Per Mile in Index Reaches	7.5	3.9	HW	HW	6.3	HW	3.0	3.5	5.6	6.4	5.9	10.2	11.1	17.9	17.9
Total Miles Surveyed in Umatilla River	61.0	50.2	HW	HW	67.2	HW	65.8	35.0	34.4	24.6	38.0	37.2	47.6	n/a	n/a
Redds Per Mile in all Areas Surveyed	4.5	2.5	HW	HW	4.5	HW	3.4	3.6	4.4	6.1	5.7	7.9	11.0	n/a	n/a

Notes: Index reaches are in Squaw, N. F. Meacham, Buckaroo, Camp, and Boston Canyon Creeks and the S. F. Umatilla River.

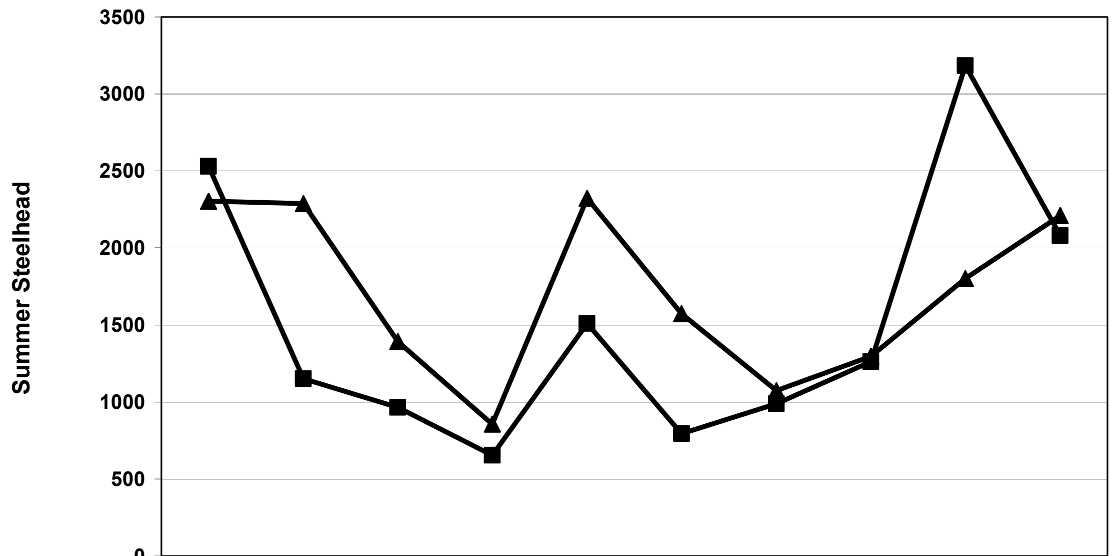
Table 4-2 Summer steelhead adult brood year returns to Three Mile Dam, Umatilla River by sex and age.

Brood Year	Sex	Natural Age 1.1	Age 1.2	Age 2.1	Age 2.2	Age 2.3	Age 3.1	Age 3.2	Age 4.1	Hatchery Age 1.1	Age 1.2	Age 1.3	Total	Total Natural	Total	Total Hatchery	Total Return
1987	Female				253*								253				
	Male				145*								145	**398**			**398**
1988	Female			1062*	497*	18		18	0		78		1595		78		
	Male			787*	141*	4		4	0		42		936	**2531**	42	**120**	**2651**
1989	Female			445*	245	12	63	57	0	171	226	2	822		399		
	Male			215*	66	3	28	18	0	231	82	1	330	**1152**	314	**713**	**1865**
1990	Female		18	329	357	0	0	0	0	139	198	14	704		351		
	Male		4	148	109	0	0	0	0	169	56	6	261	**965**	231	**582**	**1547**
1991	Female	0	0	201	169	0	43	47	14	54	63	5	474		122		
	Male	0	0	92	54	0	18	10	6	34	30	2	180	**645**	66	**188**	**842**
1992	Female	18	0	710	281	20	55	0	14	261	182	0	1098		443		
	Male	8	0	302	62	5	27	0	8	282	65	0	412	**1510**	347	**790**	**2300**
1993	Female	0	0	332	183	0	40	12	0	261	221	0	567		482		
	Male	0	0	160	40	0	23	4	0	270	75	0	227	**794**	345	**827**	**1621**
1994	Female	14	0	337	317	0	18	0	0	499	305	6	686		810		
	Male	6	0	192	93	0	11	0	0	668	130	2	302	**988**	800	**1610**	**2598**
1995	Female	0	0	406	192	26	114	77	0	225	231	8	815		464		
	Male	0	0	244	93	10	70	30	0	243	54	1	447	**1262**	298	**762**	**2024**
1996	Female	19	0	1048	890	0	90	59	0	239	30	PMFC	2106		269		
	Male	11	0	643	353	0	47	24	0	219	5	PMFC	1078	**3184**	224	**493**	**3677**
1997	Female	0	0	693	558**		138**			339	288PMFC		1389		627		
	Male	0	0	357	233**		101**			349	104PMFC		691	**2080**	453	**1080**	**3160**
1998	Female	0	0	1411**						355PMFC			1411		355		
	Male	0	0	1038**						342PMFC			1038	**2449**	342	**697**	**3146**
1999	Female																
	Male																
2000	Female																
	Male																
2001	Female																
	Male																

* Not corrected for other freshwater ages, ** Preliminary Data

Straying of non endemic adult summer steelhead into the Umatilla River has only been observed at TMD during sacrifice of hatchery fish to recover coded wire tags and at Minthorn Springs and from hatchery fish hauled from TMD for possible use as broodstock. Estimates of non endemic hatchery summer steelhead returning to TMD have varied between 6.5% and 30.4% of the hatchery return of a run year (Will Cameron, personal communication). Summer steelhead sacrificed at TMD or at Minthorn Springs did not have the opportunity to back out of the lower Umatilla River and spawn in other locations as has been observed in numerous other studies throughout the Pacific Northwest, Canada and Alaska. To determine the percentage of non endemic hatchery summer steelhead that spawn in the Umatilla River, hatchery kelts should be sacrificed at Westland to recover coded wire tags. Based on scale analysis of natural summer steelhead sampled from the 1994-2002 run years, the percentage of kelts that are repeat spawners is so low that it would have no impact on future spawning returns. This should be a high research priority.

Summer Steelhead: Escapement versus Return to TMD
Escapement and natural return data from the 1988-1997 broods (Figure 4-7) indicated that only the 1988 and 1996 broods returned to TMD at greater than one returning adult per spawner (Figure 4-8). The 1998 brood will also produce returns greater than 1.0 return per spawner, but information on five year olds will not be available until summer 2003. Return per spawner from the 1988-1997 brood years has varied between 0.51 for the 1993 brood and 1.7 for the 1996 brood and averaged 0.88. Return per spawner calculations included both natural and hatchery adults available to spawn in the parental generation.



	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Escapement	2304	2287	1392	857	2322	1572	1074	1298	1803	2210
Brood Return	2531	1152	965	654	1510	794	988	1262	3184	2080

Brood Year

Figure 4-7. Summer steelhead escapement and natural return to TMD, Umatilla River, 1988-1997 brood years.

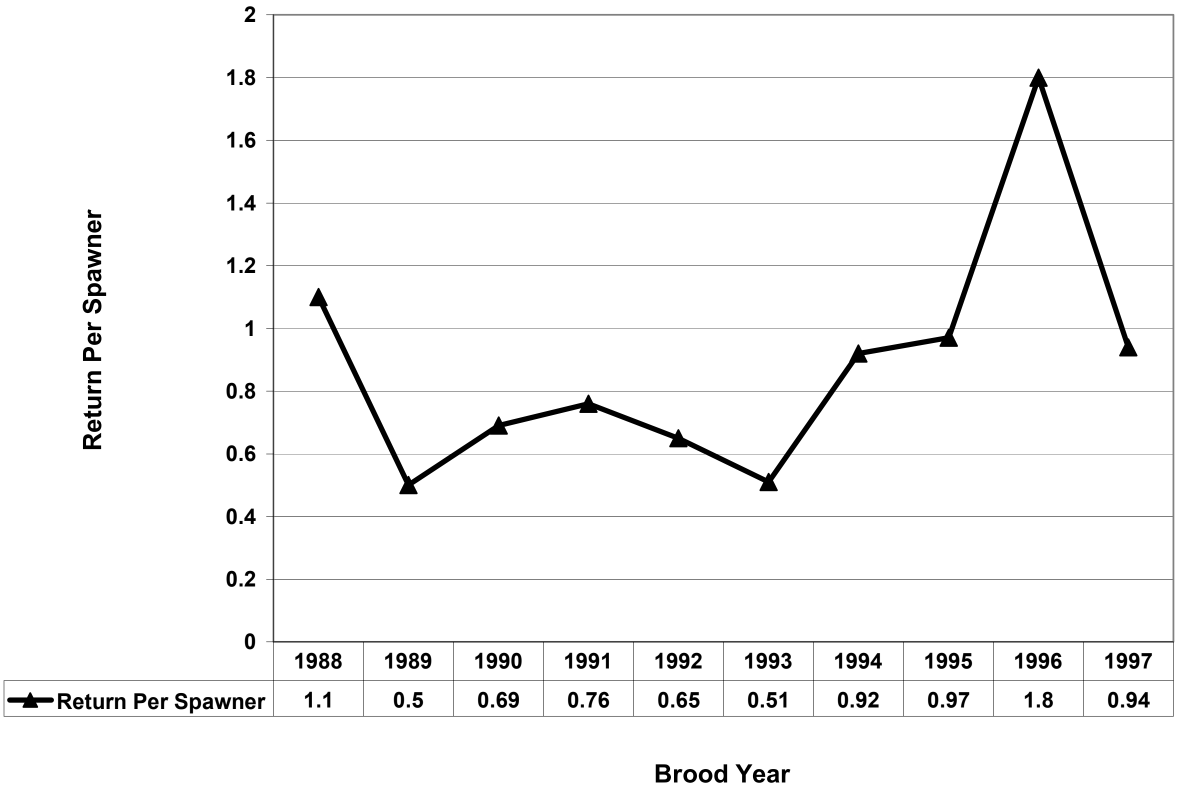


Figure 4-8. Summer steelhead return per spawner in the Umatilla River, 1988-1997 brood years.

We have observed all possible combinations of natural and hatchery summer steelhead spawning in the natural environment, and except in the areas immediately adjacent to the acclimation facilities (Minthorn Springs, Boston Canyon Creek and Bonifer Pond), it was unusual to observe paired hatchery spawners.

Spawning interactions between natural and hatchery summer steelhead were observed in the Umatilla River Subbasin in 2001 and 2002. It was often difficult to determine natural or hatchery origin by observation because of the general high flows which are normal during summer steelhead escapement enumeration. For instance, in 2002 a total of 160 summer steelhead were observed on the spawning grounds and although efforts were made to determine the origin of each fish observed, only 42 could be categorized (natural fish had an adipose fin and hatchery returns had at least an adipose clip). Origin was determined on 23 summer steelhead during escapement enumeration in 2001. Hatchery summer steelhead were not equally distributed in each tributary, based on observation and sampling on the spawning grounds. In the vicinity of Minthorn Springs and Bonifer Ponds, which are the acclimation facilities for Umatilla summer steelhead, hatchery fish made up the bulk of observed spawning. In 2001 a school of 21 spawned out summer steelhead that were mostly adipose clipped hatchery returns were observed in Bonifer Pond and in 2002 in Minthorn Springs Creek, 25 redds of mostly hatchery returns were observed. Some additional spawning of hatchery fish probably occurred in the mainstem just above Minthorn Springs Creek as has been observed in previous years. Hatchery returns below Pendleton to the Birch Creek drainage were 0.0-5.2% of the summer steelhead escapement during a five year period between 1996-2002 (Tim Bailey, ODFW, unpublished data).

Based on observations on the spawning grounds in 2001 and 2002, it appears that the majority of the hatchery return spawns with and at the same time as the natural component of the escapement in lateral tributaries of the upper Umatilla River above Pendleton. In 2002, the percentage of natural vs. hatchery summer steelhead available to spawn was 65.3% and 34.7% respectively. On the spawning grounds of index tributaries 54.8% of summer steelhead categorized were natural and 45.2% were of hatchery origin (Table 4-3). Sample size was fairly small with only 42 observations, but it does indicate that hatchery summer steelhead were spawning in index tributaries at rates similar to our estimates of natural and hatchery summer steelhead available to spawn. In 2001 the natural component of fish available to spawn was 73.4% and the hatchery component 26.6%. Combining the spawning ground observations in index tributaries, based on 23 observations 73.9% of the spawners were naturally produced and 26.1% were from hatchery returns (Table 4).

Table 4-3. Natural and hatchery summer steelhead observed during escapement surveys, Umatilla River 2002

Tributary	Squaw Creek	N.F. Meacham Creek	Camp Creek	Boston Canyon Creek	Buckaroo Creek	S. F. Umatilla River	Totals	Three Mile Dam STS	Potentially Available To Spawn
Natural n=	14	2	4	0	3	0	23	3562	3461
Percentage	70	100.0	57.1	0.0	43.9	0.0	54.8	64.5	65.34
Hatchery n=	6	0	3	6	4	0	19	1961	1842
Percentage	30.0	0.0	42.9	100.0	57.1	0.0	45.2	35.5	34.7

Table 4-4. Natural and hatchery summer steelhead observed during escapement surveys, Umatilla River 2001

Tributary	Squaw Creek	N.F. Meacham Creek	Camp Creek	Boston Canyon Creek	Buckaroo Creek	S. F. Umatilla River	Totals	Three Mile Dam STS	Potentially Available To Spawn
Natural n=	4	4	2	0	5	2	17	2596	2465
Percentage	57.1	100.0	100.0	0.0	71.4	100.0	73.9	70.9	73.4
Hatchery n=	3	0	0	1	2	0	6	1066	895
Percentage	42.9	0.0	0.0	100.0	28.6	0.0	26.1	29.1	26.6

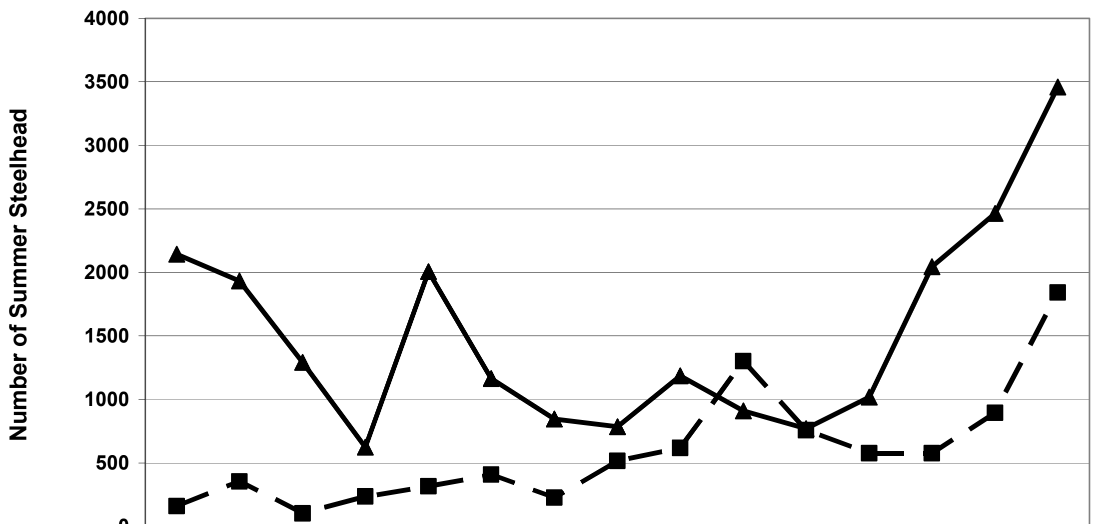
Indications from escapement vs. return data also suggest that hatchery summer steelhead are successfully spawning and contributing to the next generation of natural adults. For example the highest natural returns of adult summer steelhead since total enumeration at TMD began in 1988 occurred in 2001 and 2002. The parental broods for these record returns were mostly from summer steelhead spawning in 1997 and 1998. Summer steelhead potentially available to spawn in 1997 were 58.9% of hatchery origin and 41.1% of natural origin and in 1998 were 50.4% natural and 49.6% hatchery. The 1997 and 1998 broods had 909 and 769 natural summer steelhead potentially available to spawn (14 year average was 1370 natural spawners) and 1301 and 758 hatchery summer steelhead potentially available to spawn (14 year average was 502 hatchery spawners) (Table 4-1).

Summer Steelhead: Spawning Ground Surveys

Umatilla River summer steelhead spawning tributaries have been divided into major, medium and minor producers based on observed escapements. Major producers were drainages with estimated potential natural production of over 500 adults annually, medium producers were drainages with potential production of 100-500 adults annually and minor producers had potential production of less than 100 adults annually. Major producers ranked in order of importance are Meacham Creek and tributaries, and Birch Creek and tributaries. Medium producers also ranked in estimated order of importance are Squaw Creek, and South Fork and tributaries. Minor producers ranked in order of importance are Buckaroo and all other summer steelhead spawning streams listed in Table 4-5. Steelhead redds have also been observed in the following tributaries and areas that are not annually surveys: Bachelor Canyon Creek, Bear Creek (RM 87.1), Buck Creek, Coonskin Creek, Coyote Creek, Duncan Spring Creek, East Fork Meacham Creek, McKay Creek, Mission Creek, Moonshine Creek, Owsley Creek, Spring Creek, Upper Squaw Creek above Little Squaw Creek, Upper Mainstem Umatilla River, and Westgate Canyon Creek.

The mainstem Umatilla River is critical rearing habitat for naturally produced summer steelhead. Large numbers of young-of–the-year and lesser numbers of age 1 and 2 juvenile summer steelhead have been observed in the mainstem during escapement surveys and during sampling with electroshockers (Contor, 1997). It appears that most of these fish were spawned in lateral tributaries, and migrated to the mainstem to rear, as only small numbers of summer steelhead have been observed to spawn in the mainstem (Kissner, unpublished). The importance of the North Fork Umatilla River to natural summer steelhead production, although it is a minor summer steelhead spawning and rearing tributary, cannot be overstated. During the critical low summer flow period the influence of cold water from the North Fork moderates high summer temperatures in the mainstem and juvenile rearing can occur to near Cayuse. Below Pendleton, McKay Creek flows cool the mainstem and again permit juvenile rearing of summer steelhead.

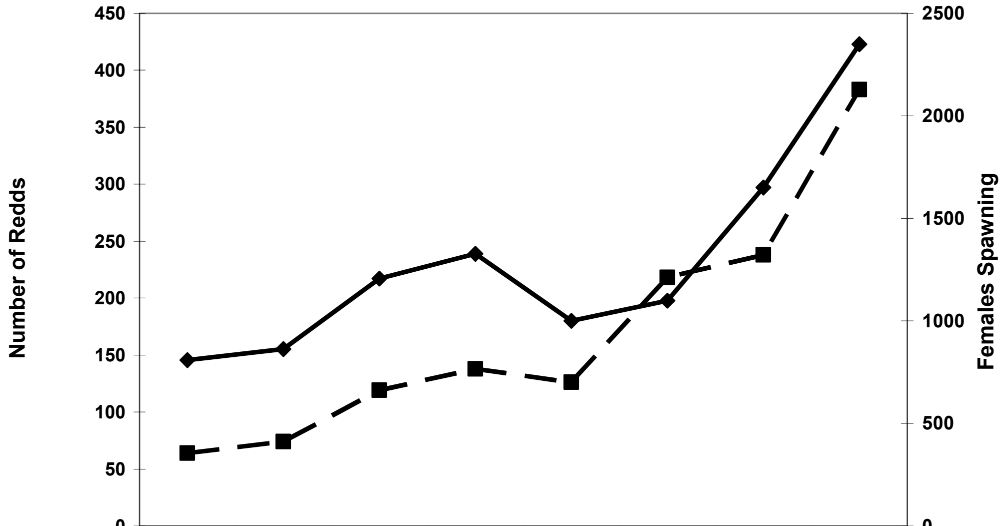
The number of natural and hatchery summer steelhead potentially available to spawn was determined by subtracting fish taken for brood, fish sacrificed or mortalities at TMD, and Tribal and sport harvest above TMD from the total return to TMD (Figure 4-9). Estimated annual harvest of summer steelhead in the Umatilla River is summarized in Table 4-1. No adjustments were made for sport catch and release hooking mortality above TMD. From 1994-2001 there has been a good correlation r=0.93 between the total number of females annually available to spawn (number of females released above TMD minus estimated harvest above TMD) in the Umatilla River and the total annual number of redds observed in the 21.4 miles of index reaches (Figure 4-10). In 2002, because of high water throughout much of the spring, fewer surveys than normal were conducted and many were under marginal survey conditions. In addition several high water periods washed out the surface of many redds. Redds per mile were thus underestimated in 2002. Comparison of redds per mile in all areas surveyed annually from 1994-2000 was similar to total redds per mile in index reaches (Figure 4-11) r=0.96, which indicates that the index reaches are probably representative of average spawning density in the Umatilla River Subbasin.



	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Natural	2144	1934	1290	623	2007	1165	847	784	1186	909	769	1019	2045	2465	3461
Hatchery	160	353	102	234	315	407	227	514	617	1301	758	575	574	895	1842

Run Year

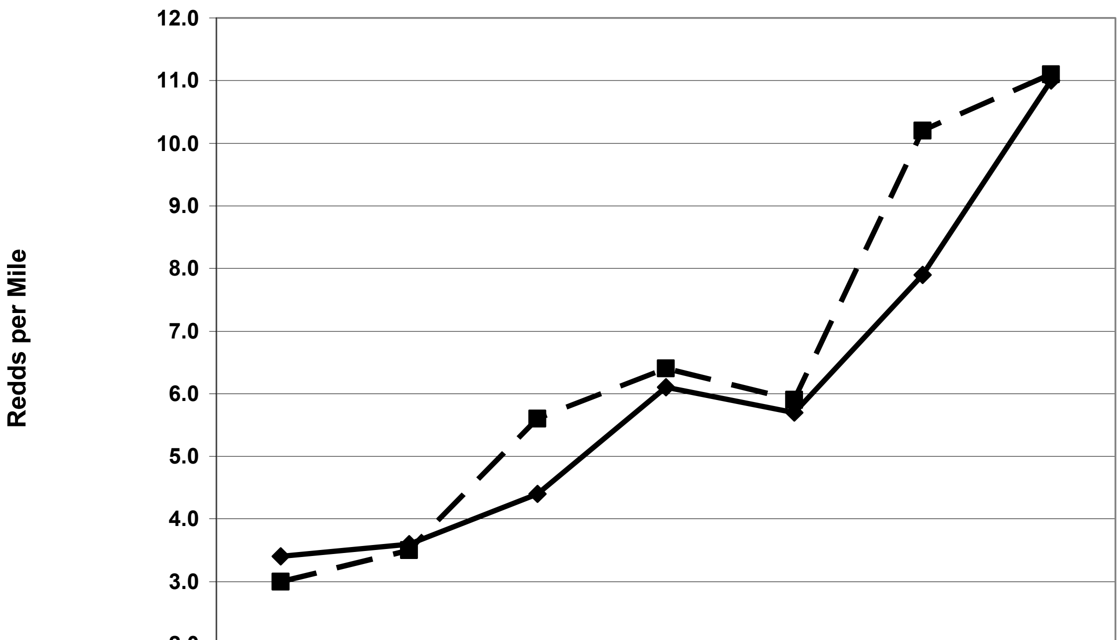
Figure 4-9. Natural and hatchery summer steelhead available to spawn by run year, Umatilla River 1988-2002.



	94	95	96	97	98	99	00	01
Redds	64	74	119	138	126	218	238	383
Female	808	862	1207	1327	1000	1099	1650	2350

Return Year

Figure 4-10. Comparison of summer steelhead redds enumerated in index areas of the Umatilla River to females available to spawn.



	94	95	96	97	98	99	00
Total Redds/Mile	3.4	3.6	4.4	6.1	5.7	7.9	11.0
Index Redds/Mile	3.0	3.5	5.6	6.4	5.9	10.2	11.1

Return Year

Figure 4-11. Summer steelhead redds per mile in index reaches compared to total redds per mile in all areas surveyed in the Umatilla River.

Table 4-5. Summary of summer steelhead escapement survey data in the Umatilla River Basin 1985-2002.

	Year	**1985**	**1986**	**1987**	**1988**	**1989***	**1990**	**1991**	**1992**	**1993***	**1994**	**1995****	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Squaw Creek	Redds	14	25	25	95	46		46	77	10	36	45	58	56	75	94	81	124	134
	STS	3	0	13	0	0		3	10	12	4	21	10	12	3	10	8	7	36
	Miles	5	3.2	6.6	6.6	6.6		6.6	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7	6.7
	Surveys	1	1	1	2	2		1	7	3	5	4	5	6	8	7	4	6	4
N.F. Meacham Creek	Redds	1	27	7	10	4			30	3	11	14	30	27	19	35	66	87	54
	STS	8	0	2	0	2			18	1	6	3	6	6	4	5	9	13	19
	Miles	3	3	3	3	3			5	3.3	5	5	5	5	5	5.0	5.0	5.0	3.0
	Surveys	1	1	1	1	1			2	1	3	2	3	5	5	6	5	3	3
Buckaroo Creek	Redds	2	3	0	20	10		18	5	6	0	6	12	25	7	18	22	27	53
	STS	0	0	0	3	2		0	0	4	0	1	5	8	2	1	4	6	14
	Miles	2	2	2	3.5	3.5		3	3	3	3	3	3	3	3	3.0	3.0	3.0	3.0
	Surveys	1	1	1	1	1		1	2	2	1	3	3	5	6	5	4	4	4
Camp Creek	Redds	4	8	12	6	1		3	8	7	6	5	7	5	7	15	18	67	44
	STS	2	7	3	0	0		1	9	4	2	1	5	0	0	2	1	5	11
	Miles	2.5	2.5	2.5	2.5	4		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	Surveys	1	1	2	1	2		1	2	2	2	3	4	3	3	4	2	3	2
Boston Canyon Creek	Redds	10	8	0	2	9			0	6	3	0	9	16	11	22	17	30	34
	STS	9	0	0	0	0			0	3	4	0	3	13	6	3	2	4	8
	Miles	1	1	1	1	1			1	1	1	1	1	1	1	1.0	1.0	1.0	1.0
	Surveys	1	1	1	1	1			2	2	1	4	3	4	6	7	5	3	2
S. F. Umatilla River	Redds			3	5	7			15	8	8	4	3	9	7	34	34	48	28
	STS			0	1	0			9	4	0	2	3	2	2	3	5	4	0
	Miles			3	2	2			4.2	4.2	4.2	3.2	5.0	3.2	3.2	3.2	3.2	3.2	3.2
	Surveys			1	1	1			2	1	1	1	1	2	3	5	3	2	1
N.F. Umatilla River	Redds			6	1	3			17		4	1			5				
	STS			2	0	0			3		0	1			0				
	Miles			2.5	2.5	1.5			2.5		4	2			3				
	Surveys			1	1	1			2		3	1	0		1				
Meacham Creek	Redds	0	49	49	51	24			120	6	40	12	6		65		69		
	STS	0	2	0	1	0			39	5	5	5	4		7		6		
	Miles	1.5	6.4	9	9	9			18	15.8	18.2	3.1			9.8		9.8		
	Surveys	1	1	3	1	1			2	1	1	1			2		1		
Ryan Creek	Redds	2	13	10	9	16			3		3					1			
	STS	0	0	0	0	0			0		0					0			
	Miles	2	2	2	2	3			2		3					3.0			
	Surveys	1	1	1	1	1			1		1					1			

Table 4-5. Continued

	Year	1985	1986	1987	1988	1989*	1990	1991	1992	1993*	1994	1995**	1996	1997	1998	1999	2000	2001	2002
Minthorn Spring Creek	Redds								5		1		2	2		23	12		
	STS								0		2		5	1		11	10		
	Miles								0.2		0.2		0.2	0.2		0.5	0.5		
	Surveys								1		1		1	1		4	2		
Person Creek	Redds			22	15				1	3	31	8	11			17	86		
	STS			0	13				1	5	9	1	1			1	20		
	Miles			6	6				6	8	5	2	4			6	6		
	Surveys			1	1				2	1						1	2		
West Birch Creek	Redds				2				0	3	20								
	STS				0				0	0	5								
	Miles				2				3.3	4.5	6								
	Surveys				1				1										
East Birch Creek	Redds			11	39				4	11	61	31				18	67		
	STS			0	10				0	2	9	5				0	14		
	Miles			5.5	11				1	4.5	7	6.5				5	5		
	Surveys			1	1				1							1	2		

Redds are the annual number observed only in the index reach
Steelhead listed were the number observed during the peak survey- most were on or near a redd.
Miles are the number of miles walked in the index reach during each survey.
Survey are the total number of surveys conducted in the index reach annually during summer steelhead escapement enumeration.
*High water was believed to wash out the surface of some redds.
** High water after April 18 washed out the surface of redds previously marked-good survey conditions before the washout
Variability in location, timing, crews and conditions make direct comparisons of redd data difficult prior to 1992.
1992- Fifteen redds observed in mainstem not listed; and five redds observed in 1994, also not listed.

INDEX AREAS AND REACHES SURVEYED (1992-2002):

Squaw Creek- Mouth to Little Squaw Creek Confluence- 6.7 miles
North Fork Meacham Creek- Mouth to Pot Creek Confluence-5.0 miles
Buckaroo Creek- Mouth to top of timber breakout meadow- 3.0 miles
Camp Creek- Mouth to large fork- 2.5 miles
Boston Canyon- Mouth to forks- 1.0 mile
South Fork Umatilla- Mouth to forks- 3.2 miles

OTHER AREAS AND REACHES OFTEN SURVEYED (1992-2002):

North Fork Umatilla- Mouth to 1.5 miles above Coyote Creek- 4.5 miles
Meacham Creek- Mouth to 18.2 miles upstream near East Meacham- 18.2 miles (as water conditions permit)
Ryan Creek- Mouth to 3.0 miles upstream- 3.0 miles, and Minthorn Springs-Headwaters to mount 0.5 miles
Pearson Creek- Mouth to 5.8 miles upstream- culvert crossing- 5.8 miles
E. Birch Cr.- Pearson Cr. to Westgate Can. 4.5 miles and West Birch Creek-Bridge to RM 16

Summer steelhead spawning has been observed as early as February 12, usually peaked during the first two weeks of April and was mostly completed by early June (Figure 4-12 and 14-13). Spawning summer steelhead have been observed in 25 tributaries and the mainstem such as Bachelor Canyon Creek, Bear Creek (RM 87.1), Buck Creek, Coonskin Creek, Coyote Creek, Duncan Spring Creek, East Fork Meacham Creek, McKay Creek, Mission Creek, Moonshine Creek, Owsley Creek, Spring Creek, Upper Squaw Creek above Little Squaw Creek, Upper Mainstem Umatilla River, and Westgate Canyon Creek as well as those listed in (Table 4-5). Reaches of six spawning tributaries (Squaw, Buckaroo, South Fork, North Fork Meacham, Camp and Boston Canyon) totaling 21.4 miles were selected as index reaches in 1996 because of reasonable numbers of spawning summer steelhead, generally good conditions for observation and land ownership that allowed easy access. Multiple spawning ground surveys were necessary for high quality data as spring freshets often caused gravel shift making observation difficult, and after more than several weeks summer steelhead redds were often difficult to observe. For example, during 1992 Squaw Creek was surveyed seven times between February 18 and May 15 to determine if multiple escapement surveys were necessary to accurately estimate redd abundance (Kissner, unpublished). In the lower three miles of Squaw Creek 67.6% of the total redds enumerated were still visible on May 15, 69.2% of the redds in mile 4.0 were still visible and in miles 5.0-6.7 a total of 90% of the redds were still visible. The percentage of redds visible during a post spawning survey will vary annually because of variations in flow (high water can cause gravel shift and make redd detection difficult) and will be very different between tributaries. Steelhead redds in small substrate were the most difficult to detect after high spring flows. Thus, one time surveys are of little value in estimating spawning success in the Umatilla Subbasin. Additionally, in some riffles with high spawning densities, if surveys were not conducted every several weeks the total number of redds in the riffle would be underestimated. Other areas were surveyed as time and stream conditions allowed to investigate summer steelhead spawning densities in other major, medium and minor producers that could not be surveyed annually because of generally poor survey conditions, or lack of access to the stream because of private land ownership.

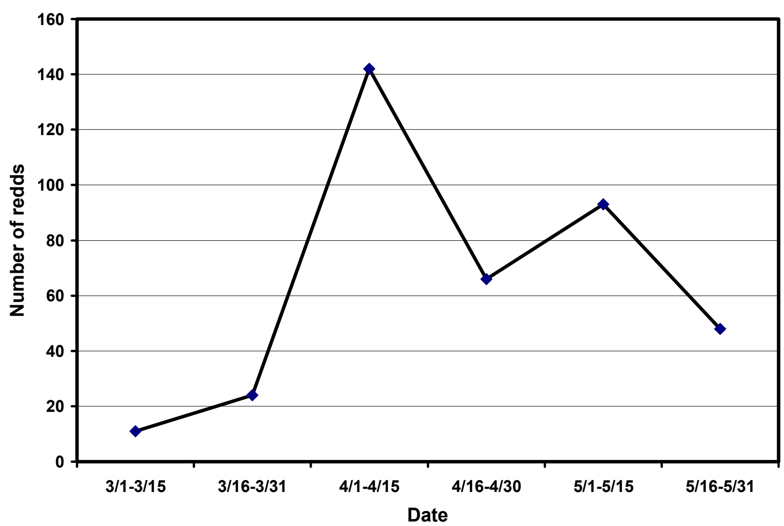


Figure 4-12. Summer steelhead redd timing in the index reaches (Camp, Squaw, Buckaroo, South Fork, N. F. Meacham, Boston Canyon) 2001.

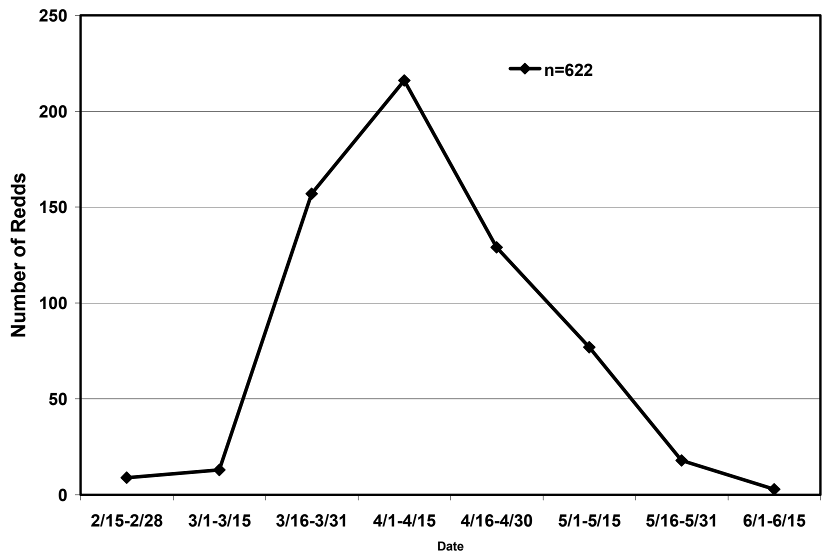


Figure 4-13. Total redds observed in squaw creek by date, 1996-2002

Squaw Creek had the largest number of redds observed in index tributaries from 1996-2001 averaging 81 redds enumerated per year (Figure 4-14). North Fork Meacham Creek had the second largest average number of redds (42). The other four index tributaries (Buckaroo, Camp, South Fork, Boston Canyon) all averaged nearly 20 redds observed per year. Boston Canyon Creek, which had mostly hatchery spawners, had an average of 17.5 redds per mile. In the other five index tributaries the average spawning density varied between six and twelve redds per mile with Squaw Creek having the highest average spawning density (Figure 4-15).

Interesting spawning behavior was observed in 2002 in Squaw Creek. A redd constructed at mile 4.4 was attended by a two ocean natural summer steelhead female and four males. The males were a two ocean natural male, a two ocean hatchery male, and two one ocean natural males. The two ocean natural male was dominant over the two ocean hatchery male and the two, one ocean males. The two ocean hatchery male was thus subordinate to the two ocean natural male, but was dominant over the natural one ocean males.

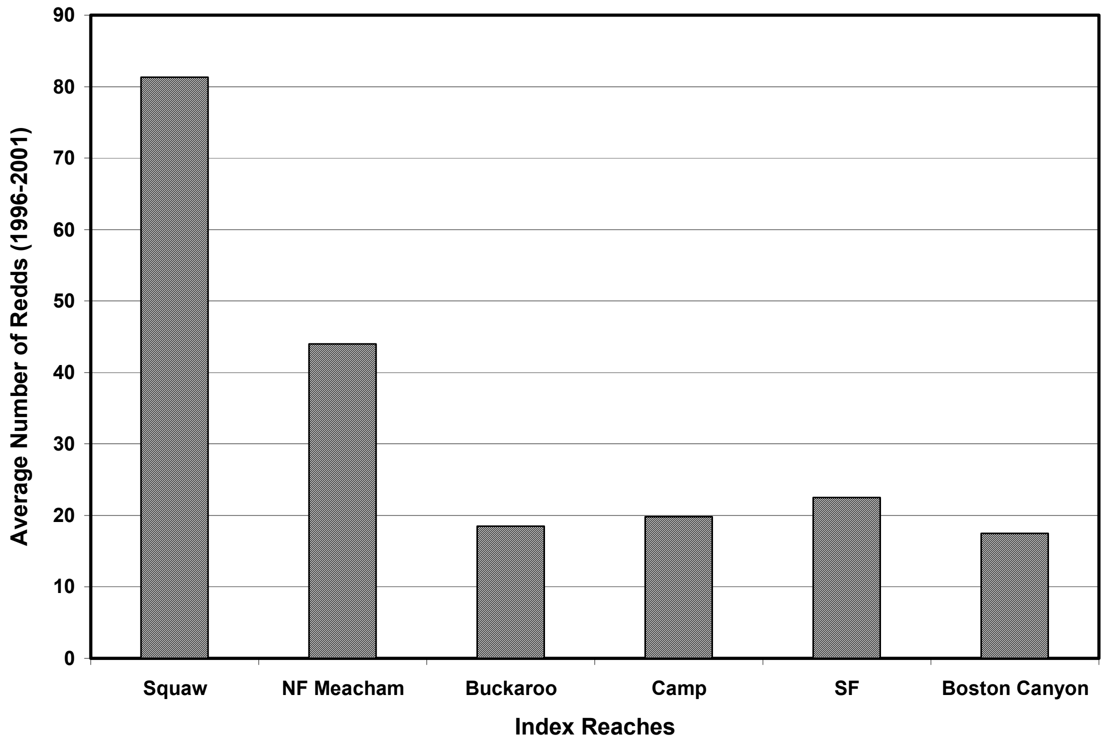


Figure 4-14. Average summer steelhead redds observed in index reaches of the Umatilla River, 1996-2001.

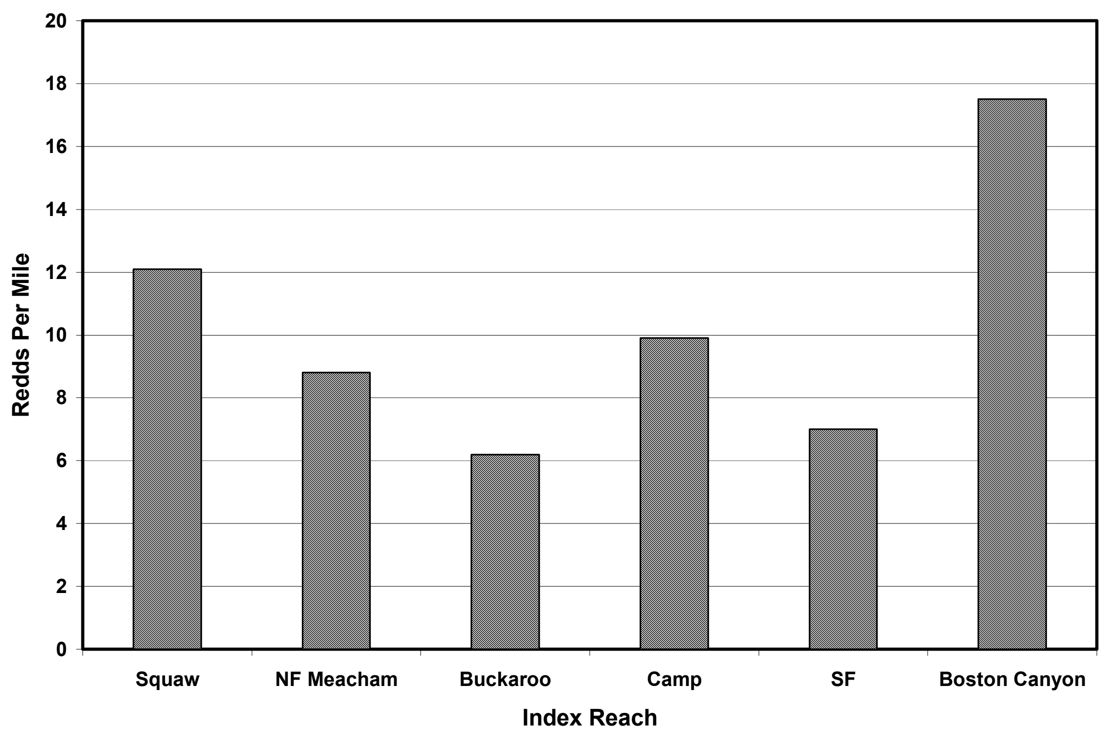
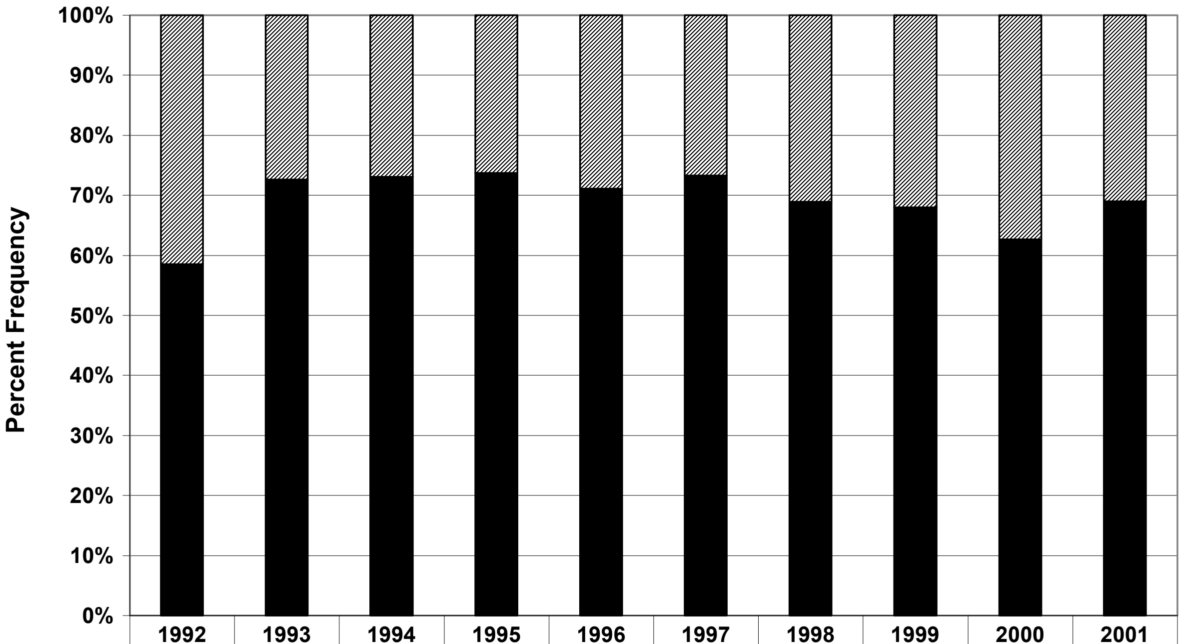


Figure 4-15. Average summer steelhead redds per mile in the index reaches of the Umatilla River 1996-2001.

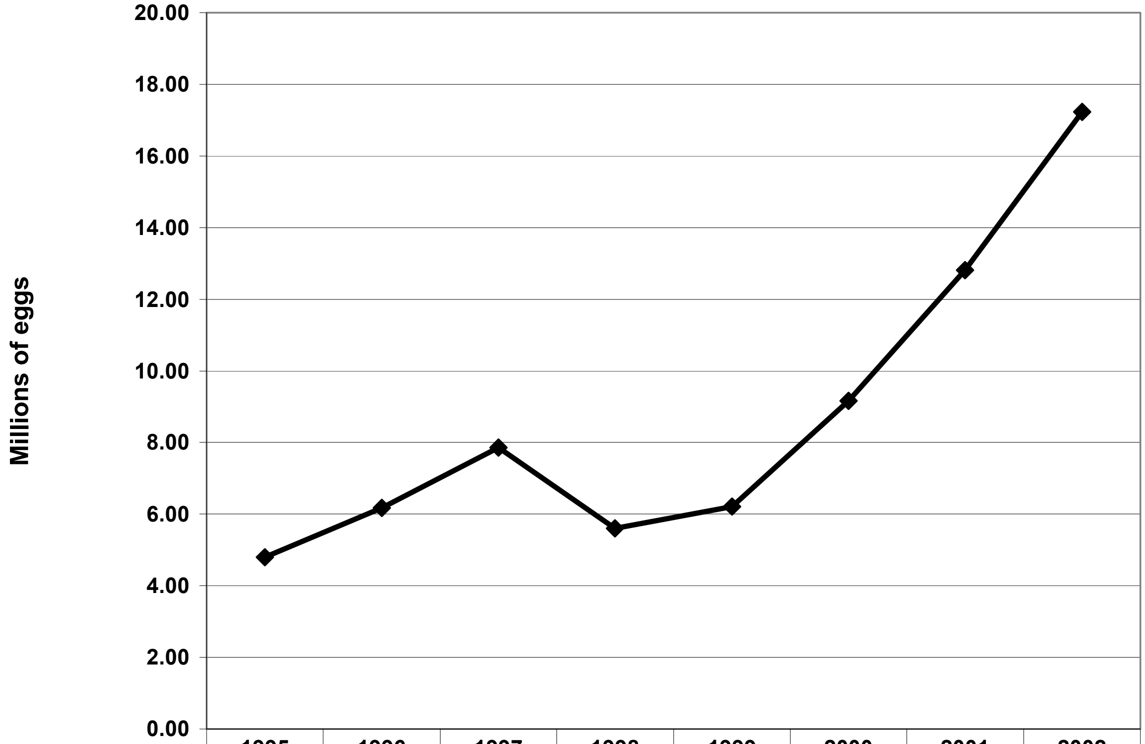
The sex ratio of natural summer steelhead returning to TMD was skewed towards females. During the 1991-2001 returns to TMD the percentage of a run year that was male has varied between 41.5% and 26.9% and averaged 30.9% (Figure 4-16). Mature resident male rainbow were often observed on or near active summer steelhead redds. These mature resident males were difficult to observe because of their small size. In redds constructed in tailout and glides they were more visible. Their appearance was distinguished by dark body coloration and a dark strip paralleling the lateral line Small males are usually sneak spawners, but especially during years of low male summer steelhead escapement, these mature resident males have been observed to be the only male available to fertilize the eggs of summer steelhead females. These resident males may aid in maintaining the genetic diversity of Umatilla River summer steelhead.



	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Male	41.5	27.4	26.9	26.3	28.9	26.7	31.1	32	37.3	31
Female	58.5	72.6	73.1	73.7	71.1	73.3	68.9	68	62.7	69

Figure 4-16. Sex ratio of natural summer steelhead returning to TMD, Umatilla River, by return year.

Egg deposition has been estimated for each run year. During escapement surveys conducted since 1991, prespawning mortality of summer steelhead has not been observed. Thus by subtracting the sport harvest of females above TMD a good estimate of egg disposition was possible. Potential egg deposition has varied between 4.80 and 17.23 million eggs and averaged 8.73 million eggs (Figure 4-17).



	1995	1996	1997	1998	1999	2000	2001	2002
Millions of eggs	4.80	6.18	7.86	5.60	6.21	9.17	12.81	17.23

Figure 4-17. Potential egg deposition by summer steelhead in the Umatilla River, 1995-2002

It is the author's opinion that for high quality escapement surveys only very experienced personnel should enumerate summer steelhead redds in the Umatilla Subbasin. Factors that make it difficult for the inexperienced surveyor include: rainbow or redband redds, false redds (test digs), redds from the previous year, and spawning of dace and suckers. These can all be classified as new summer steelhead redds by the inexperienced observer.

During summer steelhead escapement surveys a number of habitat problems have been noted that if corrected would aid in recovery of natural summer steelhead. A grazing allotment upstream from the highway bridge over Squaw Creek for about 500 yards permits large numbers of cows access to the stream. Many cow tracks have been observed in summer steelhead redds for the past 12 years. Cow tracks have also been observed in steelhead redds in the North Fork of Meacham Creek, Pot Creek, Mainstem Meacham Creek, Camp Creek and Boston Canyon Creek. These areas should be fenced to allow the riparian areas to recover.

Timber harvest and road building in the riparian areas of Squaw and Buckaroo Creeks have caused waters to warm, increased sedimentation, limited stream complexity and reduced the amount of large organic debris. Meacham Creek has been channelized in various locations to protect the railroad grade, and timber harvesting has been conducted in the riparian area.

Another major concern has been the diversion of live flow from lower Squaw Creek for the city of Pendleton water supply. Recent negotiations between the City of Pendleton and CTUIR have assisted in changing the point of diversion to near Pendleton and thus cold spring water will not be diverted. Another problem has been the narrow railroad and highway bridges over the lower end of Squaw and Buckaroo Creeks. The restriction of flow caused by narrow abutments in the streambed have allowed gravel deposition above these structures and because of this massive buildup of gravel the stream flows go subsurface in early to late spring. Migration into or out of these streams is thus not possible for 4-6 months per year, which is detrimental to young-of–the-year attempting to access the mainstem or mainstem fish attempting to access cooler water in the summer. In 1999 thousands of young-of–

the-year summer steelhead were observed stranded and dying in lower Squaw Creek because of lack of surface flow to the mouth. Now that the Pendleton diversion of cold spring water has stopped, if the bridge grade in lower Squaw Creek was widened the stream could cut through the gravel deposits and surface flow would occur to the mainstem Umatilla River. Buckaroo Creek may also flow to the mainstem if gravel deposits above the bridges were removed after abutments were widened.

The Umatilla River is one of the few areas where comparisons of known escapements to redds per mile are available. Because of the current threatened status of mid-Columbia summer steelhead, and continued uncertainties about the effects of supplementation on natural populations, it appears critical to maintain this high quality database. In addition, spawning success data, calculated in redds per mile, is necessary for comparison with other subbasins. Spawning ground survey data to determine the current status and health of individual summer steelhead populations in lateral tributaries both on and off the Reservation are of critical importance in developing land use and mitigation plans to aid in population recovery.

Summer Steelhead: Comparison with Other Subbasins
Comparisons with other summer steelhead populations in the Mid-Columbia that have not been supplemented were necessary to determine the possible effect supplementation has had on natural summer steelhead returns to the Umatilla River Subbasin.

The ratio of natural summer steelhead adults returning to TMD divided by returns at Nursery Bridge (Walla Walla) and ratio of natural redds per mile in index reaches of the Umatilla divided by redds per mile in index reaches of the John Day River indicated returns have increased more rapidly in the Umatilla River than in the Walla Walla or John Day Rivers. Umatilla River summer steelhead returns have increased from less than two times higher returns than those observed at Nursery Bridge from 1993-1995 to 2.3 to 4.2 times greater returns from 1996-2002 (Figure 4-18). Redds per mile in index areas of the John Day River were mostly higher than those observed in the Umatilla River during 1988-1994, but from 1995-2001 redds per mile in the Umatilla River index areas were 1.4-3.0 times higher than those observed in the John Day River (Figure 4-19).

Only 15 years of complete enumeration of summer steelhead adults is available on Umatilla River. Although an upward trend in returns is evident during the last three years (Figure 4-20), continued monitoring of returns is necessary as this is only a very short term trend. Increases in summer steelhead returns during the last three years parallel increased returns in both spring and fall Chinook and coho salmon in many areas of the Columbia Basin and are probably the result of increased ocean survival. Although an upward trend in adult summer steelhead returns is evident in the Umatilla subbasin, only two brood years between 1988 and 1997 returned to TMD at greater than 1.0 return per spawner. The 1998 brood will produce returns of greater than 1:1, but information for expanding five year olds (2.2) will not be available until at least the summer of 2003.

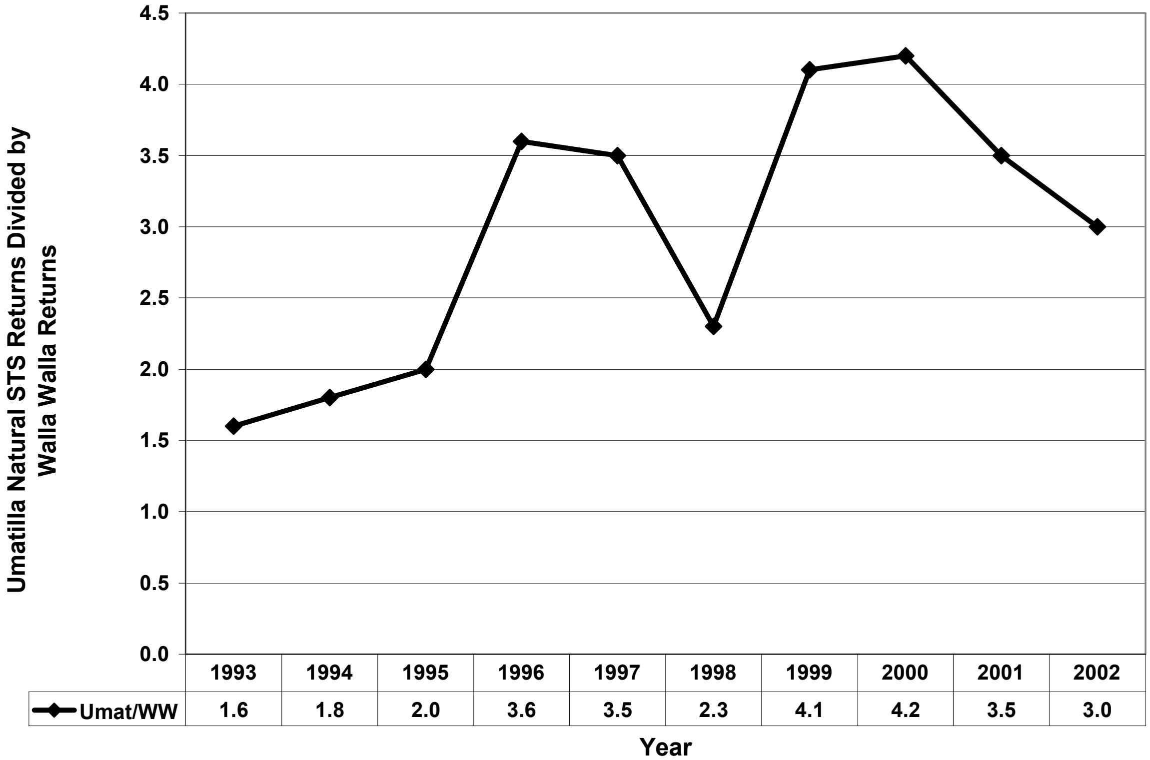
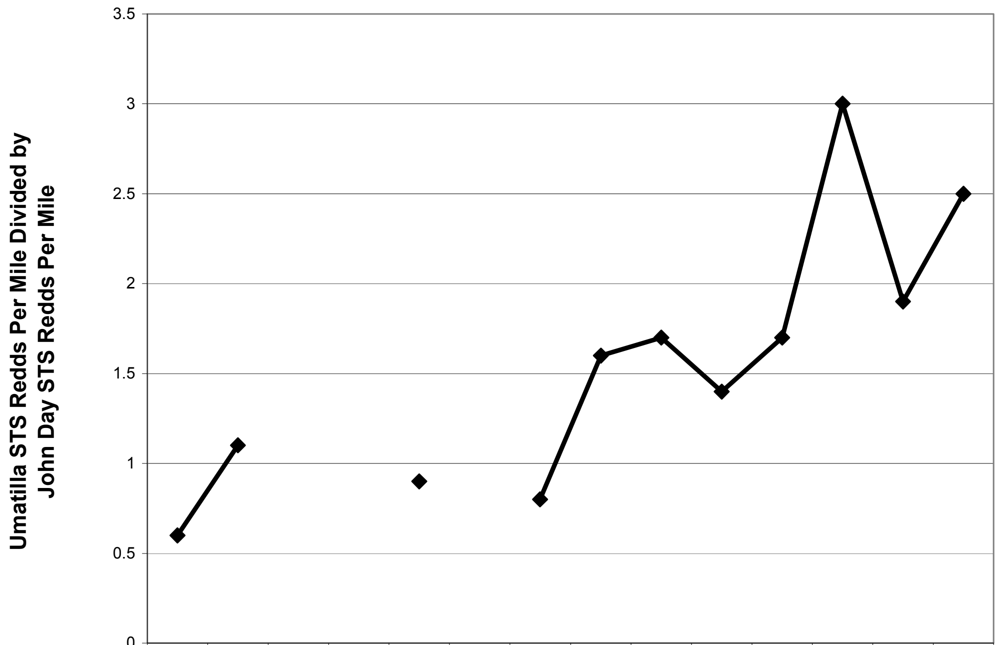


Figure 4-18. Natural summer steelhead returns from the Umatilla River divided by returns to the Walla Walla River at Nursery Bridge.

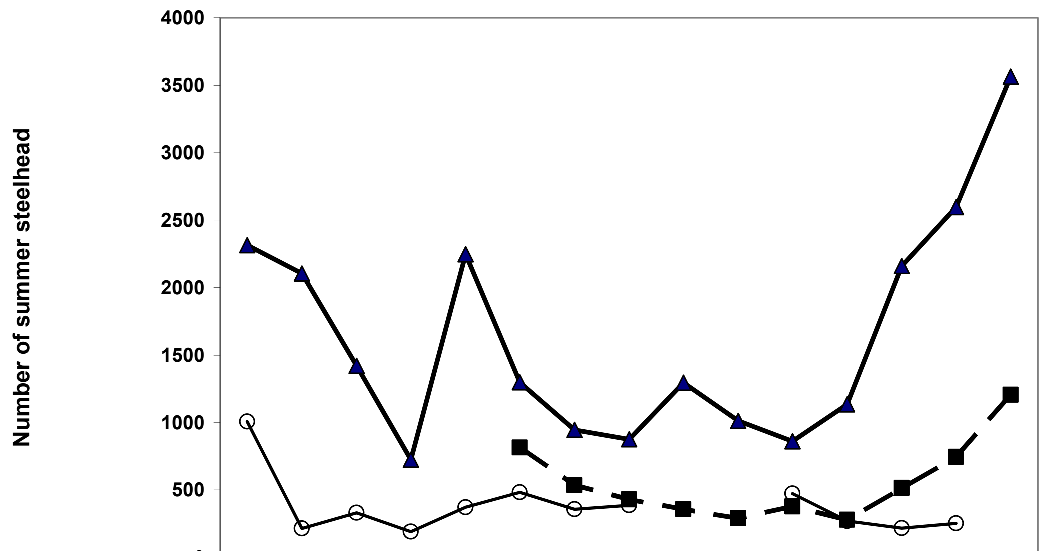
The natural summer steelhead return to the Touchet River has not shown the large increases in escapement the last three years as has been observed in other Mid-Columbia spawning tributaries. However, conditions were poor for observing the escapement in 2002 and no estimation of escapement was possible.

A long term data set of escapement and return is necessary to determine the status of summer steelhead populations. For example, the John Day Subbasin has the longest continuous data set of summer steelhead redd enumeration in the Mid-Columbia Region, beginning in 1959 and continuing to the present. The decade of the 1960's had the largest average redds per mile (8.46) and the 1990's was the lowest (2.67) (Figure 4-21). Increases in escapement from 2000-2002 parallel increases observed in the Umatilla and Walla Walla Rivers (Figures 4-20 and 4-22). Even though increases in return are evident during the short term, the long term trend suggests that the John Day summer steelhead population has seriously declined.



	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Umat/JD	0.6	1.1			0.9		0.8	1.6	1.7	1.4	1.7	3	1.9	2.5

Figure 4-19. Redds per mile in index areas of the Umatilla River divided by redds per mile in index areas in the John Day River.



	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02
Umatilla Natural	2315	2104	1422	724	2247	1298	945	875	1296	1014	862	1135	2160	2596	3562
WW Wild at NB						815	535	430	358	292	378	279	514	744	1205
Touchet Natural	1006	214	332	193	374	484	358	388			474	271	217	253	

Return Year

Figure 4-20. Natural adult summer steelhead returns to the Umatilla River, Walla Walla River at Nursery Bridge (NB) and Touchet River.

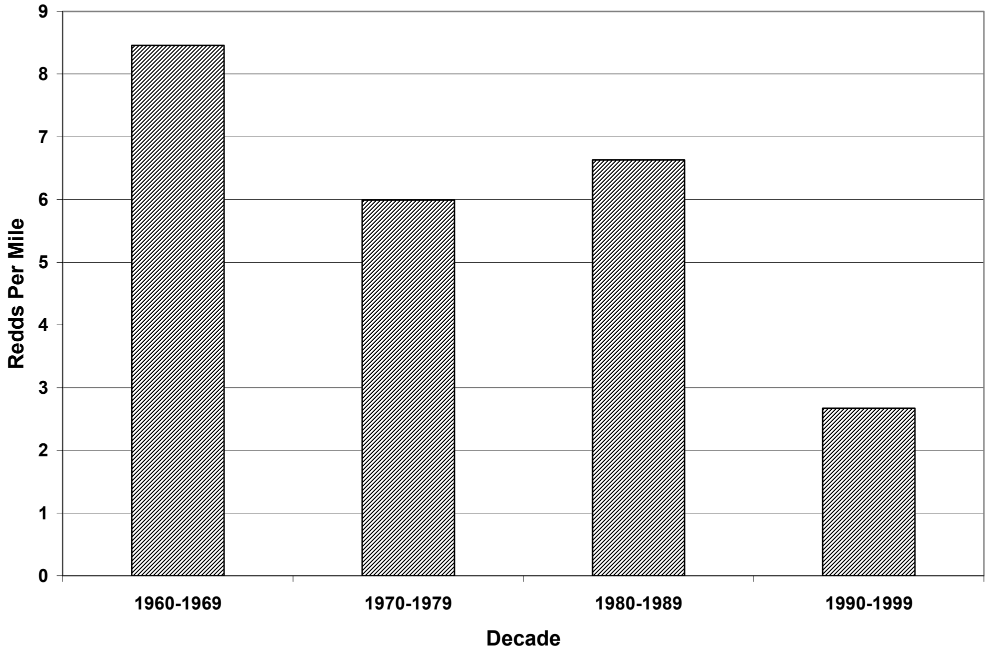
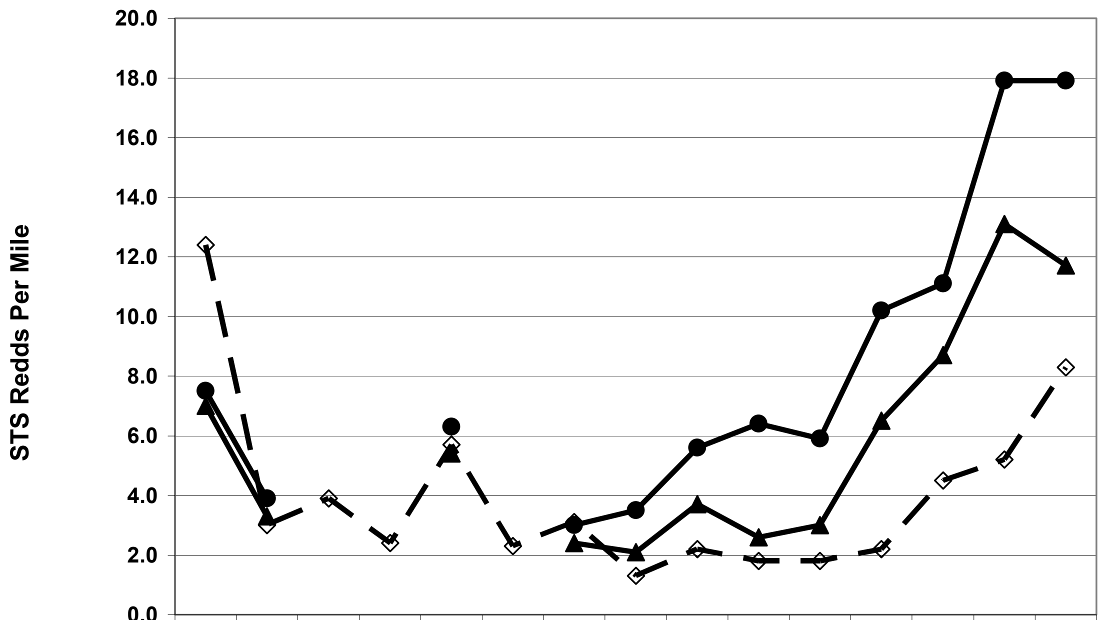


Figure 4-21. Average summer steelhead redds/mile in tributaries of the John Day River by decade.



	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02
John Day Wild	12.4	3.0	3.9	2.4	5.7	2.3	3.1	1.3	2.2	1.8	1.8	2.2	4.5	5.2	8.3
Umatilla N+H	7.5	3.9			6.3		3.0	3.5	5.6	6.4	5.9	10.2	11.1	17.9	17.9
Umatilla Natl	7.0	3.3			5.4		2.4	2.1	3.7	2.6	3.0	6.5	8.7	13.1	11.7

Return Year

Figure 4-22. Summer steelhead redds/mile in the Umatilla and John Day Rivers.

Summer Steelhead: Future Research Needs
It appears that the following high priority research objectives, listed in order of importance, should be conducted on a long term basis to better define the long term status of the Umatilla River natural summer steelhead population and determine the effects of supplementation on natural summer steelhead:

1) Monitor the return of summer steelhead at TMD by return and brood year.
2) Sample kelts at Westland to determine the percentage of non endemic summer steelhead spawning in the Umatilla River.
3) Compare genetic differences between returning natural and hatchery summer steelhead.
4) Accurately determine the tribal harvest of natural and hatchery summer steelhead.
5) Monitor spawning in index tributaries and expand index areas to include reaches of Pearson and East Birch Creeks.

SPRING CHINOOK SALMON

SPRING CHINOOK SALMON: EXECUTIVE SUMMARY

Extinction of the endemic spring Chinook salmon (*Oncorhynchus tshawytscha*) stock in the early 1900's was the result of irrigation and agricultural development (Bureau of Reclamation, 1988). Juveniles were reintroduced into the Umatilla River in 1986. This report summarizes adult spring Chinook salmon return data from entry into the trap or viewing window at Three Mile Dam (TMD), Umatilla River through spawning. The total return of spring Chinook salmon to TMD has varied between 13 and 5061 and averaged 1657 adults. The natural component of the return has varied between 22 and 348 and averaged 166 adults. In-river survival to spawning (fish potentially available to spawn vs. estimate of fish that did spawn) averaged 37.6% during the last 12 years. Fish per redd varied from 3.2-6.8 and averaged 4.4. Reach survival of adults to spawning was highest in the headwaters and decreased downstream as water temperatures increased. It appears that natural production of spring Chinook salmon occurs mostly in the North Fork and the Umatilla River from the forks down to Bar M (RM 89.6 to 87). Water temperatures were probably too warm during spawning and early incubation in most reaches below for survival to hatch. Although more years of estimating natural production of adults from the large escapements during the last four years are necessary, it appears that hatchery supplementation will be necessary if harvestable surpluses are desired.

SPRING CHINOOK SALMON: METHODS

Enumeration of returning spring Chinook salmon adults and jacks in the Umatilla River began in 1989 at Three Mile Dam (TMD). From 1989 to 1999 spring Chinook salmon were all captured, anesthetized with carbon dioxide and enumerated and categorized by gender and fin clip. Fish were also classified as either adult (610 mm fork length or larger) or jack (less than 610 mm fork length). Since 2000, the adult return has been enumerated and categorized by a combination of capturing, anesthetizing and handling, alternating with video taping without capture (alternating approximately every 7-10 days). Adult spring Chinook salmon enumerated from video tapes were apportioned (sex, fin clip and jack vs. adult) by determining the percentage of the known fish in the immediate periods before and after video taping and using that percentage to expand the unknown fish from the video taping period (Dale Chess, personal communication).

Gender was determined by external sexual characteristics. Spring Chinook salmon scales were taken in the preferred area, two rows above the lateral line in a diagonal line between the posterior edge of the dorsal fin and the anterior edge of the anal fin on the left side of the fish. Additional scales were taken above and below the lateral line and on the right side of the fish in and near the preferred area because of the high degree of regeneration in spring Chinook salmon scales in the Umatilla River. Scales were mounted on gum cards and pressed in cellulose acetate. Scales were examined under a microfiche reader at a magnification of 42x and/or 72x. Age designation utilized the European method; a fish returning in 2002 at age 1.2 was spawned in 1998, emerged from the gravel in January-March of 1999, migrated to the ocean in the spring of 2000, returned to freshwater in the spring 2002 and spawned in the late summer of 2002 at total age 4.

The number of circuli to the freshwater annulus was determined for a sample of marked (hatchery origin) and unmarked fish (unknown origin) returning to estimate the number naturally produced. From 1996 through 2000, hatchery returns should have been fin clipped, but poor clips and/or fin regeneration made scale analysis necessary to estimate natural production. In 2001 and 2002, most returning hatchery spring Chinook salmon were not marked, and natural production was determined by comparison of circuli to the annulus of marked and unmarked samples of the return.

Prespawning mortality surveys were conducted from 1991 to 1998 in many reaches of the Umatilla River to estimate the number of fish that did not survive to spawn. Surveys began in late June or early July and continued through the completion of spawning.

Escapement surveys were conducted in various reaches of the Umatilla River to sample fish and enumerate redds. Individual reaches were surveyed approximately every 7-10 days during spawning. Surveyors wore baseball caps and polarized glasses to maximize fish observing capabilities. Redds were judged to be complete (and thus spawning successful) based on redd size and depth, location, and amount and size of rock moved. Redds were marked with flagging and the date, location and number of females and males on or near the redd and their spawning status were written with permanent marker on the flagging. For each observed redd, the surveyor recorded on a data sheet the location, date the redd was first observed, sex and number of fish observed on or near the redd, fish sampled and spawning habitat type (riffle, tailout, glide). Carcasses sampled were measured from the middle of the eye to the hypural plate (MEHP) and tip of snout to fork of tail (fork length) if the fish was adipose clipped. Carcasses were cut open to determine the egg retention of females and spawning success of males. Tails of sampled fish were removed at the caudal peduncle to prevent resampling. Snouts of adipose clipped and adipose clipped plus left or right ventral fin clipped spring Chinook salmon were removed behind the orbit to recover coded wire tags. Snouts were placed in plastic bags and given individual snout numbers. The snout number linked the snout with other biological data collected from the individual fish.

Inriver survival to spawning of adult spring Chinook salmon was estimated by comparing the number of adults released above TMD, minus all harvest components, to the total number of fish that spawned. It was assumed that each female constructed one complete redd and that we enumerated all redds. It was also assumed that spawned males were sampled at a similar rate as females. Reach survival to spawning was estimated by comparing the number of spawned fish sampled to prespawning mortalities sampled by reach.

Tribal harvest of spring Chinook in the Umatilla River is an essential element in documenting the benefit of Umatilla River programs and with keeping harvest within management guidelines outlined in the Master Plan (CTUIR 1984). Harvest estimates are also important in estimating spawning escapement. Catch estimates are subtracted from the number of adults passing TMD or released above TMD. The variability from year to year of the tribal angling seasons and locations often requires significant modifications of survey designs. Inadequate coverage and lack of effort data prevented the calculation of harvest estimates with appropriate measures of uncertainty.

SPRING CHINOOK SALMON: RESULTS AND DISCUSSION

Spring Chinook Salmon: Returns to Three Mile Dam

The total return by year of spring Chinook salmon to Three Mile Dam since the first adult return in 1988 has varied between 13 (1988) and 5061 (2002) and averaged 1657 adults. Annual return of jack spring Chinook salmon during this period varied between 3 and 210 (Figure 4-23).

The estimated natural component of the adult return to TMD from 1996-2002 has varied between 22 (1999) and 348 (2000) and averaged 166 (Figure 4-24). The natural component was determined by comparison of freshwater circuli counts to the annulus of known hatchery returning adults and comparison with the unmarked component of the return. For example, in 2002 a sample of the sport harvest of spring Chinook salmon below TMD contained 58 known hatchery origin fish. Scale analysis indicated that circuli counts to the freshwater annulus of these known hatchery fish varied between 22 and 31. Circuli counts to the freshwater annulus of 207 fish of unknown origin (a mixture of natural and hatchery fish that were not marked) varied between 14 and 35 (Figure 4-25). In the mixed sport sample, fish with 18 or less circuli to the freshwater annulus were classified as naturally produced and fish with 21 or more circuli were classified as of hatchery origin. Based on this analysis, we estimated that 2.4% of the sport harvest below TMD was naturally produced.

From 1996 to 2002 comparison of freshwater circuli counts to the annulus of unmarked and marked spring Chinook salmon indicated that natural fish comprised from 1.2% to 16.1% of the spring Chinook salmon return to TMD (Figure 4-26). A summary of the number of unmarked returning adults, estimate of percentage naturally produced based on circuli counts to the freshwater annulus, and estimated naturally produced fish from 1996-2002 is presented in Table 4-6.

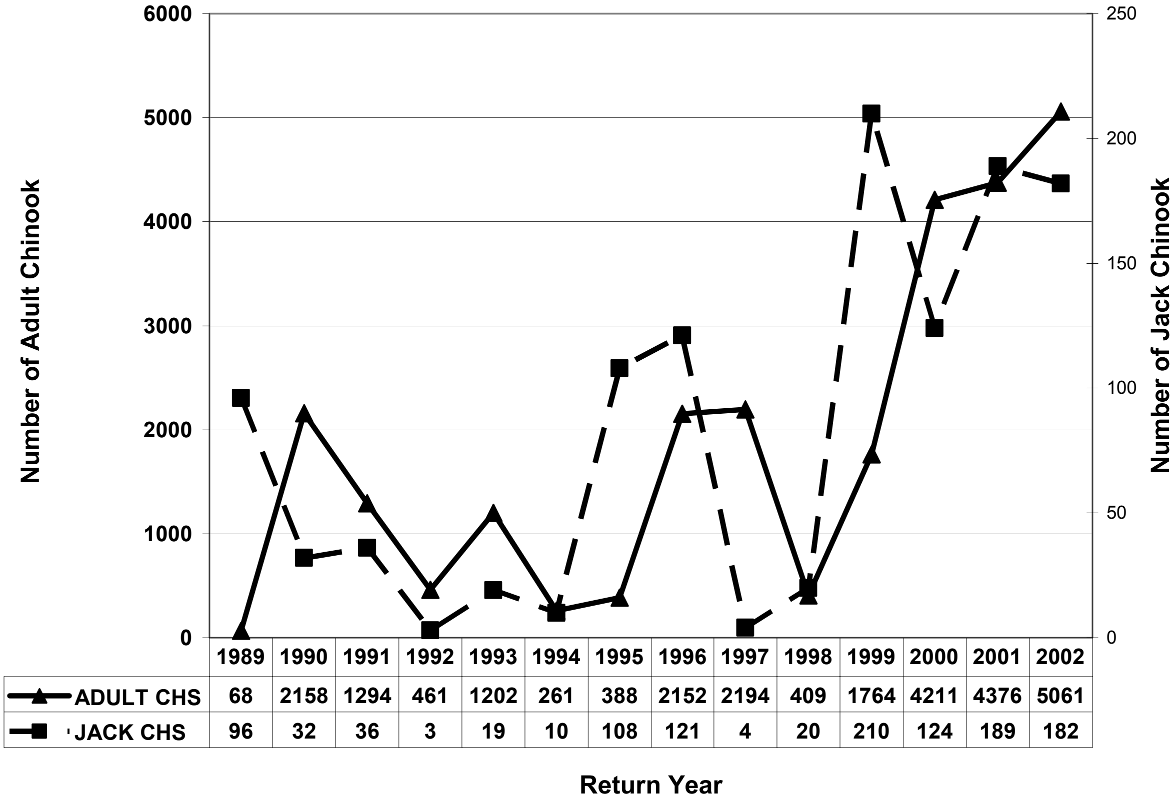
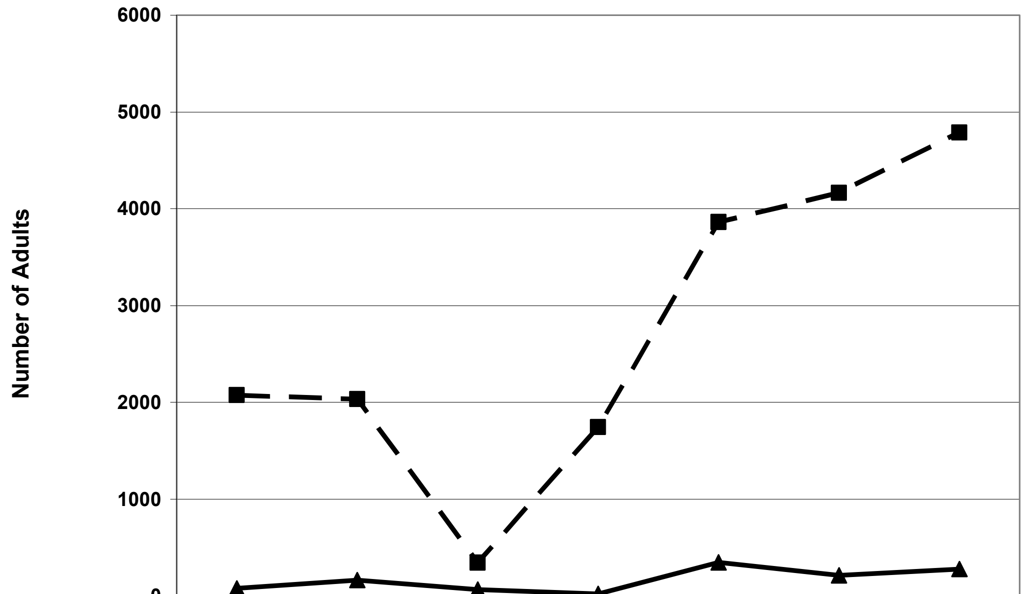


Figure 4-23. Adult and jack spring Chinook salmon returns to the Three Mile Dam, Umatilla River, 1989-2002.

Table 4-6. Estimated number of naturally produced spring Chinook salmon based on freshwater circuli counts, Umatilla River.

Return year	1996	1997	1998	1999	2000	2001	2002
Unmarked adults at TMD	165	180	68	30	420	3529	3892
Estimated percent naturally produced	46.2	90.9	100.0	73.3	82.8	6.0	7.1
Estimated naturally produced adults	77	161	66	22	348	212	276
Unmarked jacks at TMD	1	0	0	2	90	139	141
Estimated percent naturally produced						20.0	50.0
Estimated naturally produced jacks						28	70
Range of circuli counts-natural	12-15	10-17	10-16	*	*	14-19	15-18
Range of circuli counts-hatchery	20-30	24-26	22-23	*	*	21-36	21-34
Sample size n=	39	44	24	7	87	143	129

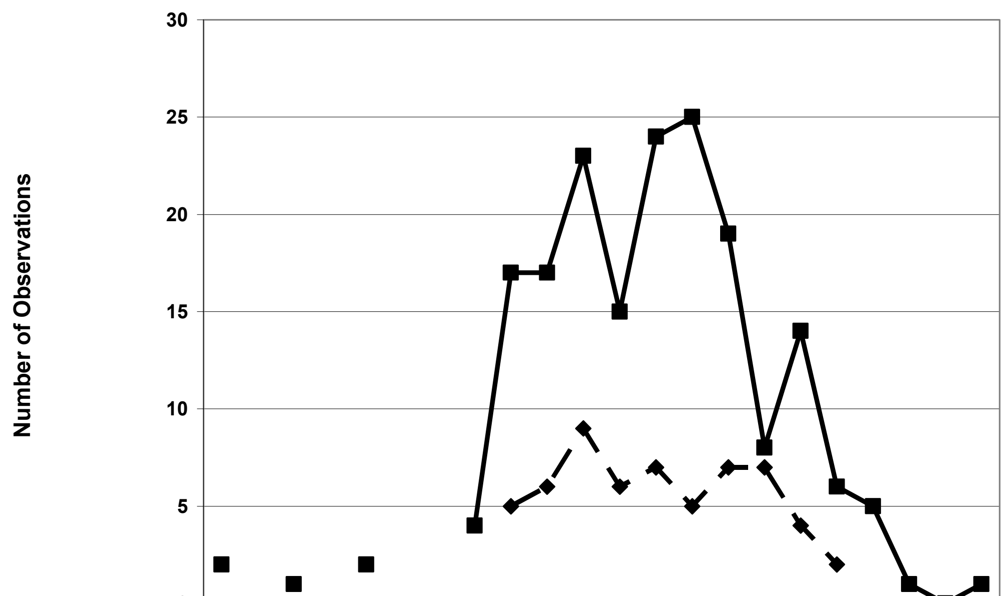
In 1997 the recovery of unmarked adults, 90.9% which were estimated to be naturally produced, indicated that approximately 58% of the natural returning adult spawners were distributed in the North Fork or Forks to Bar M reaches. Spawned natural fish were recovered in all reaches but the upstream areas had largest numbers of natural spawners (Figure 4-27).



	1996	1997	1998	1999	2000	2001	2002
Natural CHS	77	161	66	22	348	212	276
Hatchery CHS	2075	2033	343	1742	3863	4164	4785

Year

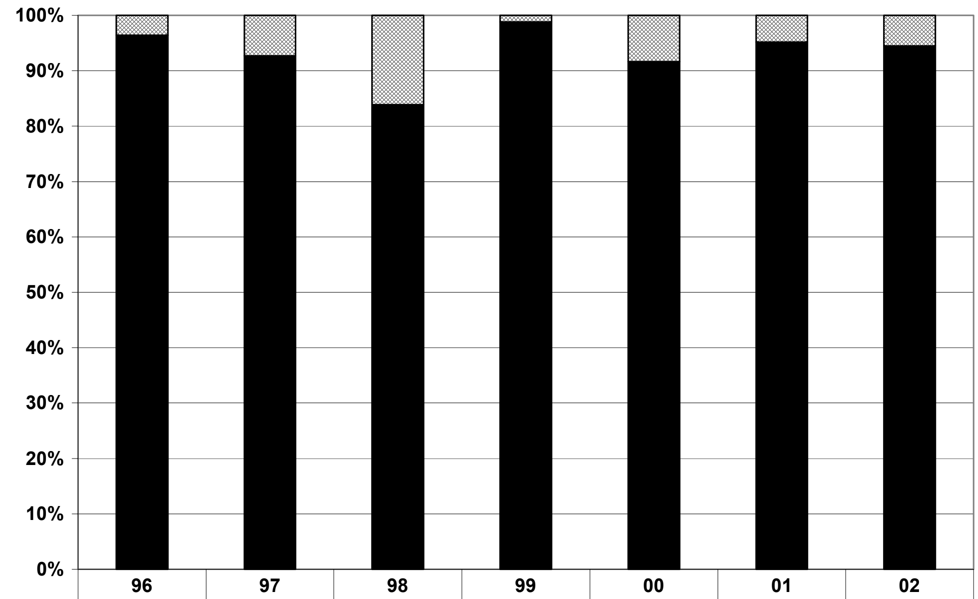
Figure 4-24. The number of natural and hatchery produced adult spring Chinook salmon returning to TMD, Umatilla River, 1996-2002.



	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
Hatchery CHS n=58									5	6	9	6	7	5	7	7	4	2				
Unknown CHS n=207	2		1		2			4	17	17	23	15	24	25	19	8	14	6	5	1	0	1

First Year Circuli Counts

Figure 4-25. Circuli counts to the first annulus of hatchery and unknown origin spring Chinook salmon



	96	97	98	99	00	01	02
%natural	3.6	7.3	16.1	1.2	8.3	4.8	5.5
%hatchery	96.4	92.7	83.9	98.8	91.7	95.2	94.5

Figure 4-26. Origin of spring Chinook salmon returning to the Umatilla River.

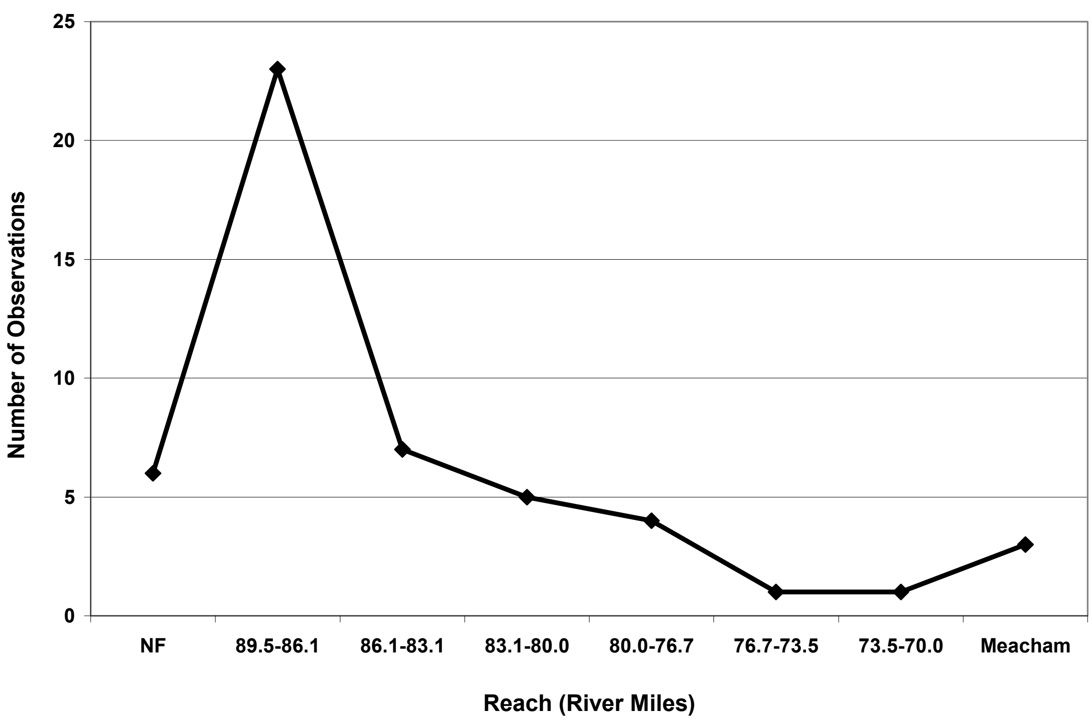


Figure 4-27. Spawning distribution of unmarked (90.9% naturally produced) spring Chinook salmon in the Umatilla River, RM 89.5-70.0, 1997. (NF is the North Fork of the Umatilla River RM 0-4; Meacham Creek includes RM 0-15).

In 2000, scale analysis indicated that of 420 unmarked adults returning to TMD a total of 348 adults were estimated to be naturally produced. Based on the assumption that the naturally produced fish returned to their natal areas to spawn, 155 (44.5%) were produced in the North Fork and 153 (44.0%) originated in the area from the Forks to the Bar M (Table 4-7). Minimal survival from natural spawning natural of spring Chinook salmon occurred below the Bar M from the 1996 brood. This was probably the result of high water temperatures during spawning and early incubation. September mean maximum, average and minimum water temperature data by river mile indicated that water temperatures for early incubation increased rapidly below the North Fork. Mean monthly water temperatures varied between 44.4 degrees F in the North Fork and 58.3 degrees F near Squaw Creek. The mean maximum September temperature varied between 50.4 degrees F in the North Fork and 63.0 degrees F near Squaw Creek.

Research has indicated a 50% mortality of lots of eggs incubated at a constant 55 and 57.5 degrees F and 100% mortality of lots incubated at 60 and 62.5 degrees F (Seymour, 1956). Other studies have shown that the upper limit for incubation of spring Chinook salmon eggs was 57.6 to 59.9 degrees F (Combs and Burrow, 1957). Heming (1982) concluded that Chinook salmon should be incubated at water temperatures below 53.6 degrees F because fish reared at or above this threshold experienced reduced survival, hatch and emerge early and are smaller than fish reared at lower temperatures (see Chapter 5 for additional water temperature data).

Table 4-7. Spring Chinook salmon sampled by area and mark, and expansions of unmarked, Umatilla River 2000.

AREA	No Marks Spawned	o Marks PM	% Natural Produced	# Natural Produced	LV Clips Spawned	LV Clips PM	RV Clips Spawned	RV Clips PM	Sampled Naturally Produced	Expanded Naturally Produced	Number Hatchery Produced	Percent Naturally Produced	Percent Hatchery Produced
North Fork-area 1	66	0	100.0	66	81	2	4	0	66	155	87	43.1	56.9
Forks to Bar M Driveway-area 2	70	3	88.9	65	236	21	25	3	65	153	293	18.2	81.8
Bar M Driveway to Larson's-area 3	13	2	70.0	11	224	18	31	1	11	26	278	3.8	96.2
Larson's to Fred Gray's Bridge-area 4	13	3	20.0	3	170	55	22	15	3	7	275	1.1	98.9
Fred Gray's Bridge to Squaw Creek-area 5+6	6	3	0.0	0	61	52	4	13	0	0	139	0.0	100.0
Squaw Creek to Thorn Hollow Bridge-area 7	1	1	0.0	0	28	4	2	4	0	0	40	0.0	100.0
Thorn Hollow Bridge to Louie Dick's Fence-area 8	2	0	0.0	0	13	5	2	0	0	0	22	0.0	100.0
Louie Dick's Fence to Minthorn Springs-area 9	0	0	0.0	0	3	0	0	0	0	0	3	0.0	100.0
Meacham Creek-area 10	3	0	100.0	3	21	0	1	0	3	7	22	12.0	88.0
TOTALS	174	12		148	837	157	91	36	148	348	1159		

Notes: Spawned= spawned all or art of gametes; PM=prespawning mortality = died before spawning

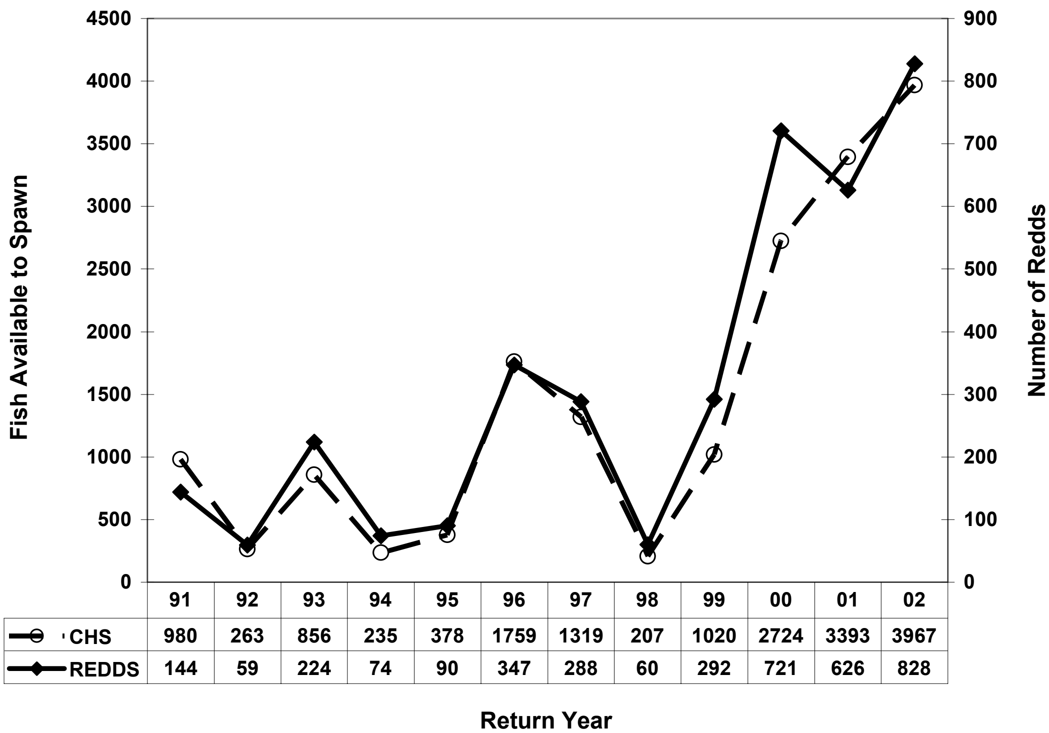
Table 4-8 Spring Chinook salmon adult return, disposition, and escapement to the Umatilla River Subbasin, 1989-2002.

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Hatchery adults enumerated at TMD	68	2158	1294	461	1202	261	388	2075	2033	343	1742	3863	4164	4785
Estimated natural adults enumerated at TMD [1]								77	161	66	22	348	212	276
Total adults enumerated at TMD	68	2158	1294	461	1202	261	388	2152	2194	409	1764	4211	4376	5061
Hatchery jacks enumerated at TMD													161	112
Estimated natural jacks enumerated at TMD [1]													28	70
Total jacks enumerated at TMD	96	32	36	3	19	10	108	121	4	20	210	124	189	182
Sacrificed or mortalities at TMD	36	25	234	200	165	31	56	57	58	11	79	27	41	25
Taken for brood stock	0	200	0	0	0	0	0	0	600	202	631	617	677	588
Adults released above TMD	64	1949	1085	263	1050	235	378	2132	1537	207	1138	3562	3720	4322
Jacks released above TMD	64	16	11	1	6	5	62	80	3	9	126	97	129	137
Adipose clipped CHS released above TMD	3	685	479	135	603	133	162	572	400	38	327	1281	739	
Harvested above TMD- CTUIR	0	0*	82	0	176	0	0	167	187	0	110 [2]	695 [3]	247 *	245*
Harvested above TMD- ODFW	0	20	23	0	18	0	0	206	31	0	11	143	80	110
Adults potentially available to spawn	64	1929	980	263	856	235	378	1759	1319	207	1020	2724	3393	3967
Adults sampled on spawning grounds	6	272	228	78	471	112	194	715	667	89	539	1388	986	1269
Jacks sampled on spawning grounds			2	1	3	1	22	24	1	2	40	32	13	30
Adult percent recovered (after harvest)	4.7	13.8	23.3	29.7	55.0	47.7	51.3	40.6	50.6	43.0	52.8	51.0	29.1	32.0
Number of ad clips sampled	0	83	136	39	356	50	78	166	182	17	137	394	135	263
Percent recovered (ad clips)	0	12.1	28.4	28.9	59	37.6	48.1	29	45.5	44.7	41.9	30.8	18.3	58.1
Prespawning mortalities sampled (adults)			88	22	124	19	60	256	230	28	157	227	460	372
Prespawning mortalities sampled (jacks)			1	1	1	1	10	5	0	0	13	7	3	13
Spawned adults sampled			130	48	336	93	126	440	401	61	361	1102	501	772
Spawned jacks sampled			1		2	0	11	19	1	1	27	20	10	15
Redds observed	14	289	144	59	224	74	90	347	288	60	292	721	626	828
Spawned females sampled			81	37	205	56	73	267	244	41	228	689	335	513

Notes:
1) The estimated escapement of natural spring Chinook salmon adults was determined by scale analysis (circuli counts) of a sample of the unmarked adults returning to Three Mile Dam.
2) Harvest includes 8 gaff mortalities sampled and 4 seriously injured fish that would not survive to spawn
3) Harvest includes 17 gaff mortalities sampled after fishery
* Complete creel not conducted, minimum estimate of harvest
Jack=<450 mm MEPH length

Spring Chinook Salmon Available to Spawn
Some spring Chinook salmon returning to Three Mile Dam were sacrificed to recover coded wire tags from 1989-1993, small numbers died associated with holding and handling, and since 1997 some fish have been removed for brood stock development. Summary of returns, dispositions and escapement information from 1989-2002 is in Table 4-8.

A total of from 11 to 234 fish were annually sacrificed to recover coded wire tags or were holding and/or handling mortalities. Since 1994, adult spring Chinook salmon were not sacrificed at TMD because of spawning ground recoveries of coded wire tags. From 1997 to 2002, from 202-677 (average 553) spring Chinook salmon were captured annually and hauled to the South Fork Walla Walla brood holding facility. Many additional coded wire tags were recovered from the brood at spawning. All remaining fish were released upstream. To determine the estimated number of fish potentially available to spawn, the Tribal harvest on the Reservation and sport harvest from TMD to the lower Reservation Boundary were subtracted from the fish released above the Dam. Adults potentially available to spawn by return year from 1991to 2002 varied between 207 and 3967 and averaged 1364 (Figure 4-28). Estimates of Tribal harvest of spring Chinook salmon in the Umatilla River are listed in Table 4-8 but are point estimates only and reflect reported harvest and do not include expanded estimates based on standard creel survey methods.

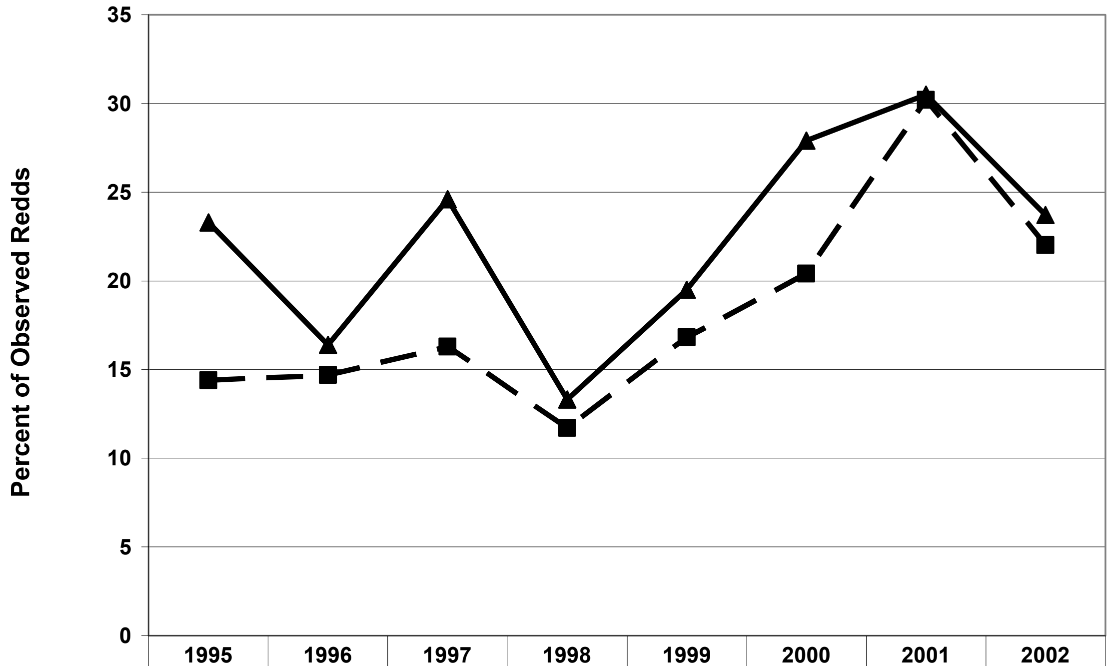


	91	92	93	94	95	96	97	98	99	00	01	02
CHS	980	263	856	235	378	1759	1319	207	1020	2724	3393	3967
REDDS	144	59	224	74	90	347	288	60	292	721	626	828

Figure 4-28. The number of spring Chinook salmon available to spawn in the Umatilla River (total return minus harvest and brood stock collections).

Spring Chinook Salmon: Spawning Ground Surveys
Intensive escapement surveys to enumerate redds and sample the spawning return of spring Chinook salmon have been conducted in various reaches of the Umatilla River Subbasin since 1991. The number of redds enumerated during escapement surveys has varied between 14 in 1989 and 828 in 2002 and averaged 289 (Figure 4-28). In the upper four miles of the North Fork and the three mile reach from the Forks to Bar M, where it appears that the majority of the natural production occurs, the total number of redds annually observed from 1991 to 2002 has varied between 15 in 1998 and 380 in 2001 (Figure 4-29). There was an excellent correlation (r=.97) between adult spring Chinook salmon potentially available to spawn and total redds annually enumerated in the Umatilla River (Figure 4-

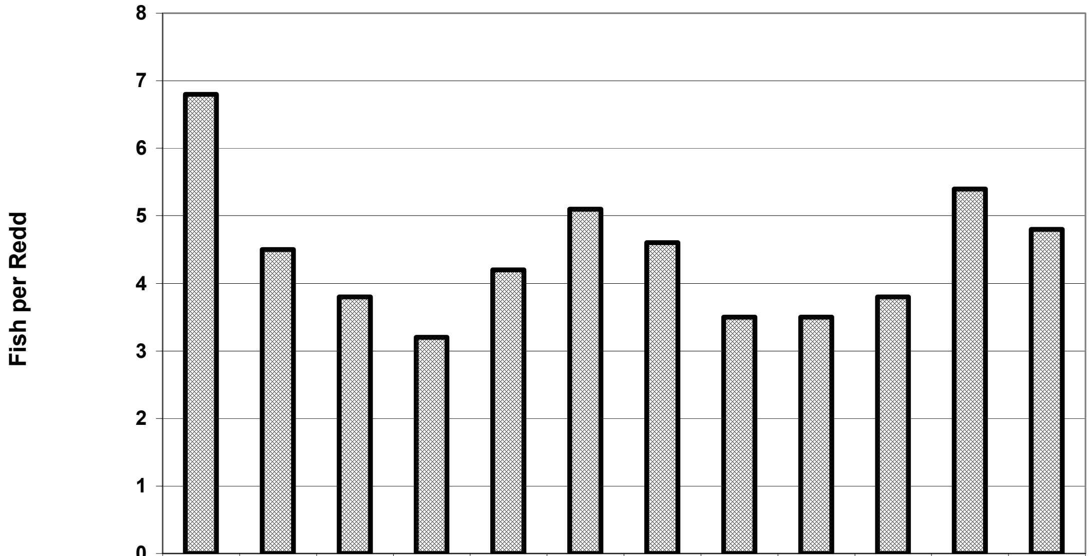
28). However, the number of fish per redd (the fish available to spawn divided by total redds enumerated) was very high compared to other subbasins in Eastern Oregon in most years. The number of fish per redd varied between 3.2 and 6.8 and averaged 4.4 (Figure 4-30). Since we enumerate 100% of the Umatilla River spring Chinook redds in the Umatilla River above Pendleton and sample a high percentage of the spawned females (Figure 4-31), large numbers of returning fish potentially available to spawn are not accounted for. Past studies indicated that fallback over TMD was not a serious problem (Zimmerman and Duke 1996). Estimated fallback was .9% in 1996.



	1995	1996	1997	1998	1999	2000	2001	2002
North Fork	14.4	14.7	16.3	11.7	16.8	20.4	30.2	22.0
Forks-Bar M	23.3	16.4	24.6	13.3	19.5	27.9	30.5	23.7

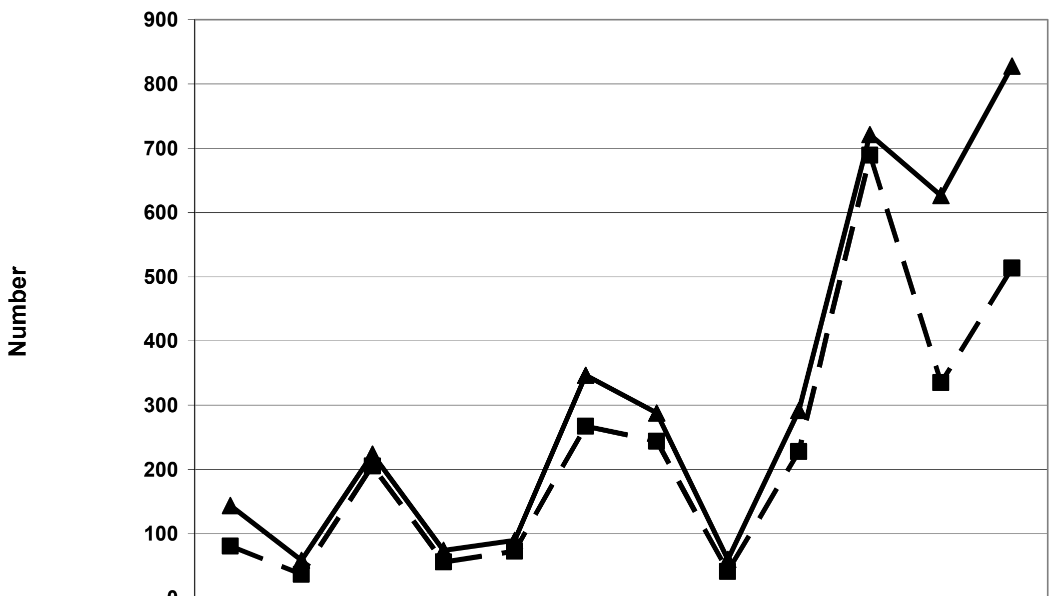
Return Year

Figure 4-29. Percent of spring Chinook salmon redds observed for the entire Umatilla River that were enumerated in two primary production areas (by return year, N. F. Umatilla River RM 0-4 and Umatilla River RM 86.1 to 89.5).



	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Fish per Redd	6.8	4.5	3.8	3.2	4.2	5.1	4.6	3.5	3.5	3.8	5.4	4.8

Figure 4-30. The number of spring Chinook salmon per redd, Umatilla River, 1991-2002.



	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Redds observed	144	59	224	74	90	347	288	60	292	721	626	828
Spawned females	81	37	205	56	73	267	244	41	228	689	335	513

Figure 4-31. The number of both redds and spawned out females enumerated during spawning surveys in the Umatilla River, 1991-2002.

Inriver survival of adult spring Chinook has been estimated by comparing the number of fish potentially available to spawn (fish released at or above TMD, minus all harvest components) to the total number of fish that did spawn. For instance, in 1999 we enumerated 292 spring Chinook salmon redds and sampled 228 spawned females. Thus we sampled 78.1% of the spawned females. We assumed that we sampled spawned out males at the same rate. Thus inriver survival (fish potentially available to spawn vs. estimate of fish that spawned) was 45.3%. Over the past 12 years, inriver survival to spawning has varied between 23.6% and 52.3% and averaged 37.4% (Figure 4-32). This loss in potential spawners is probably a combination of prespawning mortality, undocumented harvest and mortality below Pendleton, which was difficult to assess because of turbid water conditions.

Prespawning mortality has been determined to be a serious problem in the Umatilla River. Based on carcass sampling, reach survival (comparison of spawned out to prespawning mortalities sampled by reach) to spawning of adult spring Chinook salmon varied greatly. Mean survival to spawning was highest in the colder headwaters and decreased downstream as average water temperatures increased (Table 4-9 and Figure 4-33). In the North Fork reach survival varied between 86.7% and 100% and averaged 95.9%. Maximum average water temperature during July adult holding was 59.2 degrees F in 1998 and mean daily water temperature in this reach was 55.0 degrees F during July 1998. Reach survival decreased in each approximate three mile reach and 12 miles below the North and South Fork Confluence the 12 year reach survival declined to 32.6%-51.7% and averaged 41.1%. Average daily maximum water temperature during July adult holding in this reach were between 70.2 and 72.0 degrees F and average daily water temperature varied between 63.4 and 65.7 degrees F during July 1999-2001.

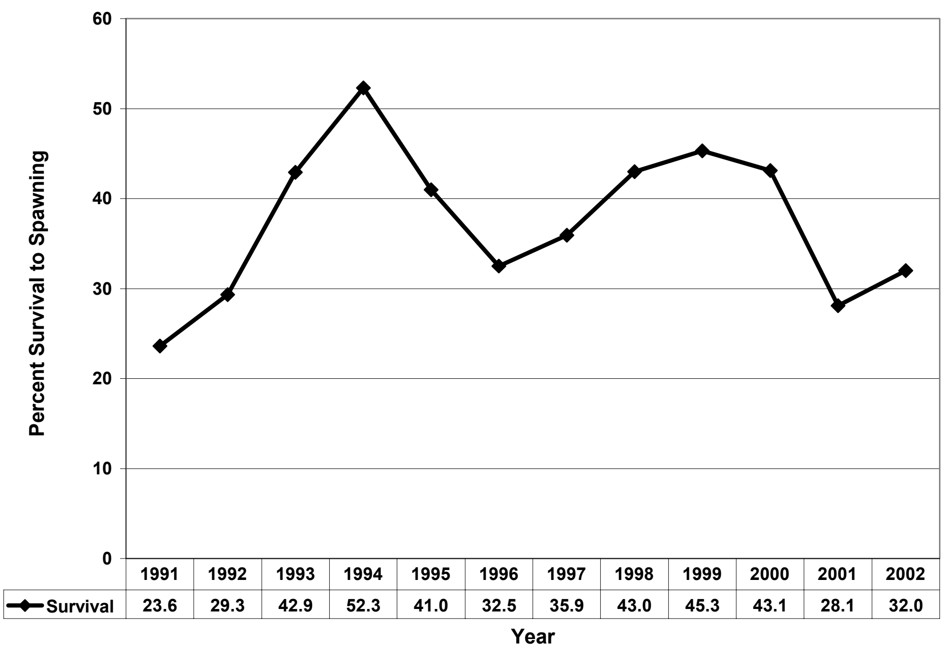


Figure 4-32. Survival to spawning for spring Chinook available to spawn in the Umatilla River, 1991-2002.

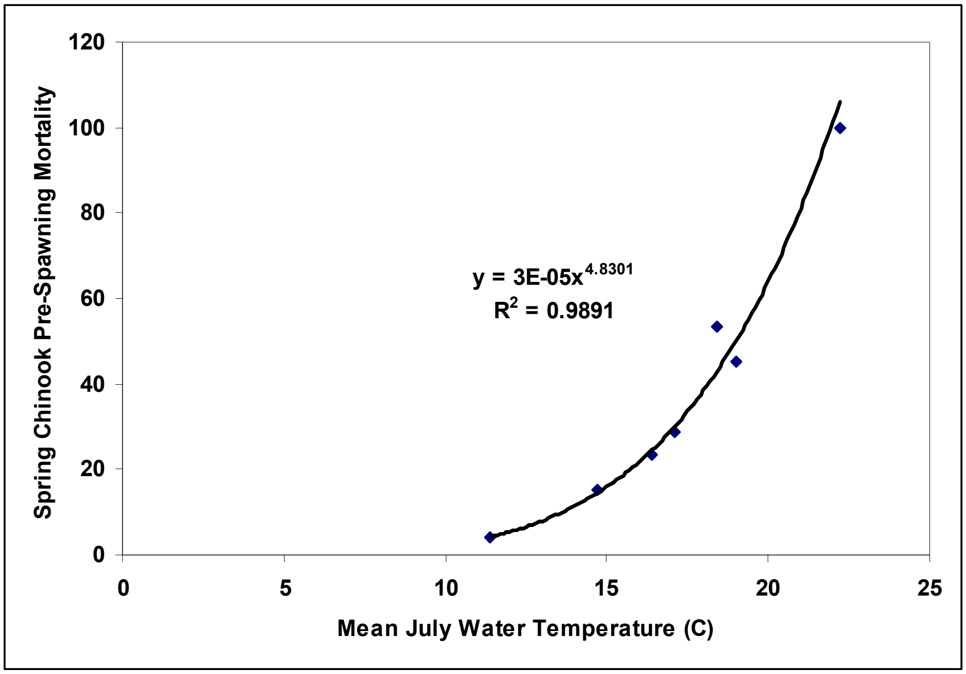
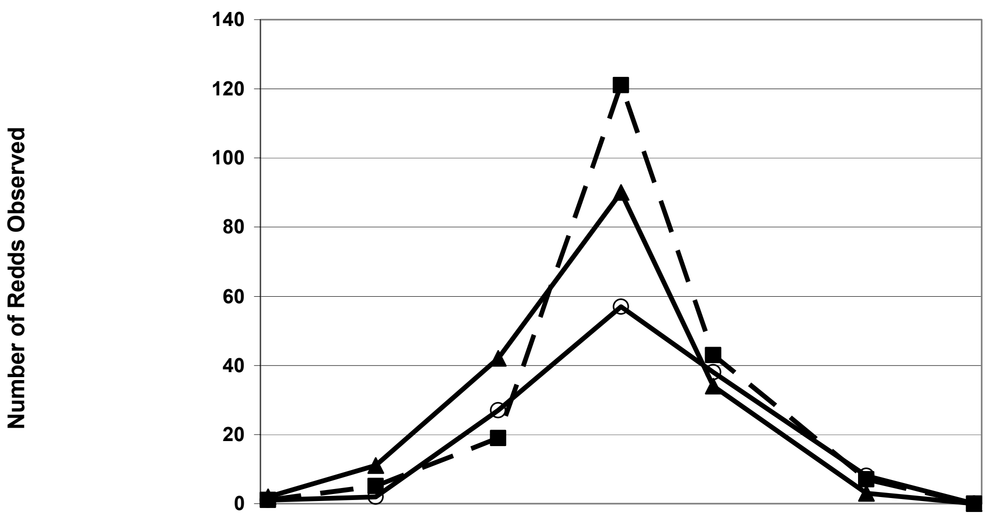


Figure 4-33. Mean prespawning mortality of spring Chinook in the Umatilla River, by reach, 1992-2002 plotted by the associated mean July 2000 water temperatures for each respective reach (from Contor and Crump, 2003, Chapter 5).



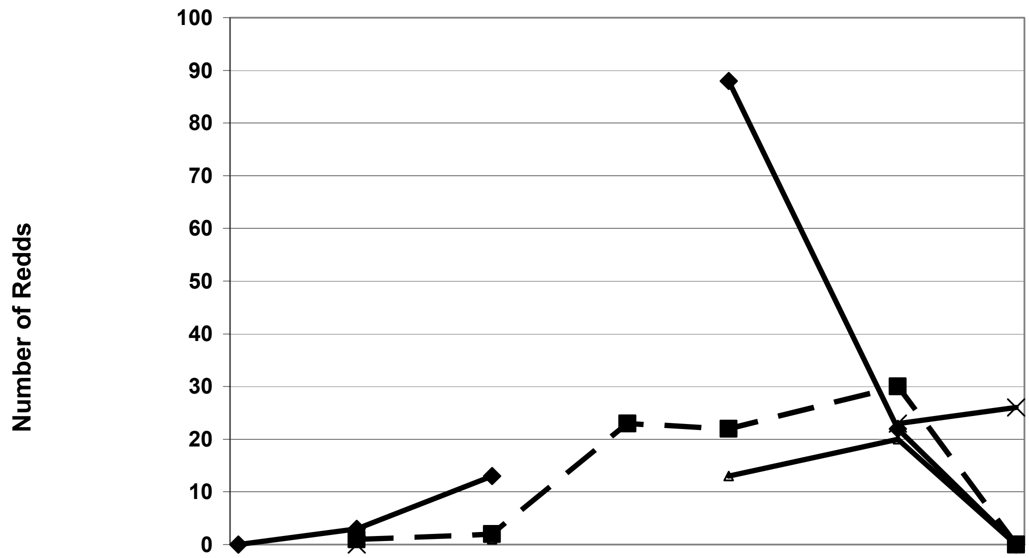
	8/5	8/12	8/20	8/28	9/3	9/13	9/20
North Fork RM>89.5	2	11	42	90	34	3	0
Forks-Bar M RM 89.5-86.1	1	5	19	121	43	7	0
Bar M-Larson's RM 86.1-83.1	1	2	27	57	38	8	0

Date

Figure 4-34. The timing of new spring Chinook redds observed in the Umatilla River, 2002.

I believed for many years that columnaris was the causative factor in most of the fish that died before spawning. Serious gill erosion was evident in most prespawning mortalities although head burn was also observed. Columnaris was confirmed by samples collected from prespawning mortalities in 2001 with the assistance of ODFW, Northeast Oregon Fish Pathology Laboratory (Sam Onjukka, ODFW, personal communication).

The spawning distribution of spring Chinook salmon in the Umatilla River has shifted towards the headwater reaches during the last three years. In the primary production areas, the North Fork and Forks to Bar M, an average of over 50% of all redds observed in 2000-2002 were in these reaches. From 1995 to 1999 an average of 34.2% of the observed redds were in these reaches. In Alaska, Chinook salmon have been observed to spawn further upstream in high water years (Paul Kissner, unpublished) but water levels in the Upper Umatilla River change little from year to year. Possibly fish are being drawn to the headwaters because of increased rearing of juvenile Chinook salmon or possibly because natural adults are returning to their area of origin and are “pulling” hatchery returning fish further upstream. The number of redds observed by reach from 1989 to 2002 is in Table 4-10.



	8/5	8/12	8/20	8/28	9/3	9/13	9/20
Larson's-FGB RM 83.1-80.0	0	3	13		88	22	0
FGB-Squaw RM 80.0-76.7		1	2	23	22	30	0
Squaw-Thorn RM 76.7-73.5			1		13	20	0
Thorn-LDF RM 73.5-70.0		0				23	26

Date

Figure 4-35. The timing of new spring Chinook redds observed in the Umatilla River, 2002

Table 4-9. Spring Chinook salmon reach survival to spawning, Umatilla River, based on carcass sampling, 1991-2002.

RIVER REACH	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	MEAN
NF-Mouth to Coyote Cr. Confluence RM 0.0 to 3.0	86.7	100.0	93.1	100.0	92.9	95.5	97.8	100.0	97.9	98.7	96.4	92.1	95.9
Forks to Bar M Drive RM 89.5 to 86.1	84.0	73.3	76.7	93.3	78.8	88.9	91.4	73.3	88.1	92.3	88.7	90.4	84.9
Bar M Drive to Larson's Drive- RM 86.1 to 83.1	71.0	74.1	84.8	93.8	84.0	85.6	80.3	74.0	76.1	92.8	38.2	63.1	76.5
Larson's Drive to Fred Gray's Bridge- RM 83.1 to 80.0	75.0	83.3	81.7	83.3	85.0	80.5	56.0	83.3	69.0	71.4	23.0	61.8	71.1
Fred Gray's Bridge to Meacham Creek Confluence-RM 80.0 to 79.0	90.0	50.0	75.0	76.9	63.2	79.7	42.9	50.0	47.1	50.0	22.6	36.4	57.0
Meacham Creek Confluence to Squaw Creek Con. RM 79.0 to 76.7	32.6	44.4	51.7	53.8	33.3	46.9	37.7	44.4	39.0	50.0	22.6	36.4	41.1
Squaw Creek Con. to Thorn Hollow Highway Bridge RM 76.7 to 73.5	0.0	50.0	66.7	83.3	41.9	36.4	43.2	0.0	58.3	76.7	31.3	69.4	46.4
Thorn Hollow Highway Bridge to Louie Dick's Fence RM 73.5 to 70.0			58.8			43.8	18.6			66.6	69.0	70.7	54.6
Louie Dick's Fence to Mission Springs RM 70.0 to 63.8						10.7							10.7
Meacham Creek Mouth to Mile 3.0 RM 0.0 to 3.0	56.9	50.0	69.2	60.0	100.0		66.7		100.0	100.0	80.0	66.7	75.0
Meacham Creek Miles 3-6 RM 3.0 to 6.0			33.3	75.0	100.0	100.0		100.0					
Meacham Creek Mile 6.0 to NF RM 6.0 to 13.9			89.1	57.1	100.0	50.0	33.3	0.0	100.0				
Sample size n=											974		

Table 4-10. Umatilla River spring Chinook salmon redd distribution, number redd/percent by reach, 1989-2002

RIVER REACH	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
NF-Mouth to Coyote Ridge Confluence RM 0.0 to 4.0	0/0	68/23.5	13/9.0	10/16.9	27/12.1	16/21.6	13/14.4	51/14.7	47/16.3	7/11.7	49/16.8	147/20.4	189/30.2	182/22.0
Forks to Bar M Drive RM 89.5 to 86.1	14/100		21/14.6	13/22.0	25/11.2	13/17.6	21/23.3	57/16.4	71/24.6	8/13.3	57/19.5	201/27.9	191/30.5	196/23.7
Bar M Drive to Larson's Drive- RM 86.1 to 83.1		174/60.3	29/20.1	15/25.4	14/6.5	6/8.1	10/11.1	50/14.4	72/25.0	16/26.7	49/16.8	131/18.2	106/16.9	133/16.1
Larson's Drive to Fred Gray's Bridge- RM 83.1 to 80.0	0/0		26/18.1	13/22.0	31/13.8	9/12.2	13/14.4	44/12.7	37/12.8	14/23.3	46/15.8	84/11.6	49/7.8	126/15.2
Fred Gray's Bridge to Meacham Creek Confluence-RM 80.0 to 79.0	0/0		20/13.9	6/10.2	39/17.4	14/18.9	13/14.4	34/9.8	10/3.5	6/10.0	13/4.5	16/2.2	9/1.4	32/3.9
Meacham Creek Confluence to Squaw Creek Con. RM 79.0 to 76.7	0/0						7/7.8	29/8.4	19/6.6	8/13.3	24/8.2	33/4.6	11/1.8	46/5.6
Squaw Creek to Thorn Hollow Highway Bridge RM 76.7 to 73.5	0/0	36/12.5	0/0	1/1.7	25/11.1	2/2.7	4/4.4	42/12.1	12/4.2	0/0	27/9.2	25/3.5	13/2.1	34/4.1
Thorn Hollow Hwy Bridge to Louie Dick's Fence RM 73.5 to 70.0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	21/6.1	12/4.2	0/0	7/2.4	31/4.3	42/6.7	49/5.9
Louie Dick's Fence to Cayuse RR Bridge RM 70.0 to 66.9	0/0	0/0	0/0	0/0	0/0	0/0	0/0	8/2.3	0/0	0/0	0/0	0/0	0/0	3/.3
Cayuse RR Bridge to Minthorn Spring's RM 66.9 to 63.8	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
Minthorn Spring's to Mission Bridge RM 63.8 to 59.5	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0	0/0
Meacham Creek Mouth to NF Meacham Con. RM 0.0 to 13.9	0	2/.7	35/24.3	1/1.7	63/28.1	14/18.9	9/10.0	11/3.1	8/2.8	1/1.7	20/6.8	53/7.3	16/2.6	27/3.3
Total # of Redds Observed	**14**	**280**	**144**	**59**	**224**	**74**	**90**	**347**	**288**	**60**	**292**	**721**	**626**	**828**

NOTE: In 1990 an additional 7 redds were enumerated in McKay Creek and 2 between Stanfield Diversion and Cold Springs Diversion.

Spawning of spring Chinook salmon in 2002 began in early August in the colder headwaters, peaked in late August and was complete by September 13 (Figures 4-34 and 4-35). Spawning occurs later below RM 80.0 because water temperatures are 5 to 10 degrees F warmer than in the headwaters. Spawning timing has little annual variation in the Umatilla River. A summary table with number of redds enumerated by year, spawned out females and males sampled, and prespawn mortality females and males sampled by year by reach are in Table 4-11.

Summary of natural spring Chinook salmon age composition by return year is in Table 4-12. Natural returns by brood year were not completed because of small sample sizes and too few years of natural returns. Sample sizes for age analysis were small associated with the relatively small percentage of natural fish vs. hatchery fish returning annually. In 2002 we took 140 scales during egg takes to estimate natural production, and only 10 fish were naturally produced. Sample sizes need to be increased in future years to better understand brood returns of natural spring Chinook salmon. It appeared that natural spring Chinook salmon probably return after three years in the ocean at a higher rate than hatchery fish. This may be related to the size of smolts at outmigration. Natural Umatilla smolts averaged approximately 112.4 mm in March 1994 at TMD and hatchery fish averaged over 160 mm for the 1994 brood (Focher et al. 1996). Studies at Little Port Walter on Baranof Island in Southeastern Alaska have showed that large Chinook salmon smolt size was positively correlated with early adult return (Bill Heard, NMFS, personal communication).

Spring Chinook Salmon: Future Research Needs
It appears that the following research objectives, listed in order of importance, should be conducted to better understand the relationship of naturally produced spring Chinook salmon in the Umatilla River supplementation program:

1) Monitor the natural and hatchery return of spring Chinook salmon at TMD by return and brood year.
2) Accurately estimate the harvest of spring Chinook salmon above and below TMD.
3) Monitor water temperatures and spawning success by reach.
4) Determine the downstream limit of survival of incubating spring Chinook salmon eggs.

Spring Chinook Salmon: Future Habitat Needs
In the upper river (RM 89.5-80.0), habitat improvements to lower water temperatures are critical to increase survival of spring Chinook salmon eggs during incubation. The highway has constricted the river in many places and the cottonwood gallery in much of the area is gone. In many cases lands close to the river were cleared for home development. The area should be fenced to keep cows out of the river and riparian area, and cottonwood and willow trees should be planted.

Table 4-11. Summary of spring Chinook salmon escapement data, Umatilla River, 1989-2002

YEAR	NORTH FORK UMATILLA					FORKS TO BAR M DRIVEWAY					BAR M TO LARSON'S DRIVE				
	REDDS	SOF	SOM	PMF	PMM	REDDS	SOF	SOM	PMF	PMM	REDDS	SOF	SOM	PMF	PMM
1989	0	0	0	0	0	14	5 FISH SAMPLED				0	0	0	0	0
1990	68	25 FISH SAMPLED				174	210 FISH SAMPLED								
1991	13	8	5	0	2	21	12	9	-1	3	29	10	12	2	5 (2)
1992*	10	5	3	0	0	13	9	4	10	5	15	13	1	0	0
1993	27	21	6	1	1	25	20	13	2	8	14	21	18	2	4 (1)
1994	16	13	9	0	0	13	9	5	1	0	6	5	10	1	0
1995	13	8	5	0	1	21	17	24	5	6	10	9	12	2	2
1996	51	38	4	1	1	57	46	32	1	3	50	46	49	4	12
1997	47	33	11	0	1	71	69	53	2	3	72	63	35	12	12
1998	7	3	0	0	0	8	5	6	1	3	16	13	7	1	6
1999	49	30	16	1	0	57	67	52	9	7	49	41	29	13	9
2000	147	107	45	1	1	201	205	130	12	16	131	161	110	14	7
2001	189	97	35	1	4	191	120	61	11	12	106	45	23	83	27
2002	182	82	23	4	5	196	141	86	19	5	133	72	29	38	21

YEAR	LARSON'S TO GRAY'S BRIDGE					GRAY'S TO MEACHAM MOUTH					MEACHAM M TO SQUAW CR.				
	REDDS	SOF	SOM	PMF	PMM	REDDS	SOF	SOM	PMF	PMM	REDDS	SOF	SOM	PMF	PMM
1989	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1990											36	23 FISH SAMPLED			
1991	26	12	9	6	1	6	5	4	0	1	14	12	3	21	9 (1)
1992*	13	4	1	1	1 (1)	6	5	0	0	0					-1
1993	31	37	21	6	6 (1)	20	19	17	5	6 (1)	19	19	12	21	6 (2)
1994	9	7	3	1	1	9	6	4	1	2	5	5	2	3	1 (2)
1995	13	11	6	1	2	13	13	11	7	7	7	7	3	11	9
1996	44	42	24	6	10	34	32	23	7	7	29	21	17	26	17
1997	37	33	28	37	11	10	9	6	15	5	19	17	12	32	16
1998	14	10	5	0	3	6	3	0	2	1	8	6	2	8	2
1999	46	42	27	20	11	13	9	7	13	5	24	23	16	51	10
2000	84	126	81	64	19	16	40	34	49	25	33				
2001	49	34	27	161	43	9	7	7	42	6	11				
2002	126	110	81	77	41	32	57	19	96	37	46				

Table 4-11. Continued

YEAR	SQUAW TO THORN HOLLOW B.					THORN TO L DICK'S FENCE					L DICK'S FENCE TO MISSION				
	REDDS	SOF	SOM	PMF	PMM	REDDS	SOF	SOM	PMF	PMM	REDDS	SOF	SOM	PMF	PMM
1989															
1990															
1991				3	1 (1)										
1992*		1	0	1	0										
1993	16	15	9	8	4	9	6	4	4	2 (1)	0	0	0	6	0
1994	2	2	3	1	0	0	0	0	0	0	0	0	0	0	0
1995	4	4	9	15	3	0	0	0	0	0	0	0	0	0	0
1996	42	19	17	51	12	21	15	17	34	7	8	4	2	35	15
1997	12	12	7	19	6	12	4	4	14	21	0	0	0	0	0
1998	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
1999	27	12	9	11	4	7	2	1	0	0	0	0	0	0	0
2000	25	19	14	6	4	31	9	9	7	2	0	1	3	0	0
2001	13	10	10	37	7	42	20	9	9	4	0	0	0	0	0
2002	34	20	14	13	2	49	25	16	14	3	3	0	0	0	0

YEAR	MEACHAM CR.- MILES 0-3					MEACHAM CR.- MILES 3-6					MEACHAM CR.- MILES 6-9.8				
	REDDS	SOF	SOM	PMF	PMM	REDDS	SOF	SOM	PMF	PMM	REDDS	SOF	SOM	PMF	PMM
1989															
1990	5	1 FISH SAMPLED													
1991	35	21	8	12	2 (8)										
1992*	1		1	1											
1993	11	10	8	6	2	11	5	2	6	7 (1)	29	24	17	0	5
1994	3	3	0	1	1	6	3	0	1	0	5	3	1	3	0
1995	3	1	1	0	0	4	1	1	0	0	2	2	0	0	0
1996	0	0	0	0	0	5	0	2	0	0	3	1	0	0	1
1997	3	0	2	0	1	0	0	0	0	0	4	3	0	6	0
1998	0	0	0	0	0	1	1	1	0	0	0	0	0	0	1
1999	11	1	3	0	0	4	0	0	0	0	2	1	0	0	0
2000	53TOTAL	21	6												
2001	16TOTAL	2	2	1	0										
2002	27TOTAL	6	2	3	1										

Table 4-11. Continued

YEAR	MEACHAM-9.8 TO N. F.					N. F. MEACHAM CR.				
	REDDS	SOF	SOM	PMF	PMM	REDDS	SOF	SOM	PMF	PMM
1989										
1990										
1991										
1992*										
1993	9	5	5	0	0	3	3	1	0	0
1994	0	0	0	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	3	1	0	0	0
1997	0	0	0	0	0	1	1	0	0	0
1998	0	0	0	0	0	0	0	0	0	0
1999	0	0	0	0	0	2	0	0	0	0
2000										
2001										
2002										

Table 4-11. Notes

In 1989 and 1990 no data on sex or spawning status available

( ) = Unknown sex-carcasses in poor condition

* Rescue operation below TMD and truck transport to headwaters

Totals include jacks

SOF= Spawned females sampled

SOM= Spawned males sampled

PMF= Prespawn mortality females sampled

PMM= Prespawn mortality males sampled

Areas Surveyed

North Fork-mouth to Coyote Ridge Trail-4.0 miles

Forks to Bar M Driveway-3.4 miles

Bar M Driveway to Larson's Mailbox-3.0 miles

Larson's Driveway to Fred Gray's Bridge-3.1 miles

Fred Gray's Bridge to Squaw Creek Confluence-3.3 miles

Squaw Creek Confluence to Thorn Hollow Bridge-3.2 miles

Thorn Hollow Bridge to Louie Dick's Fence-3.5 miles

Louie Dick's Fence to Cayuse Railroad Bridge-2.5 miles

Cayuse Railroad Bridge to Minthorn Springs-3.1

Meacham Creek Confluence to Mouth of NF Meacham-13.8 miles

North Fork Meacham-Mouth to Bear Creek Confluence-3.0 miles

Table 4-12. Natural spring Chinook salmon age data, Umatilla River, 1998-2002.

Return	**Natural CHS Sample Size by Age**				**Expanded Natural CHS Age Data**				**Comments**
Year	**1.1**	**1.2**	**1.3**	**Total**	**1.1**	**1.2**	**1.3**	**Total**	
1998		6	15	21	0	19	49	68	
1999		3	6	9	0	7	15	22	
2000	1	72		73	0	348	0	348	Didn't expand jacks
2001	2	8		10	28	212	0	240	
2002	1	3	6	10	70	92	184	346	Poor jack data

FALL CHINOOK AND COHO SALMON

FALL CHINOOK AND COHO SALMON: EXECUTIVE SUMMARY

The return of adult fall Chinook salmon (*Oncorhynchus tshawytscha*) to Three Mile Dam (TMD) from 1988-2001 has varied between 91and 1146. The return of adult coho salmon (*Oncorhynchus kisutch*) has varied between 356 and 22792. Fall Chinook salmon females potentially available to spawn in the Umatilla River from 1991-2001 have varied between 6 and 566. There were always more males potentially available to spawn than females because of the return of jacks and subjacks. Coho salmon females available to spawn have varied between 29 and 9568 during the same time period. Conditions for observation and sampling of the escapement were generally poor. Survival to spawning of fall Chinook salmon varied between 71.4% and 100% and survival of coho salmon varied between 59.0% and 100%. Below Pendleton, Oregon, which was the primary spawning area for both fall Chinook and coho salmon, siltation levels were extreme and water quality very poor. Based on the number of unmarked fall Chinook salmon returning to TMD, it appears that natural production must be very low. Natural production of coho salmon must also be very low.

FALL CHINOOK AND COHO SALMON: METHODS

Fall Chinook and coho salmon return records to Three Mile Dam (TMD) provided by the Trap and Haul Project were reviewed to extract various categories of the annual return for disposition tables (Table 4-13). Fall Chinook salmon were classified as adults, (fork length 610 mm or larger), jacks, (fork length 609 mm to 381 mm) or subjack, (fork length less than 381 mm). Coho salmon were classified as adults (fork length of 457 mm or larger) or jack (fork length less than 457 mm) (Zimmerman and Duke, 1998). Tribal harvest of fall Chinook and coho salmon was not monitored and is believed to be minimal above TMD.

Escapement surveys were conducted in various reaches of the Umatilla River to sample fish and enumerate redds. Individual reaches were surveyed as time and conditions permitted before, during and after spawning. Surveyors wore baseball caps and polarized glasses to maximize fish observing capabilities. Redds were judged to be complete (and thus spawning successful) based on redd size and depth, location, and amount and size of rock moved. Redds were marked with flagging and the date, location and number of females and males on or near the redd and their spawning status were written with permanent marker on the flagging. For each observed redd, the surveyor recorded on a data sheet the location, date the redd was first observed, sex and number of fish observed on or near the redd, fish sampled and spawning habitat type (riffle, tailout, glide). Carcasses sampled were measured from the middle of the eye to the hypural plate (MEHP) and tip of snout to fork of tail (fork length) if the fish was adipose clipped. Carcasses were cut open to determine the egg retention of females and spawning success of males. Tails of sampled fish were removed at the caudal peduncle to prevent re-sampling. Snouts of adipose clipped and adipose clipped plus left or right ventral fin clipped spring Chinook salmon were removed behind the orbit to recover coded wire tags. Snouts were placed in plastic bags and given individual snout numbers. The snout number linked the snout with other biological data collected from the individual fish.

Table 4-13. Fall Chinook and coho salmon adult returns, deposition, and escapement to the Umatilla River, 1988-2001

YEAR	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Adult CHF enumerated at TMD	91	271	329	522	225	368	692	595	646	354	286	737	643	1146
Jack CHF enumerated at TMD	195	267	113	468	79	29	230	291	80	207	154	137	437	1158
Sub jack CHF enumerated at TMD	1268	65	618	273	0	15	367	343	606	189	230	152	4948	970
CHF sacrificed or mortalities at TMD	921	333	192	731	6	8	166	195	95	159	78	67	409	2/92/10
CHF taken for brood stock	0	0	0	348	211	385	0	0	576	300	201	465	603	462/24
Adult female CHF released above TMD	?	?	?	57	7	6	305	213	9	30	5	133	59	81
Adult male CHF released above TMD	?	?	?	112	29	27	288	302	79	12	84	147	10	601
Total adult CHF released above TMD	58	192	168	169	36	33	593	515	88	42	89	280	69	682
Jack CHF released above TMD	138	78	89	18	51	7	213	255	53	131	114	99	298	1042
Sub jack CHF released above TMD	0	0	611	0	0	12	317	264	520	118	188	115	4647	960
Adult female CHF outplanted in Umatilla	0	0	0	0	0	0	0	0	423	483	74	433	245	465
Maturing male CHF outplanted in Umatilla	0	0	0	0	0	0	0	0	285	457	126	458	226	478
Total female CHF released - TMD+outplant	?	?	?	57	7	6	305	213	432	513	79	566	304	546
Total male CHF released -TMD+outplant	?	?	?	130	80	46	818	821	937	718	512	819	5181	2603
Adult coho enumerated at TMD	936	4154	409	1732	356	1533	984	947	618	670	3081	3702	4654	22792
Jack coho enumerated at TMD	746	479	515	189	173	16	62	52	24	137	191	205	1276	80
Coho sacrificed or mortalities at TMD	0	4001	110	445	0	79	113	0	20	42	222	236	219/96	279/4
Coho taken for brood stock	0	0	0	0	0	580	0	860	0	0	0	0	0	0
Adult female coho released above TMD	?	?	?	387	141	395	398	29	293	337	1464	1595	2235	9568
Adult male coho released above TMD	?	?	?	612	201	486	481	76	305	301	1406	1873	2185	12945
Total adult coho released above TMD	936	580	364	999*	342	881	879	105	598	638	2870	3468	4435	22513
Jack coho released above TMD	746	52	450	91	168	13	54	34	24	127	180	196	1180	76
CHF redds observed		0	0	0	0	0	82	9	170	301	6	89	0	0
Coho redds observed		0	0	0	12	44	24	1	18	51	90	42	0	10
Unidentified redds observed		92	50	18	0	0	7	1	1	22	24	25	165	0

In 1991 an additional 208 female and 178 male coho salmon trapped at TMD were released downstream near the mouth for additional harvest opportunities.
2001 salmon return numbers are split into adults/jacks/sub jacks

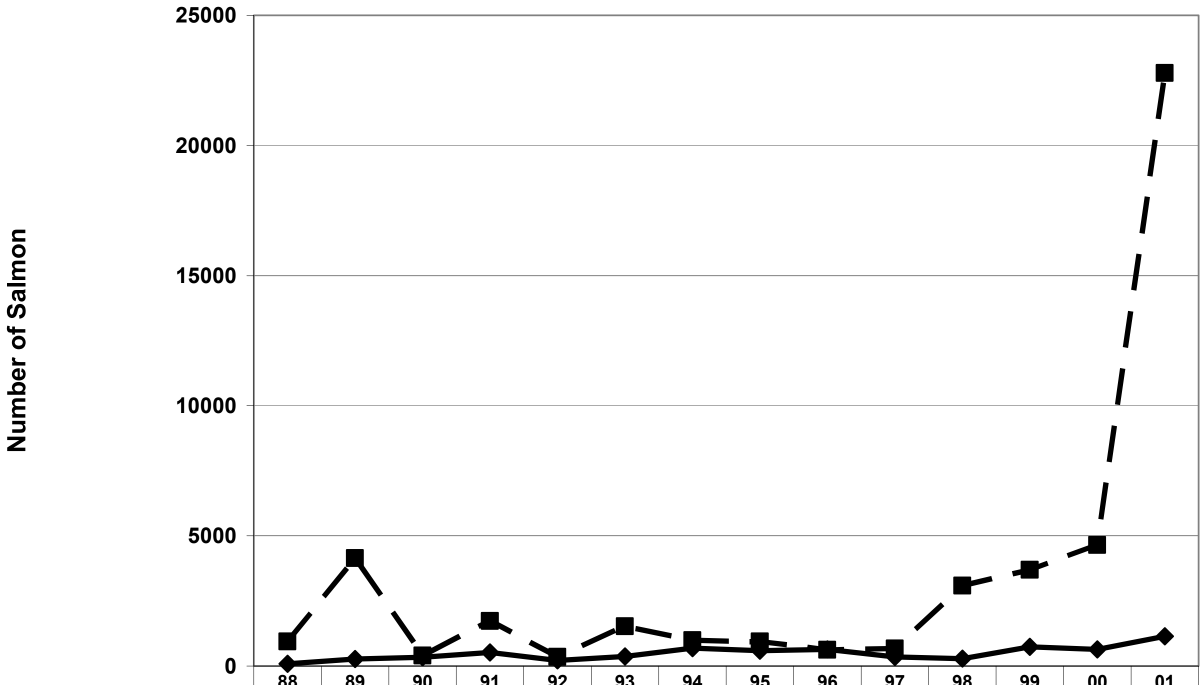
Potential egg deposition was estimated by determining the number of females released above TMD, determining the percentage that survived to spawn based on sampling, subtracting the average number of eggs retained per female, and multiplying by the average fecundity. Unmarked fall Chinook salmon returning to TMD could be naturally produced Umatilla River fish. Some returning unmarked fish may have lost body wire tags.

FALL CHINOOK AND COHO SALMON: RESULTS AND DISCUSSION

Fall Chinook and Coho Salmon: Return to Three Mile Dam

The return of adult fall Chinook salmon to TMD has varied between 91and1146 during the period 1988-2001 (Figure 4-36). Jack returns varied between 29 and 1158. Sub jack returns varied between 0 and 4948. Coho salmon adult returns varied between 356 and 22792. Coho jack returns varied between 16 and 1276.

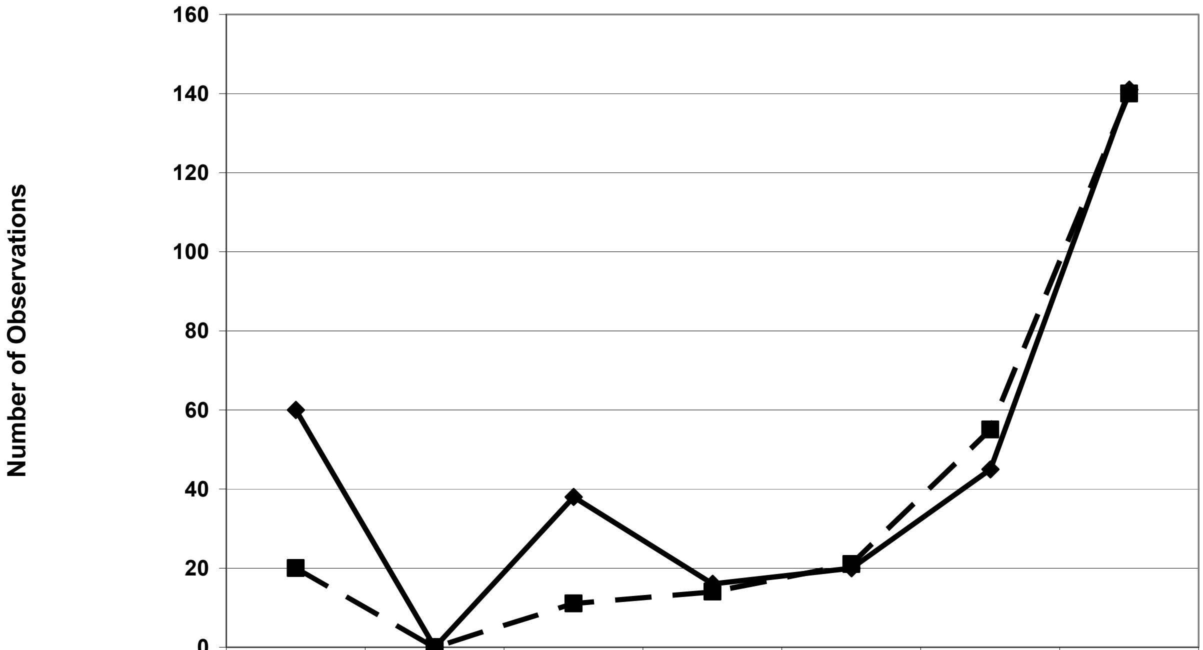
The fall Chinook salmon unmarked return to TMD, a portion of which could be natural production (some unmarked fish in the return could have shed a body tag) from the Umatilla River, has varied between 0-141 adults and averaged 46 (Figure 4-37). It appears that escapement to returning adult was very low.



	88	89	90	91	92	93	94	95	96	97	98	99	00	01
FALL CHINOOK	91	271	329	522	225	368	692	595	646	354	286	737	643	1146
COHO	936	4154	409	1732	356	1533	984	947	618	670	3081	3702	4654	22792

Year

Figure 4-36. Adult fall Chinook and coho salmon returns to Three Mile Dam, Umatilla River, 1988-2001.



	1995	1996	1997	1998	1999	2000	2001
Adult CHF	60	0	38	16	20	45	141
Jack CHF	20	0	11	14	21	55	140

Year

Figure 4-37. Number of unmarked fall Chinook salmon returning to the Umatilla River, 1995-2001.

Fall Chinook and Coho Salmon: Disposition

The disposition of maturing fall Chinook and coho salmon returning to Three Mile Dam from 1988-2001 are presented in Table 4-13. A portion of returning fish were sacrificed for research objectives, a small number died associated with holding and handling and in certain years fall Chinook and/or coho were held and spawned for brood stock development. The number of fall Chinook and coho salmon not released above TMD were subtracted from the return to determine the number of fall Chinook and coho salmon potentially available to spawn. Fall Chinook salmon potentially available to spawn included outplants from Priest Rapids Hatchery, which have occurred annually since 1996. The number of female fall Chinook salmon potentially available to spawn has varied between 6 and 566 (Figure 4-38). The number of adult male, jack and sub jack fall Chinook salmon available to spawn has varied between 46 and 5181. The number of adult coho salmon potentially available to spawn varied between 105 and 22513.

Fall Chinook and Coho Salmon: Spawning Ground Surveys

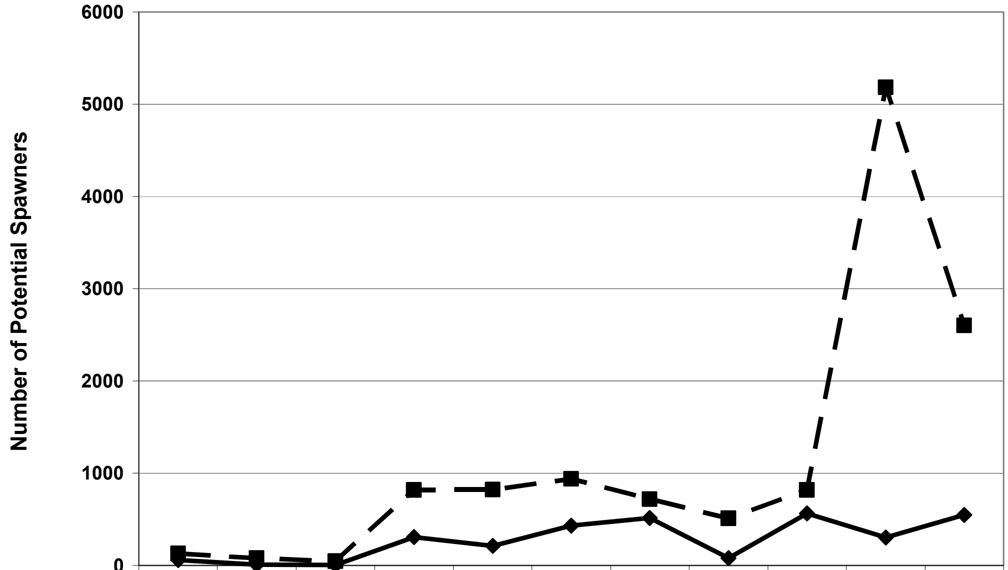
Escapement surveys to enumerate redds and sample the spawning return of fall Chinook and coho salmon have been conducted in various reaches of the Umatilla River since 1989 (Table 4-13). High flows in many years and generally poor conditions for observation were normal. Therefore, enumeration of redds was not a good indicator of spawning success. A better indicator of spawning success was sampling of carcasses throughout migration and spawning. Redds were enumerated when possible to better define spawning distribution. Survival to spawning of fall Chinook salmon based on sampling of carcasses has varied between 71.4% and 100% and averaged 89.5% (Figure 4-39. Survival to spawning of coho salmon varied between 59.0% and 100% and averaged 86.8%. Sample sizes were low in some years associated with either low escapements and/or poor survey conditions (Table 4-14)

Table 4-14. Spawning status of fall Chinook and coho salmon based on sampling of carcasses in the Umatilla River, 1991-2001.

Year	Carcass Status	CHF n	CHF %	Coho n	Coho %
1991	Spawned Out	10	71.4	69	59
	Prespawning Mortality	4	28.6	48	41
1992	Spawned Out	82	98.8	16	66.7
	Prespawning Mortality	1	1.2	8	33.3
1993	Spawned Out	41	83.7	94	75.2
	Prespawning Mortality	8	16.3	31	24.8
1994	Spawned Out	68	95.8	48	92.3
	Prespawning Mortality	3	4.2	4	7.7
1995	Spawned Out	5	83.3	2	100
	Prespawning Mortality	1	16.7	0	0
1996	Spawned Out	40	93	18	100
	Prespawning Mortality	3	7	0	0
1997	Spawned Out	270	91.5	52	88.1
	Prespawning Mortality	25	8.5	7	11.9
1998	Spawned Out	1	100	44	93.6
	Prespawning Mortality	0	0	3	6.4
1999	Spawned Out	154	92.8	138	97.2
	Prespawning Mortality	12	7.2	4	2.8
2000	Spawned Out	40	93	50	90.9
	Prespawning Mortality	3	7	5	9.1
2001	Spawned Out	22	81.5	96	91.4
	Prespawning Mortality	5	18.5	9	8.6

During escapement surveys conducted from November 11 through December 9, 1998 a total of 6 fall Chinook salmon redds, 86 coho redds and 24 unidentified salmon redds were enumerated along 31.8 miles of the mainstem. An additional 4 coho redds were observed in Buckaroo Creek. Only one fall Chinook and 51 coho salmon were sampled during escapement surveys. Survey conditions were generally poor throughout most of the spawning period because of high, turbid flows

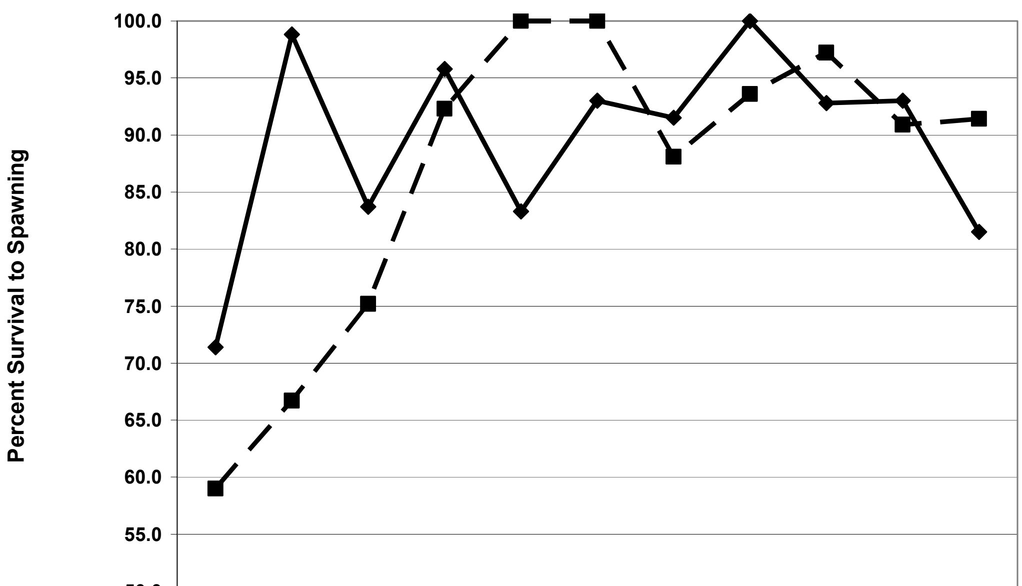
During escapement surveys conducted from November 17 through December 10, 1999 a total of 89 fall Chinook redds, 42 coho redds and 25 unidentified redds were enumerated in the area between Cayuse Railroad Bridge to the crossing of I84 below Echo, a distance of 42.7 miles. High water during the third week of November made redd enumeration difficult and efforts after that time were directed at sampling of carcasses to determine spawning success. A total of 166 fall Chinook and 142 coho salmon were sampled on the spawning grounds.



	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Females	57	7	6	305	213	432	513	79	566	304	546
Males	130	80	46	818	821	937	718	512	819	5181	2603

Return Year

Figure 4-38. Female and male fall Chinook salmon potentially available to spawn in the Umatilla River, 1991-2001.



	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Fall chinook	71.4	98.8	83.7	95.8	83.3	93.0	91.5	100.0	92.8	93.0	81.5
Coho	59.0	66.7	75.2	92.3	100.0	100.0	88.1	93.6	97.2	90.9	91.4

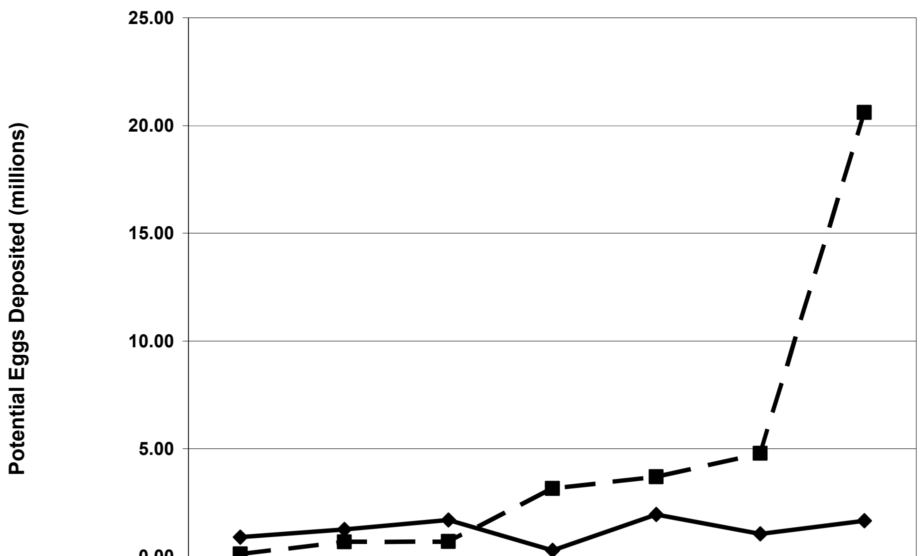
Year

Figure 4-39. Percent survival of fall Chinook and coho salmon to spawning in the Umatilla River, 1991-2001, (based on carcass surveys).

During escapement surveys conducted from November 27 through December 5, 2000 a total of 165 redds were observed and 43 fall Chinook and 56 coho salmon were sampled. Five reaches between Cayuse Railroad Bridge and Echo Bridge were surveyed and high water prevented further surveys. In 2001 a total of 28 fall Chinook and 119 coho salmon were sampled during the period December 11 through 19 in four reaches between Squaw Creek and Echo.

Estimated potential egg deposition from 1995-2001 varied between 0.9 and 1.9 million for fall Chinook salmon and .1 and 20.6 million for coho salmon (Figure 4-40). In the primary spawning areas below Pendleton, siltation loads have been extremely high and water quality extremely low. In 1997, because of unusually good survey conditions, new concerns for fish spawning habitat in the river below Pendleton became apparent. During surveys special care was necessary to avoid completely obliterating one's view, as walking downstream churned up massive amounts of silt. Even the freshly dug redds were usually full of silt. In addition input to the river from the Pendleton sewer plant was very obvious. Survival of fall Chinook salmon to emergence must be very low below Pendleton. Juvenile fall Chinook salmon may also migrate late in the year as survival conditions become marginal in the lower river. Chinook salmon approximately 70-90 mm fork length, which were probably fall Chinook salmon smolts, have been observed at Westland Diversion in early July. If migration of fall Chinook salmon from the Umatilla occurs in June through early July, conditions for emigration would often be marginal for survival.

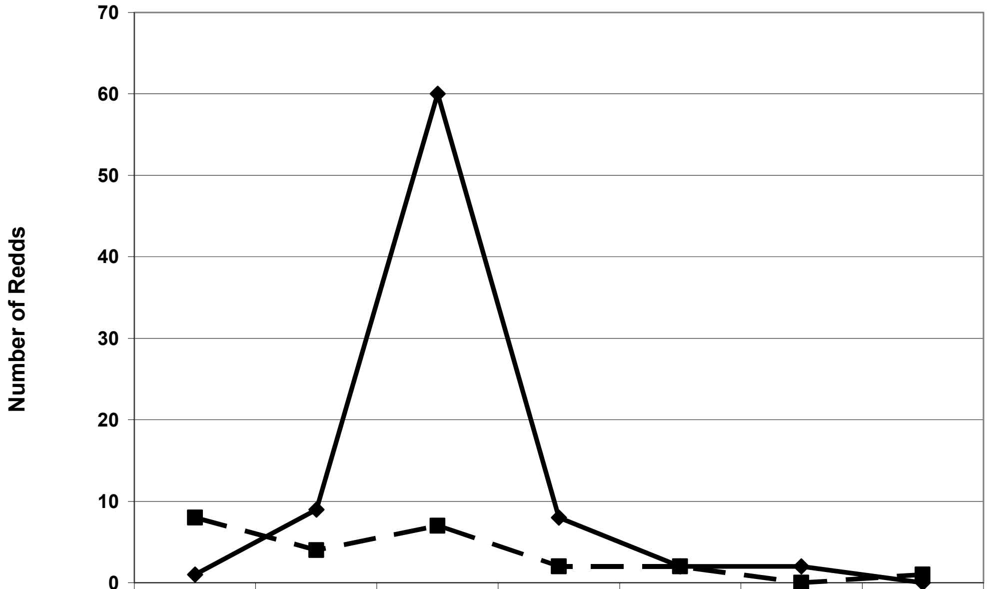
Natural production of coho salmon must also be very low. Coho salmon also mostly spawn below Pendleton and would be subjected to the same silt loads during spawning and incubation. In addition, juvenile coho salmon mostly rear for one year before emigration. Fall Chinook and coho salmon spawning began in late October or early November, usually peaked in mid to late November and was mostly complete by mid December (Figures 4-41 and 4-42).



	1995	1996	1997	1998	1999	2000	2001
Fall Chinook Salmon	0.90	1.26	1.70	0.30	1.95	1.06	1.66
Coho Salmon	0.12	0.68	0.69	3.16	3.70	4.79	20.60

Return Year

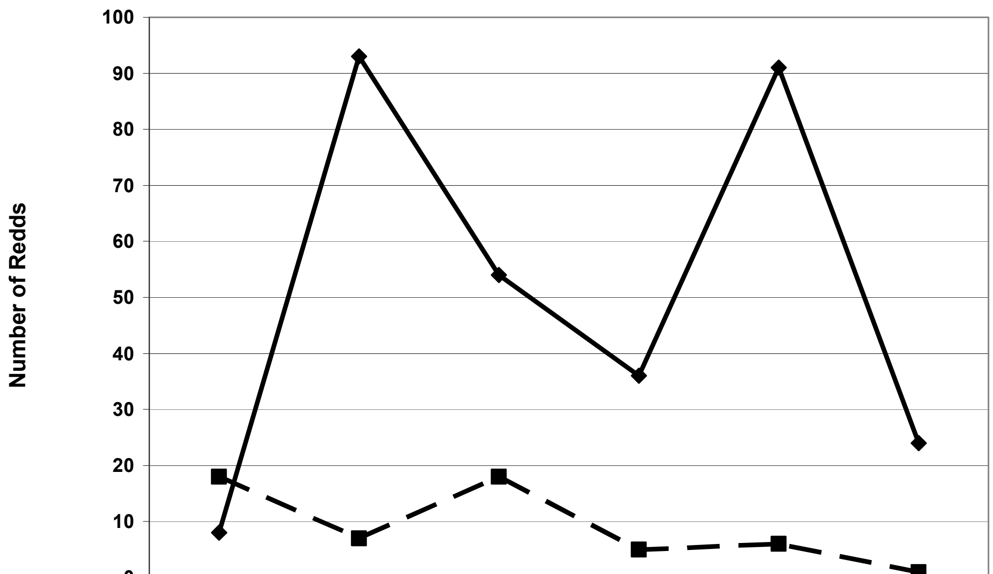
Figure 4-40. Fall Chinook and coho salmon potential egg deposition in the Umatilla, 1995-2001.



	11/1-11/7	11/8-11/14	11/15-11/21	11/22-11/28	11/29-12/5	12/6-12/12	12/13-12/19
CHF Redds	1	9	60	8	2	2	0
Coho Redds	8	4	7	2	2	0	1

Date

Figure 4-41. The timing of new fall Chinook and coho salmon redds observed in the Umatilla River, 1994.



	11/-11/7	11/8-11/14	11/15-11/21	11/22-11/28	11/28-12/5	12/6-12/12
CHF Redds	8	93	54	36	91	24
Coho Redds	18	7	18	5	6	1

Date

Figure 4-42. The timing of new fall Chinook and coho salmon redds observed in the Umatilla River, 1997.

Fall Chinook and Coho Salmon: Future Research Needs
It appears that the following research objectives, listed in order of importance, should be conducted to better define the natural production of fall Chinook salmon in the Umatilla River:

1) Monitor the natural and hatchery return of fall Chinook salmon at TMD by return and brood year.
2) Determine the survival of incubating fall Chinook salmon eggs by reach.
3) Monitor spawning success by reach.

Fall Chinook and Coho Salmon: Future Habitat Needs
In the Umatilla River below Pendleton, habitat projects to limit siltation and decrease water temperatures would benefit fall Chinook salmon. The highway and diking to protect fields have constricted the river in many places and the cottonwood gallery in much of the area is gone. The area should be fenced to keep cows out of the river and riparian area, and cottonwood and willow trees should be planted.

ACKNOWLEDGEMENTS

Many people assisted in collection of salmon and steelhead data for this report. Brian Conner, Larry Cowapoo, Bill Duke, Vern Spenser and Brian Zimmerman collected most of the adult summer steelhead return data from Three Mile Dam. In addition Brian Zimmerman edited an earlier draft of this report. Gerry Rowan, Louis Case, Tysen Minthorn, Mike “Blue” McCloud and Melvin “Bear” Farrow collected biological data from the natural brood. Thanks to Melvin Farrow, Ken Hall, and Darryl Thompson for assistance in conducting spawning ground surveys. Dale Chess and Will Cameron from ODFW reviewed data from video taping and provided expansions for 2001-2002. They also provided creel harvest estimates and estimates of nonendemic summer steelhead sampled at Three Mile Dam. Tim Bailey from ODFW provided Walla Walla escapement estimates and Tim Unterwegner from ODFW provided redd count data from the John Day River. Joe Bumgarner from Washington Department of Fisheries provided escapement estimates from the Touchet River. Julie Burke, Celeste Reeves and Ester Huesties provided office administrative support for this project. This project was funded by Bonneville Power Administration.

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APPENDIX

Table 4-A15 Natural adult summer steelhead, age versus sex, by return year, Umatilla River 1991-2001.

AGE	1.1	1.2	1.3	2.1	2.2	2.3	3.1	3.2	3.3	4.1	Total
	1991-1992 Return, data from Ken Kennistion of ODFW										
n=	2	2	1	18	58	1	1	3	0	0	86
%=	2.3	2.3	1.2	20.9	67.4	1.2	1.2	3.5	0.0	0.0	100.0
	1993-1994 Return										
Female n=	0	1	0	10	6	0	1	0	0	0	18
Male n=	0	0	0	11	8	1	3	1	0	0	24
%=	0.0	2.4	0.0	50.0	33.3	2.4	9.5	2.4	0.0	0.0	100.0
	1994-1995 Return										
Female n=	0	0	0	6	18	0	0	2	0	0	26
Male n=	1	0	0	5	13	1	0	3	0	0	23
%=	2.0	0.0	0.0	22.4	63.3	2.0	0.0	10.2	0.0	0.0	99.9
	1995-1996 Return										
Female n=	0	0	0	16	8	0	1	0	0	0	25
Male n=	0	0	0	17	1	0	1	0	0	0	19
%=	0.0	0.0	0.0	75.0	20.5	0.0	4.5	0.0	0.0	0.0	100.0
	1996-1997 Return										
Female n=	0	1	0	11	10	0	0	3	0	1	26
Male n=	0	0	0	13	8	0	4	0	0	0	25
%=	0.0	2.0	0.0	47.1	35.3	0.0	7.8	5.9	0.0	2.0	100.1
	1997-1998 Return										
Female n=	0	0	0	12	6	1	1	0	0	1	21
Male n=	0	0	0	13	3	0	2	0	0	0	18
%=	0.0	0.0	0.0	64.1	23.1	2.6	7.7	0.0	0.0	2.6	100.1
	1998-1999 Return										
Female n=	0	0	0	9	17	0	1	0	0	0	27
Male n=	1	0	0	13	9	0	0	1	0	0	24
%=	2.0	0.0	0.0	43.1	51.0	0.0	2.0	2.0	0.0	0.0	100.1
	1999-2000 Return										
Female n=	0	0	0	23	5	0	4	0	0	0	32
Male n=	0	0	0	23	1	0	1	0	0	0	25
%=	0.0	0.0	0.0	80.7	10.5	0.0	8.8	0.0	0.0	0.0	100.0
	2000-2001 Return										
Female n=	0	0	0	8	22	0	2	2	0	0	34
Male n=		0	0	15	13	1	1	1	0	0	31
%=	0.0	0.0	0.0	35.4	53.8	1.5	4.6	4.6	0.0	0.0	99.9
	2001-2002 Return										
Female n=	0	0	0	21	14	0	3	1	0	0	39
Male n=	0	0	0	30	5	0	2	1	0	0	38
%=	0.0	0.0	0.0	66.2	24.7	0.0	6.5	2.6	0.0	0.0	100.0

Table 4-A16. Natural and hatchery summer steelhead adult ocean age versus fork lengths observed at TMD and corrections for length/age misclassifications.

Return		Observed Number of STS at TMD				Correction for Age V. Length %				Adjusted Age Versus Length			
		Natural		Hatchery		Natural		Hatchery		Natural		Hatchery	
Year	Sex	1 Salt	2 Salt	1 Salt	2 Salt	1 Salt	2 Salt	1 Salt	2 Salt	1 Salt	2 Salt	1 Salt	2 Salt
1990	**Female**							1.0					
	Male							1.0					
1991	**Female**							0.0	5.7				
	Male							0.0	7.5				
1992	**Female**	1062	253	193	58			3.2	50.0			171	78
	Male	787	145	239	33			3.2	50.0			230	42
1993	**Female**	445	497	168	196			0.0	15.0			139	225
	Male	215	141	180	71			0.0	15.0			169	82
1994	**Female**	410	279	71	183	4.0	12.5	9.1	12.5	391	298	54	200
	Male	179	77	38	53	4.0	12.5	9.1	12.5	176	80	34	57
1995	**Female**	224	421	255	83	8.3	5.6	4.8	7.1	219	426	261	77
	Male	99	131	272	46	8.3	5.6	4.8	7.1	100	130	282	36
1996	**Female**	715	207	259	189	8.6	11.1	2.6	2.6	753	169	261	187
	Male	302	72	265	72	8.6	11.1	2.6	2.6	320	54	270	67
1997	**Female**	378	366	476	244	10.0	0.0	9.9	10.0	416	328	499	221
	Male	180	90	619	124	10.0	0.0	9.9	10.0	199	72	668	75
1998	**Female**	387	207	225	305	6.9	11.1	0.0	0.0	391	203	225	305
	Male	214	54	243	130	6.9	11.1	0.0	0.0	223	45	243	130
1999	**Female**	419	353	241	235	8.3	3.1	7.1	7.9	443	329	239	237
	Male	249	114	209	66	8.3	3.1	7.1	7.9	266	97	219	56
2000	**Female**	1140	215	303	74	2.0	0.0	11.9	0.0	1163	192	339	38
	Male	698	107	312	43	2.0	0.0	11.9	0.0	712	93	349	6
2001	**Female**	828	948	355	288	3.8	7.9			784	992		
	Male	417	380	342	104	3.8	7.9			403	394		
2002	**Female**	1487	693	736	229	7.8	10.5			1549	617		
	Male	1094	288	826	167	7.8	10.5			1139	257		

Table 4-A17. Summer steelhead adult return by age, sex and return year to TMD, Umatilla River.

Return		Natural Steelhead Age								Hatchery Steelhead Age			Natural		Hatchery		Total
Year	**Sex**	**1.1**	**1.2**	**2.1**	**2.2**	**2.3**	**3.1**	**3.2**	**4.1**	**1.1**	**1.2**	**1.3**	**F/M**	**Total**	**F/M**	**Total**	**Return**
1992	**Female**			1062*	253*					171	78	0	1315		249		
	Male			787*	145*					231	42	0	932	2247	273	522	2769
1993	**Female**			445*	497*					139	226		942		365		
	Male			215*	141*					169	82		356	1298	251	616	1914
1994	**Female**	0	18	329	245	18	63	18	0	54	198	2	691		254		
	Male	0	4	148	66	4	28	4	0	34	56	1	254	945	91	345	1290
1995	**Female**	18	0	201	357	12	0	57	0	261	63	14	645		338		
	Male	8	0	92	109	3	0	18	0	282	30	6	230	875	318	656	1531
1996	**Female**	0	0	710	169	0	43	0	0	261	182	5	922		448		
	Male	0	0	302	54	0	18	0	0	270	65	2	374	1296	337	785	2081
1997	**Female**	14	0	332	281	0	55	47	14	499	221	0	743		720		
	Male	6	0	160	62	0	27	10	6	668	75	0	271	1014	743	1463	2477
1998	**Female**	0	0	337	183	20	40	0	14	225	305	0	594		530		
	Male	0	0	192	40	5	23	0	8	243	130	0	268	862	373	903	1765
1999	**Female**	19	0	406	317	0	18	12	0	239	231	6	772		476		
	Male	11	0	244	93	0	11	4	0	219	54	2	363	1135	275	751	1886
2000	**Female**	0	0	1048	192	0	114	0	0	339	30	8	1354		377		
	Male	0	0	643	93	0	70	0	0	349	5	1	806	2160	355	732	2892
2001	**Female**	0	0	693	890	26	90	77	0	355*	288*	*	1776		643		
	Male	0	0	357	353	10	47	30	0	342*	104*	*	797	2573	446	1089	3662
2002	**Female**	0	0	1411	558	0	138	59	0	*	*	*	2166		*		
	Male	0	0	1038	233	0	101	24	0	*	*	*	1396	3562	*	1961	5523

Notes: Data was taken from Three Mile Falls Dam observation, corrected for fork length versus age data and expanded based on natural summer steelhead sampled by return year. Hatchery fish were expanded based on coded wire tag data.

* Not corrected for other freshwater ages.

** Data for 2001 and 2002 are preliminary, Pacific States Marine Fisheries Commission has not completed CWT data for those years.

CHAPTER FIVE: WATER TEMPERATURE MONITORING

THE UMATILLA BASIN NATURAL PRODUCTION MONITORING AND EVALUATION PROJECT

PROGRESS REPORT
1999-2002

Prepared By:

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Department of Natural Resources
Confederated Tribes of the
Umatilla Indian Reservation

P.O. Box 638
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Contract Period
September 30, 1998 to December 31, 2002
Project Number 1990-005-01

Prepared for:

U.S. Department of Energy
Bonneville Power Administration
Division of Fish and Wildlife
P.O. Box 3621
Portland, Oregon 97208-3621

September 2003

INTRODUCTION

The Umatilla Basin Natural Production Monitoring and Evaluation Project (UBNPME) was funded by Bonneville Power Administration (BPA) as directed by section 4(h) of the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (P. L. 96-501). This project is in accordance with and pursuant to measures 4.2A, 4.3C.1, 7.1A.2, 7.1C.3, 7.1C.4 and 7.1D.2 of the Northwest Power Planning Council's (NPPC) Columbia River Basin Fish and Wildlife Program (NPPC 1994). Work was conducted by the Fisheries Program of the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) under the Umatilla Basin Natural Production Monitoring and Evaluation Project. Summary data from previous annual reports are also included in this chapter and can be found in Contor et al (1995, 1996, 1997, 1998, and 2000) and at http://www.umatilla.nsn.us (CTUIR website).

Objective and Tasks

This chapter summarizes temperature monitoring efforts completed during the contract year September 30, 1998 through December 31, 2002.

Objective F, Objective 5 in the 1999-2002 Work Statements. Monitor stream temperatures in coordination with other projects in the Umatilla River Basins.

Task F.1 Coordinate deployment protocols and thermograph locations with ODFW, ODEQ, USFS, the Watershed Council and other CTUIR projects. Ensure optimum coverage in priority areas without duplication.

Task F.2

Deploy thermographs during April and May (June for some backcountry sites). Conceal cables and thermographs to minimize tampering by the public. Check the status, function and concealment of each thermograph monthly throughout the deployment period.

Task F.3

Retrieve thermographs in November.

Task F.4

Download, summarize and graph data. Examine trends, report findings and discuss management implications.

This objective documents water temperature profiles over time. Stream temperature profiles are important in assessing the salmonid rearing potential of a stream or reach. Water temperature data also aids managers in developing and prioritizing restoration activities and strategies. Managers are also interested in documenting any long-term changes in temperature profiles related to habitat improvement or degradation. The temperature data is also needed for modeling water temperatures under various planning and management scenarios such as the ODEQ's Total Maximum Daily Load process (TMDL) and flow enhancement management and planning (Phases I, II and III).

MATERIALS AND METHODS

We coordinated the deployment of thermographs in the Umatilla River Basin with other projects and agencies to maximize consistency and coverage without duplicating effort (1993 through 2002). Figure 5-1 shows the location of the UBNPME project thermographs (Table 5-1 is the key for Figure 5-1). Some of the thermograph locations have been monitored consistently since 1993 while other sites were only monitored one or two years. Specifics regarding the location and deployment dates of thermographs are summarized in Table 5-2. Details of all project water temperature data are currently available at http://www.umatilla.nsn.us (CTUIR website). The website also lists water temperature from other projects with additional data being added regularly.

We used Ryan RTM2000 thermographs from 1993 through 1996. In 1997 we began using the newly developed Vemco Mini-Loggers because of their smaller size, lower cost, and improved reliability. The Vemco instruments replaced all the Ryan instruments by 2001. Instruments were initialized in the office. The batteries, seals and clamps of the Ryan instruments were cleaned, inspected and changed as needed. Steel chains or cables anchored all units to large trees or boulders on the shore. We concealed thermographs, chains and cables to minimize tampering by the public. Thermographs were checked after deployment to ensure proper function and placement. In November and December we collected all thermographs and downloaded data. During 1993 and 1994 we deployed thermographs during the winter but we discontinued that practice in 1995 to avoid instrument loss and damage during high flows.

Crews took photographs and wrote detailed descriptions of each thermograph location to aid collection of the units later by other staff if necessary. We also drew vicinity maps and marked topographic maps. Water temperature data are summarized in Excel files with daily and monthly maximum, mean and minimum temperatures (all sites will have GPS references by 2004). In addition, we calculate and report the number of hours (by month) when water temperatures exceed benchmark temperatures of 12.78, 17.78, 20.0 and 25°C (55, 64, 68, and 77°F respectively). Temperature data is examined in relation to past data, seasonal discharge, water quality standards, and critical levels published in the literature (Black 1953, Brett 1952). Protocols for deploying thermographs and summarizing data are outlined below.

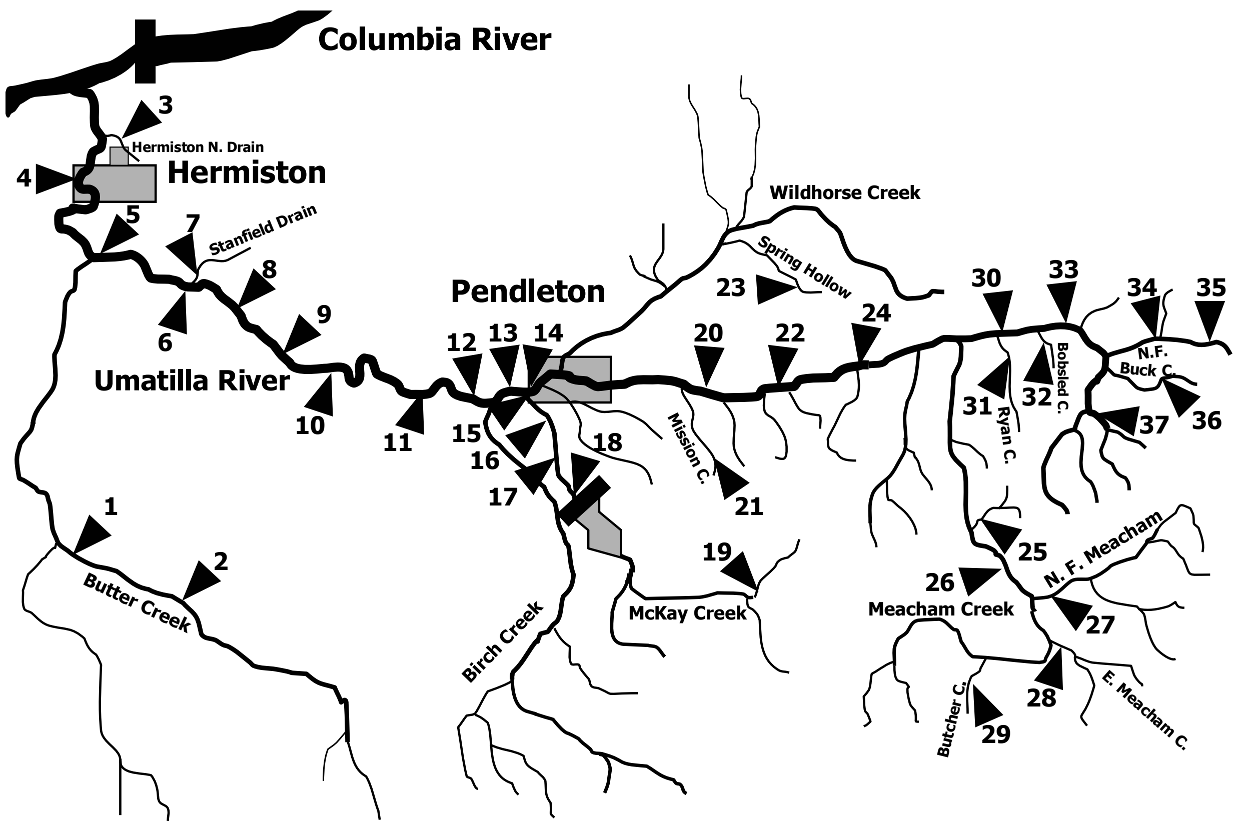

Figure 5-1 The location of UBNPME project thermographs

Table 5-1 The location key for Figure 5-1

Stream	Location	River Mile	Site Number
Butter Creek	Pine City	20	1
Butter Creek	USGS Gage	28.5	2
Hermiston N. Drain	Below treatment plant	0.1	3
Umatilla River	Steelhead Park	8.8	4
Umatilla River	Ponds Farm	8.7	4
Umatilla River	Maxwell Dam	15.3	5
Umatilla River	Below Stanfield Bridge	21.6	6
Stanfield Drain	At the mouth	0.1	7
Umatilla River	At Westland Dam	27.2	8
Umatilla River	At Stanfield Dam	32.4	9
Umatilla River	At Yoakum	37	10
Umatilla River	Near Barnhart	42.5	11
Umatilla River	Near Coombs Canyon	47.5	12
Umatilla River	Near the Rieth Bridge	49	13
Umatilla River	Near Mouth of McKay C.	50	14
Umatilla River	Near McKennon Station	50.8	14
McKay Creek	Near the Mouth	0.1	15
McKay Creek	Near McKay School	1.9	16
McKay Creek	Heavens Lane Bridge	3.7	17
McKay Creek	Just Below Dam	6	18
McKay Cr, N. F.	At USGS Gage	0.2	19
Umatilla River	Above Minthorn Springs	63	20
Mission Creek	Above the springs	4	21
Umatilla River	0.2 miles above Cayuse Br.	67.7	22
Spring Hollow C.	At Wamisha Road Bridge	4.5	23
Umatilla River	At Thorn Hollow	73.1	24
Camp Creek	Meacham Creek Basin	0.5	25
Meacham Creek	Near Duncan	13	26
N. F. Meacham C.	Near the lower camp	0.5	27
E. Meacham C.	Meacham Creek Basin	0.2	28
Butcher Creek	Meacham Creek Basin	1	29
Umatilla River	Above Ryan Creek	82.5	30
Ryan Creek	Near Forest Boundary	1.5	31
Bobsled Creek	Near Umatilla RM 84.6	0.2	32
Umatilla River	Bar-M Ranch Road	87	33
N. F. Umatilla	Below Coyote Creek	2.7	34
N. F. Umatilla	End of N. F. River Trail	4	35
Buck Creek	Below Lake Creek	3	36
Thomas Creek	Upstream of lower bridge	0.25	37

Table 5-2 Summary of the water temperature data collected from 1993 to 2002 by UBNPME Project. RTM denotes a Ryan RTM 2000 thermograph, Mini denotes a Vemco Mini-Logger.

Stream	Location	River Mile	Start Date	End Date	Unit Type	Unit Number
Bobsled Creek	Near Umatilla RM 84.6	0.2	13-Jul-93	3-Nov-93	RTM	906045
Buck Creek	Below Lake Creek	3	23-Jul-97	2-Nov-97	Mini	3857
Buck Creek	Below Lake Creek	3	1-May-98	21-Dec-98	Mini	4906
Buck Creek	Below Lake Creek	3	11-Jun-99	1-Nov-99	Mini	4898
Buck Creek	Below Lake Creek	3	29-Apr-00	28-Mar-01	Mini	3855
Buck Creek	Below Lake Creek	3	2-Jun-02	13-Nov-02	Mini	7555
Butcher Creek	Meacham Creek Basin	1	3-May-93	19-Jul-93	RTM	906045
Butcher Creek	Meacham Creek Basin	1	5-Nov-93	23-Jun-94	RTM	906045
Butcher Creek	Meacham Creek Basin	1	2-Apr-95	11-Jul-95	RTM	906044
Butter Creek	Near Pine City	20	5-May-00	20-Nov-00	RTM	906048
Butter Creek	Near USGS Gage	28.5	4-May-00	20-Nov-00	RTM	906051
Camp Creek	Meacham Creek Basin	0.5	6-Nov-93	18-Jun-94	RTM	906045
Camp Creek	Meacham Creek Basin	0.5	29-Jul-94	4-Nov-94	RTM	90605?
Camp Creek	Meacham Creek Basin	0.5	1-Dec-94	19-Feb-95	RTM	906045
Camp Creek	Meacham Creek Basin	0.5	4-Apr-95	14-May-95	RTM	906045
Camp Creek	Meacham Creek Basin	0.5	25-Aug-95	2-Jan-96	RTM	906885
Camp Creek	Meacham Creek Basin	0.5	1-Mar-96	16-May-96	RTM	906885
Camp Creek	Meacham Creek Basin	0.5	8-Aug-96	29-Aug-96	RTM	906049
Camp Creek	Meacham Creek Basin	0.5	13-May-97	30-Oct-97	RTM	906051
Camp Creek	Meacham Creek Basin	0.5	8-Apr-98	18-Dec-98	Mini	3859
Camp Creek	Meacham Creek Basin	0.5	30-Apr-99	15-Nov-99	Mini	2858
Camp Creek	Meacham Creek Basin	0.5	29-Apr-00	3-Nov-00	Mini	7549
Camp Creek	Meacham Creek Basin	0.5	22-May-01	4-Dec-01	Mini	3862
Camp Creek	Meacham Creek Basin	0.5	29-May-02	5-Nov-02	Mini	3862
E. Meacham C.	Meacham Creek Basin	0.2	3-May-93	17-Jul-93	RTM	906045
E. Meacham C.	Meacham Creek Basin	0.2	21-Jul-93	3-Nov-93	RTM	906046
E. Meacham C.	Meacham Creek Basin	0.2	6-Nov-93	13-Mar-94	RTM	906046
E. Meacham C.	Meacham Creek Basin	0.2	28-Jul-94	1-Aug-94	RTM	906046
E. Meacham C.	Meacham Creek Basin	0.2	2-Apr-95	20-Jul-95	RTM	906046
E. Meacham C.	Meacham Creek Basin	0.2	22-Jul-95	27-Jun-95	RTM	906046
E. Meacham C.	Meacham Creek Basin	0.2	3-Jul-96	7-Aug-96	RTM	906046
E. Meacham C.	Meacham Creek Basin	0.2	9-Aug-96	23-Dec-96	RTM	906046
E. Meacham C.	Meacham Creek Basin	0.2	13-May-97	17-May-97	RTM	906049
E. Meacham C.	Meacham Creek Basin	0.2	8-Apr-98	17-Dec-98	Mini	3858
E. Meacham C.	Meacham Creek Basin	0.2	30-Apr-99	4-Nov-99	Mini	3856
E. Meacham C.	Meacham Creek Basin	0.2	5-May-00	2-Nov-00	Mini	7458
E. Meacham C.	Meacham Creek Basin	0.2	22-May-01	4-Dec-01	Mini	7552
E. Meacham C.	Meacham Creek Basin	0.2	29-May-02	5-Nov-02	Mini	7552
Hermiston N.D.	Below treatment plant	0.1	8-Aug-97	29-Oct-97	Mini	3853
Hermiston N.D.	Below treatment plant	0.1	10-Apr-98	16-Dec-98	RTM	906051
McKay Creek	Near the Mouth	0.1	5-May-99	24-Oct-99	RTM	906050
McKay Creek	Near the Mouth	0.1	28-Apr-00	11-Sep-00	Mini	7554
McKay Creek	Near the Mouth	0.1	13-Sep-00	1-Nov-00	Mini	7554
McKay Creek	Near the Mouth	0.1	21-Dec-00	11-Jun-01	Mini	7556
McKay Creek	Near the Mouth	0.1	14-Jun-01	22-Jul-01	Mini	7557
McKay Creek	Near the Mouth	0.1	26-Jul-01	9-Dec-01	Mini	7557
McKay Creek	Near the Mouth	0.1	22-May-02	7-Nov-02	Mini	7557

McKay Creek	Near McKay School	1.9	7-May-99	24-Oct-99	RTM	906051
McKay Creek	Near McKay School	1.9	28-Apr-00	11-Sep-00	Mini	7552
McKay Creek	Near McKay School	1.9	13-Sep-00	1-Nov-00	Mini	7552
McKay Creek	Near McKay School	1.9	21-Dec-00	11-Jun-01	Mini	7557
McKay Creek	Near McKay School	1.9	14-Jun-01	22-Jul-01	Mini	7556
McKay Creek	Near McKay School	1.9	26-Jul-01	9-Dec-01	Mini	7558
McKay Creek	Near McKay School	1.9	22-May-02	7-Nov-02	Mini	7558
McKay Creek	Heavens Lane Bridge	3.7	28-Apr-00	11-Sep-00	Mini	7553
McKay Creek	Heavens Lane Bridge	3.7	13-Sep-00	1-Nov-00	Mini	7553
McKay Creek	Heavens Lane Bridge	3.7	21-Dec-00	11-Jun-01	Mini	7558
McKay Creek	Heavens Lane Bridge	3.7	14-Jun-01	22-Jul-01	Mini	7558
McKay Creek	Heavens Lane Bridge	3.7	26-Jul-01	9-Dec-01	Mini	7556
McKay Creek	Heavens Lane Bridge	3.7	24-Apr-02	8-Nov-02	Mini	7556
McKay Creek	Just below dam	6	4-May-99	24-Oct-99	RTM	906048
McKay Cr, N. F.	At USGS gage	0.2	5-May-00	2-Nov-00	RTM	906050
Meacham Creek	Near Duncan	13	5-May-93	19-Jul-93	RTM	906042
Meacham Creek	Near Duncan	13	21-Jul-93	3-Nov-93	RTM	906042
Meacham Creek	Near Duncan	13	6-Nov-93	2-May-94	RTM	906042
Meacham Creek	Near Duncan	13	28-Jul-94	1-Aug-94	RTM	906042
Meacham Creek	Near Duncan	13	8-Aug-96	23-Oct-96	RTM	906051
Meacham Creek	Near Duncan	13	13-May-97	30-Oct-97	RTM	906050
Meacham Creek	Near Duncan	13	8-Apr-98	17-Dec-98	Mini	3862
Meacham Creek	Near Duncan	13	30-Apr-99	4-Nov-99	Mini	7554
Meacham Creek	Near Duncan	13	29-Apr-00	3-Nov-00	Mini	7551
Meacham Creek	Near Duncan	13	23-May-01	4-Dec-01	Mini	4899
Meacham Creek	Near Duncan	13	2-Jun-02	7-Nov-02	Mini	4899
Mission Creek	Above the springs	4	28-May-97	28-Oct-97	RTM	913251
N. F. Meacham C.	Near the lower camp	0.5	18-May-96	23-Oct-96	RTM	906885
N. F. Meacham C.	Near the lower camp	0.5	13-May-97	30-Oct-97	RTM	906885
N. F. Meacham C.	Near the lower camp	0.5	8-Apr-98	17-Dec-98	Mini	3854
N. F. Meacham C.	Near the lower camp	0.5	30-Apr-99	15-Nov-99	Mini	3855
N. F. Meacham C.	Near the lower camp	0.5	29-Apr-00	2-Nov-00	Mini	7550
N. F. Meacham C.	Near the lower camp	0.5	22-May-01	4-Dec-01	Mini	3854
N. F. Meacham C.	Near the lower camp	0.5	2-Jun-02	7-Nov-02	Mini	3845
N. F. Umatilla	Below Coyote Creek	2.7	21-Apr-98	21-Dec-98	Mini	3856
N. F. Umatilla	Below Coyote Creek	2.7	7-May-99	1-Nov-99	Mini	7550
N. F. Umatilla	Below Coyote Creek	2.7	29-Apr-00	31-Oct-00	Mini	3854
N. F. Umatilla	Below Coyote Creek	2.7	30-Jun-02	8-Nov-02	Mini	3861
N. F. Umatilla	End of N. F. River Trail	4	19-Jul-97	30-Oct-97	Mini	3859
N. F. Umatilla	End of N. F. River Trail	4	21-Apr-98	21-Dec-98	Mini	3853
N. F. Umatilla	End of N. F. River Trail	4	7-May-99	1-Nov-99	Mini	7552
N. F. Umatilla	End of N. F. River Trail	4	29-Apr-00	31-Oct-00	Mini	3853
N. F. Umatilla	End of N. F. River Trail	4	30-Jun-02	8-Nov-02	Mini	4898
Ryan Creek	Near Forest Boundary	1.5	12-May-93	21-Jul-93	RTM	906047
Ryan Creek	Near Forest Boundary	1.5	24-Jul-93	3-Nov-93	RTM	906047
Ryan Creek	Near Forest Boundary	1.5	7-Nov-93	14-Jun-94	RTM	906047
Ryan Creek	Near Forest Boundary	1.5	19-Aug-94	23-Aug-94	RTM	906047
Ryan Creek	Near Forest Boundary	1.5	8-Aug-96	6-Nov-96	RTM	906050
Ryan Creek	Near Forest Boundary	1.5	13-May-97	17-Jul-97	RTM	906046
Spring Hollow C.	At Wamisha Road Bridge	4.5	7-Aug-97	29-Oct-97	Mini	3858
Spring Hollow C.	At Wamisha Road Bridge	4.5	9-Apr-98	16-Dec-98	RTM	906049
Spring Hollow C.	At Wamisha Road Bridge	4.5	4-May-99	4-Nov-99	RTM	906046
Spring Hollow C.	At Wamisha Road Bridge	4.5	5-May-00	17-Oct-00	RTM	906046

Stanfield Drain	At the mouth	0.1	7-Aug-97	29-Oct-97	Mini	3858
Stanfield Drain	At the mouth	0.1	9-Apr-98	16-Dec-98	RTM	906049
Thomas Creek	Upstream of lower bridge	0.25	18-Apr-98	17-Dec-98	Mini	3861
Thomas Creek	Upstream of lower bridge	0.25	30-Apr-99	4-Nov-99	Mini	3854
Thomas Creek	Upstream of lower bridge	0.25	27-Apr-00	31-Oct-00	Mini	3865
Thomas Creek	Upstream of lower bridge	0.25	25-Jun-02	12-Nov-02	Mini	7554
Umatilla River	Steelhead Park	8.8	27-Apr-99	18-Oct-99	Mini	3853
Umatilla River	Pond’s Farm	8.7	28-Apr-00	31-Oct-00	Mini	4906
Umatilla River	Pond’s Farm	8.7	23-May-01	5-Dec-01	Mini	4901
Umatilla River	Pond’s Farm	8.7	16-Apr-02	5-Nov-02	Mini	3855
Umatilla River	Maxwell Dam	15.3	27-Apr-99	26-Oct-99	Mini	4906
Umatilla River	Maxwell Dam	15.3	28-Apr-00	31-Oct-00	Mini	4904
Umatilla River	Maxwell Dam	15.3	11-Jul-01	5-Dec-01	Mini	5600
Umatilla River	Maxwell Dam	15.3	11-Jun-02	4-Nov-02	Mini	5600
Umatilla River	Below Stanfield Bridge	21.6	27-Apr-99	18-Oct-99	Mini	4904
Umatilla River	Below Stanfield Bridge	21.6	28-Apr-00	31-Oct-00	Mini	4903
Umatilla River	Below Stanfield Bridge	21.6	18-Apr-01	5-Dec-01	Mini	4903
Umatilla River	Below Stanfield Bridge	21.6	17-Apr-02	4-Nov-02	Mini	4903
Umatilla River	At Westland Dam	27.2	27-Apr-99	18-Oct-99	Mini	4903
Umatilla River	At Westland Dam	27.2	28-Apr-00	31-Oct-00	Mini	4902
Umatilla River	At Westland Dam	27.2	18-Apr-01	5-Dec-01	Mini	7549
Umatilla River	At Westland Dam	27.2	16-Apr-02	5-Nov-02	Mini	7549
Umatilla River	At Stanfield Dam	32.4	7-May-98	16-Dec-98	Mini	4900
Umatilla River	At Stanfield Dam	32.4	27-Apr-99	18-Oct-99	Mini	4902
Umatilla River	At Stanfield Dam	32.4	28-Apr-00	31-Oct-00	Mini	4901
Umatilla River	At Stanfield Dam	32.4	18-Apr-01	5-Dec-01	Mini	7548
Umatilla River	At Stanfield Dam	32.4	19-Apr-02	4-Nov-02	Mini	7548
Umatilla River	At Yoakum	37	27-Apr-99	24-Oct-99	Mini	4901
Umatilla River	At Yoakum	37	28-Apr-00	31-Oct-00	Mini	4900
Umatilla River	At Yoakum	37	23-May-01	5-Dec-01	Mini	4896
Umatilla River	At Yoakum	37	19-May-02	4-Nov-02	Mini	4896
Umatilla River	Near Barnhart	42.5	16-Feb-95	20-Mar-95	RTM	906884
Umatilla River	Near Barnhart	42.5	5-Apr-95	14-Jun-95	RTM	906048
Umatilla River	Near Barnhart	42.5	16-Jun-95	15-Aug-95	RTM	906048
Umatilla River	Near Barnhart	42.5	17-Aug-95	17-Dec-95	RTM	906048
Umatilla River	Near Barnhart	42.5	10-May-96	8-Aug-96	RTM	906048
Umatilla River	Near Barnhart	42.5	9-Aug-96	28-Oct-96	RTM	906048
Umatilla River	Near Barnhart	42.5	14-May-97	29-Oct-97	RTM	906048
Umatilla River	Near Barnhart	42.5	9-Apr-98	16-Dec-98	RTM	906046
Umatilla River	Near Barnhart	42.5	30-Apr-99	24-Oct-99	Mini	3862
Umatilla River	Near Barnhart	42.5	26-Apr-00	31-Oct-00	Mini	4899
Umatilla River	Near Barnhart	42.5	23-May-01	5-Dec-01	Mini	3858
Umatilla River	Near Barnhart	42.5	19-Apr-02	4-Nov-02	Mini	3858
Umatilla River	Near Coombs Canyon	47.5	30-Apr-99	26-Oct-99	Mini	3861
Umatilla River	Near Coombs Canyon	47.5	27-Apr-00	31-Oct-00	Mini	4898
Umatilla River	Near Coombs Canyon	47.5	11-Jul-01	5-Dec-01	Mini	5602
Umatilla River	Near Coombs Canyon	47.5	18-Apr-02	5-Nov-02	Mini	5602
Umatilla River	Near the Rieth Bridge	49	1-May-93	18-Jul-93	RTM	906048
Umatilla River	Near the Rieth Bridge	49	21-Jul-93	3-Nov-93	RTM	906048
Umatilla River	Near the Rieth Bridge	49	6-Nov-93	17-Jun-94	RTM	906048
Umatilla River	Near the Rieth Bridge	49	17-Dec-94	29-May-95	RTM	906043
Umatilla River	Near the Rieth Bridge	48.5	27-Apr-00	31-Oct-00	Mini	4897
Umatilla River	Near the Rieth Bridge	48.5	23-May-01	5-Dec-01	Mini	3856

Umatilla River	Near the Rieth Bridge	48.5	19-Apr-02	4-Nov-02	Mini	3856
Umatilla River	Near Mouth of McKay C.	50	30-Apr-99	26-Oct-99	Mini	3960
Umatilla River	Near McKennon Station	50.8	5-May-99	24-Oct-99	RTM	906049
Umatilla River	Near McKennon Station	50.8	27-Apr-00	31-Oct-00	Mini	4896
Umatilla River	Near McKennon Station	50.8	23-May-01	5-Dec-01	Mini	3860
Umatilla River	Near McKennon Station	50.8	22-May-02	4-Nov-02	Mini	3860
Umatilla River	Above Minthorn Springs	63	30-Apr-99	7-Nov-99	Mini	4900
Umatilla River	Above Minthorn Springs	63	27-Apr-00	1-Nov-00	Mini	3862
Umatilla River	Above Minthorn Springs	63	19-Apr-01	5-Dec-01	Mini	4906
Umatilla River	Above Minthorn Springs	63	24-Apr-02	7-Nov-02	Mini	4906
Umatilla River	0.2 miles above Cayuse Br.	67.7	7-May-98	8-Dec-98	Mini	3860
Umatilla River	0.2 miles above Cayuse Br.	67.7	30-Apr-99	4-Nov-99	Mini	4899
Umatilla River	0.2 miles above Cayuse Br.	67.7	27-Apr-00	3-Jul-00	Mini	3861
Umatilla River	0.2 miles above Cayuse Br.	67.7	23-May-01	9-Dec-01	Mini	3859
Umatilla River	0.2 miles above Cayuse Br.	67.7	22-May-02	7-Nov-02	Mini	3859
Umatilla River	At Thorn Hollow	73.1	5-May-99	4-Nov-99	Mini	7558
Umatilla River	At Thorn Hollow	73.1	27-Apr-00	1-Nov-00	Mini	3860
Umatilla River	At Thorn Hollow	73.1	23-May-01	28-Nov-01	Mini	7550
Umatilla River	At Thorn Hollow	73.1	22-May-02	5-Nov-02	Mini	7550
Umatilla River	Above Ryan Creek	82.5	23-Jul-97	30-Oct-97	Mini	3862
Umatilla River	Above Ryan Creek	82.5	9-Apr-98	17-Dec-98	RTM	906048
Umatilla River	Above Ryan Creek	82.5	30-Apr-99	4-Nov-99	Mini	4897
Umatilla River	Above Ryan Creek	82.5	27-Apr-00	31-Oct-00	Mini	3859
Umatilla River	Above Ryan Creek	82.5	12-Jul-01	28-Nov-01	Mini	5601
Umatilla River	Above Ryan Creek	82.5	7-May-02	8-Nov-02	Mini	5601
Umatilla River	Bar-M Ranch Road	87	23-Jul-97	30-Oct-97	Mini	3854
Umatilla River	Bar-M Ranch Road	87	9-Apr-98	19-Nov-98	RTM	906885
Umatilla River	Bar-M Ranch Road	87	30-Apr-99	4-Nov-99	Mini	3859
Umatilla River	Bar-M Ranch Road	87	27-Apr-00	31-Oct-00	Mini	3858
Umatilla River	Bar-M Ranch Road	87	22-May-01	28-Nov-01	Mini	7551
Umatilla River	Bar-M Ranch Road	87	7-May-02	7-Nov-02	Mini	7551

Thermograph Deployment Protocol

The protocol for deploying thermographs has evolved through time as more and more agencies and individuals began to use our data. Certification and calibration of Ryan instruments was completed at the factory. Some units were re-calibrated and re-certified after three years. When the UBNPME project began using Vemco thermographs we tested their accuracy and consistency. The units were bound together and placed in a water bath. The water bath was stirred continuously, monitored with a thermometer at specific time intervals, and changed from cold to warm by adding hot water. All tested Vemco thermographs were within +/- 0.1 ^{o}C at stable temperatures, and had a slight lag behind the hand held thermometer when the hot water was mixed into the bath. From 1993 to 1999, thermographs were deployed and checked several times during the spring when flows were receding and once in late summer. Beginning in 2000, thermographs were checked each month. The current deployment protocol includes annual pre-season and post-season calibration checks, but these pre-season calibration tests were not conducted during 1999-2002. The stricter protocols have been added to increase the utility of the thermograph data beyond project objectives. The deployment, monthly checks and recovery protocols described below (sections 2-7) have been in place since 2000 with the exception of the ANSI rated thermometer which began in 2001.

Pre-Season Calibration

1. Initialize all thermographs to 1 minute intervals.
2. Edit file header information to denote that these are pre-season calibration tests for the given year.
3. Band initialized units together with thermo-sensors on the same end.

4. Place thermographs in a warm water bath (25-30 ^{o}C) with sensors facing up and in the center of the container.
5. Continually mix the water during the calibration tests to ensure consistent water temperatures at each sensor.
6. Monitor and record the water temperature with an ANSI certified thermometer at five minute intervals throughout the test.
7. Ensure that the sensor end of the thermometer is located near the thermograph sensors.
8. Monitor water temperatures for 60 minutes.
9. Add ice water to bring the temperature to 5^{o}C or below, 30 minutes into the calibration exercise.
10. After 60 minutes extract the thermographs and download the temperature data.
11. Compare temperatures from each unit to the ANSI data for each time reading.
12. Report the maximum, minimum and mean variance of each instrument from the ANSI data.
13. Calculate the response delay for each unit in relation to the ANSI certified instrument.
14. Record and summarize the calibration data and post on the website.

Protocol for Using ANSI Certified Thermometers

1. Protect the ANSI certified instrument from shock, compression, bending and high temperatures.
2. Place the ANSI instrument within 10 cm of the thermographs sensor in flowing water.
3. Read the instrument several times to ensure readings have stabilized before recording temperatures.
4. Read the instrument perpendicular to its axis; reading at other angles will give erroneous readings.

Initialize Thermographs

1. Using the PC and the unit interface, write the correct site name and river mile in the unit header.
2. Set recording interval to 1 hour, with external sensor etc.
3. Double check all settings, time and date.
4. Check function indicator light on thermograph.
5. Label unit with site name and river mile with a Tyvek tag.
6. Develop a unit deployment record sheet with site, river mile, unit number and places to record date, time, temp and comments about the deployment.

Protocol for Setting Thermographs

1. Place the unit in the water at the site prior to May 1 (except for backcountry sites).
2. Read tag and ensure that tag matches site, and unit ID number matches the deployment record sheet.
3. On the Tyvek tag and deployment record sheet write the deployment time, date and temperature using the ANSI certified thermometer.
4. Place the unit in the main channel and in deeper water that is moving (and will continue to move at lower flows).
5. Cable or chain to a tree or large boulder.
6. Hide the cable (or chain) and the thermograph.
7. Ensure that water flows around the sensor end of the unit.
8. If the site is new or significantly different than previous deployments, photograph the site and provide both near and overview photos. Record the photo numbers on the deployment record sheet.

Monthly Quality Control Checks

1. Ensure that the unit is still in the main channel in moving water.
2. Ensure that the unit is hidden, and the cable.
3. Ensure that water flows around the sensor end of the unit.
4. Record the date, time and water temperature of ANSI certified thermograph on the Quality and Assurance Record Sheet.
5. Record observations and actions. For example: "unit in backwater, unit moved 20 m upstream," “unit ok and concealed", "unit in mud-reset" or "unit out of water and reset", etc.

Protocol for Extracting Thermographs

1. Pull units after October 31st and prior to November 30 (to avoid loss during high water events).
2. Record the date, time and temperature when the unit was pulled from the water.

3. Attach a new Tyvek tag to the unit with the site name, data, time and temperature.
4. Clean the mud and algae off the unit.
5. Download the data into the computer, check headers with Tyvek tag.
6. Check dates, times and temperatures of deployment and Q&A Record Sheets with recorded temperatures and times.
7. Save and archive original data file and create and ASCII file (or DOS Text file) with the Vemco software.

Post Season Calibration

1-14. Repeat pre-season calibration protocol outlined above.

Protocol for Summarizing Thermograph Data

The protocol used to summarize thermograph data began in 1993 and includes a standard file naming format developed when file names were limited to eight characters. Thermograph interface software generates their own file names based on the serial number of the unit and the presence of other files with the same serial number in the defined data directory. Because these file names can be easily confused and can be over-written, we rename the files and store the original binary data, the converted ASCII file and the Excel file together in folders specific to each monitoring site. The protocol outlined below is the process used to summarize all UBNPME thermograph data from 1993-2002.

Rename Data Files

Rename files to match the standard file name format. For example, thermograph number 3854 had been deployed in the North Fork of Meacham in April of 2002 and the binary file BIN3854.001 was generated by the Vemco proprietary software. In this case, we rename the binary file to MBMN0204.001. The Excel file would be named MXMN0204.xls. The file name denotes it is a file from a Vemco Mini-logger (M, in MXMN0204), in Excel format (X in MXMN0204), from the North Fork of Meacham Creek (MN in MXMN0204, deployed in 2002 (02 in MXMN0204) in April (04 in MXMN0204). The BIN file for that same data set would be labeled MBMN0204 and the ASCII file would be named MAMN0204. The BIN and ASCII files should only be renamed and without any other alterations. Only the Excel file will have the data summaries and deletions (if the thermograph was out-of-water or had other problems).

Rename the files before saving additional data files from subsequent thermograph deployments or the current file may overwrite an earlier data set. For example, file BIN3854.000, collected in 2001, could be replaced by BIN3854.000 collected in 2002. If such a replacement occurs, the older data (2001 data in this case) would be permanently lost. The Vemco software will usually check the folder for existing file names and name the sequential files with extensions of 001 or 002 etc. However, files can be easily over-written if other data is stored on back-up disks or elsewhere with the same name.

Import the ASCII file into Excel

There are several ways to transfer ASCII files into Excel but we have had fewer difficulties with the following method. Other methods limited the utility of pivot tables.

1. Open a blank Excel Worksheet
2. Select DATA from main menu,
3. Select Import External Data and click on "Import Data"
4. Go to raw the thermograph data folder
5. Change file type to "all" file type,
6. Select the appropriate ASCII file and import
7. Select Delimited
8. Check on the coma delimiter
9. Click on the date column.
10. Change date column from "general" to "date" in the "column data form"
11. Change the date format to YMD for the date column
12. Change the last column to "do not import"
13. Click on "Finish" in the import wizard and examine the file and header
14. Save with new file format using X in the second character of the file name. Follow the standard file name format. Do not save Excel files over the machine language (BIN) files or the DOS Text file (ASCII) files. We want to keep the BIN and ASCII files as they are with their new file names. Use "save as" instead of "save" to save the file with the new name. Be sure the file type is .xls before saving.

Check File Headers

Compare the Excel file header with the instrument number listed on the thermograph pull sheets. It is very important that we verify that the header matches where the thermograph was actually deployed. It is possible to place thermographs in the wrong place. If the header was incorrect, place a notation in the Excel file header to clarify that the Binary (BIN) file data did not match the header information. Include the correct information in the header notation.

The Excel file header should include the stream name, river mile, thermograph unit number; start date and time, end date and time, sample period (usually 1 hour) and the file name (this makes it easer to go back to the electronic version of the data when looking at hardcopy printouts). Include any notes, data deletions etc. in the header.

Rename the BIN and ASCII and Excel files for the proper stream code. For example: file BIN3854.000 and its associated ASCII file ASC3854.000 have headers that say N.F. Meacham Creek RM 0.5. Check the thermograph pull sheet to ensure that unit 3854 was actually recovered from N.F. Meacham Creek, RM 0.5. If the header is incorrect, make a note of the correction in the header of the Excel file.

Check Quality of Recorded Temperatures

Compare the temperatures recorded on the thermograph with those recorded by the ANSI certified thermometer. Check the times and dates when units were deployed, checked and recovered. Use the field data sheets directly; making sure that the instrument number is correct. Record and investigate any abnormalities or problems.

Plot Temperatures

Chart time versus temperature in Excel in a separate sheet. Examine the graph and check for abnormalities.

1. Highlight the date, time and temperature headers and associated data down to the bottom of the columns
2. Select the Excel chart wizard
3. Select the Line Chart
4. Place the Chart on a separate worksheet and select finish.
5. Look at the chart for anomalies
6. Place the curser on the anomalies data point and record dates,
7. Examine data in tabular form in the hourly sheet when anomalies occurred.

Expel Invalid Data

Delete partial days, days out of the water etc. from the data set in the Excel file. Record all deletions (if any) in a header notation.

Develop the Hourly Data Sheets

Copy the hourly report calculations from the template file with temperature conversion and exceedence counter formulas. Be very careful to copy items in the correct places and to keep files separate. Check formulas. Create and label "Hourly, Daily, Monthly and Chart" work sheets.

Develop the Daily and Monthly Summary Sheets

Copy the daily and monthly pivot tables onto separate worksheets, ensure that the data source labels match the data from the correct data sheet. Double check which sheet you are working on and not mix data between files as will occur when you first copy the pivot tables.

1. Go to the daily and monthly pivot tables in the template file. Follow the steps below for each of the two summary sheets.
2. Highlight the entire pivot table on the daily or monthly sheet
3. Select Edit and Copy from the main menu.
4. Go to the appropriate daily or monthly sheet in the file you are working on
5. Place the curser where you want the upper left side of the pivot table to start (usually A-9), hit paste.
6. Click somewhere inside the pivot table to highlight the entire table.
7. Right click and select pivot table wizard, select back and click on the data range box icon.
8. Select the header and the data for the appropriate daily or monthly pivot table
9. Click again on the data range box icon, select next, and examine layout.

10. Correct any layout related problems such as missing data fields (these omissions sometimes occur in the "copy template" processes).
11. For the monthly summary select "layout" and drag "Date" and "Year" to far left column (labeled Rows) in the layout template.
12. Hit OK and select finish
13. For the monthly pivot table, click in the far left had column of the pivot table and right click
14. Select "Group and Show Detail"
15. Select "Group"
16. Select "month" and "year" for type. This will summarize the table by months and years.

Edit Tables

Edit tables for correct decimal places, column widths, headers etc. Ensure that the start and end times match the data. Use the 14-March-2002 format for dates to reduce ambiguity. List any data deletions or other data abnormalities in the header of each sheet. Add dates in monthly pivot table row headers for any month with partial data (i.e. May 15-30).

Save File and Make Backups

Save the file with the proper file-name-format. Move the Excel file and the renamed ASCII and BIN files to the correct sub-folder (organized by location). Backup a copy of the folders in one or more appropriate locations (CD and/or Zip Disks).

Post Data on the Website

Provide copies of the thermograph data to the both the project leader and website coordinator.

RESULTS AND DISCUSSION

Hourly data as well as daily and monthly summaries from each thermograph deployment from 1993-2002 are available at the CTUIR website http://www.umatilla.nsn.us. The raw data from each thermograph was plotted in an Excel chart. Examples of several data sets are shown in Figures 5-2 though 5-4 and Tables 5-3 through 5-5. We have collated water temperature data to provide an overview of Umatilla River water temperatures from 1995-2002 (Figures 5-5 through 5-7).

Water temperatures in the Umatilla River are suitable for salmonids in two major sections including RM 80-90 and RM 40-50. All but the lower reaches of most tributaries in the basin are suitable for salmonids. Most tributaries that enter the Umatilla River above RM 76.7 near the mouth of Squaw Creek have suitable water temperatures for salmonids for their entire length. The upper river has naturally cool water from the N. F. Umatilla River and provides spawning and rearing habitat for steelhead and spring Chinook. The Umatilla River from RM 40 -50 is artificially cool during the summer because of cold water released from McKay Reservoir for irrigation and fish benefits. The lower reach has suitable temperatures but flow can fluctuate significantly when McKay Reservoir is closed and water temperatures can become lethal to salmonids. During the last two to three years, managers have attempted to mitigate water temperatures during the summer by releasing "fish water" when irrigation flows are reduced. The water dedicated for fish management was originally planned to assist spring and fall migrations of salmon and steelhead. Currently, available water storage is not enough to assist both migratory and rearing life history stages below McKay Creek. Phase III of the flow augmentation planning should consider salmonid rearing habitat needs below McKay Creek.

High water temperatures and related dewatering during the summer appear to be the primary factors limiting juvenile salmonid distribution and abundance in the Umatilla Basin (Contor et al. 1995-2000). Brett (1952) and Black (1953) reported that water temperatures of 24-25 ^{o}C are near salmonids lethal limit. The Umatilla River below the mouth of Meacham Creek (RM 78.9) is often warmer than 24-25 ^{o}C (Figure 5-5). It is essential to note that ocean conditions, survival in the Columbia River during migration, and spawner abundance are also important factors influencing salmonid abundance.

Prespawning mortalities of spring Chinook salmon (1991-2002) in the Umatilla River are directly correlated with maximum water temperatures (r = 0.93, with a linear equation). Spawning survey and water temperature data show an average prespawning mortality below Meacham Creek (RM 70-79) of 45-

55% with an associated average July temperature of 18-19 ^{o}C (Kissner 2003). In upstream reaches, where water temperatures are sequentially cooler, prespawning mortalities are sequentially lower (Figure 5-8). In the N. F. Umatilla River, prespawning mortalities averaged 4% and mean July water temperature was 11^{o}C. The relationship between prespawning mortality by reach and water temperature was curvilinear and a power equation fit to the data generated an r^2 of 0.989 (Figure 5-9).

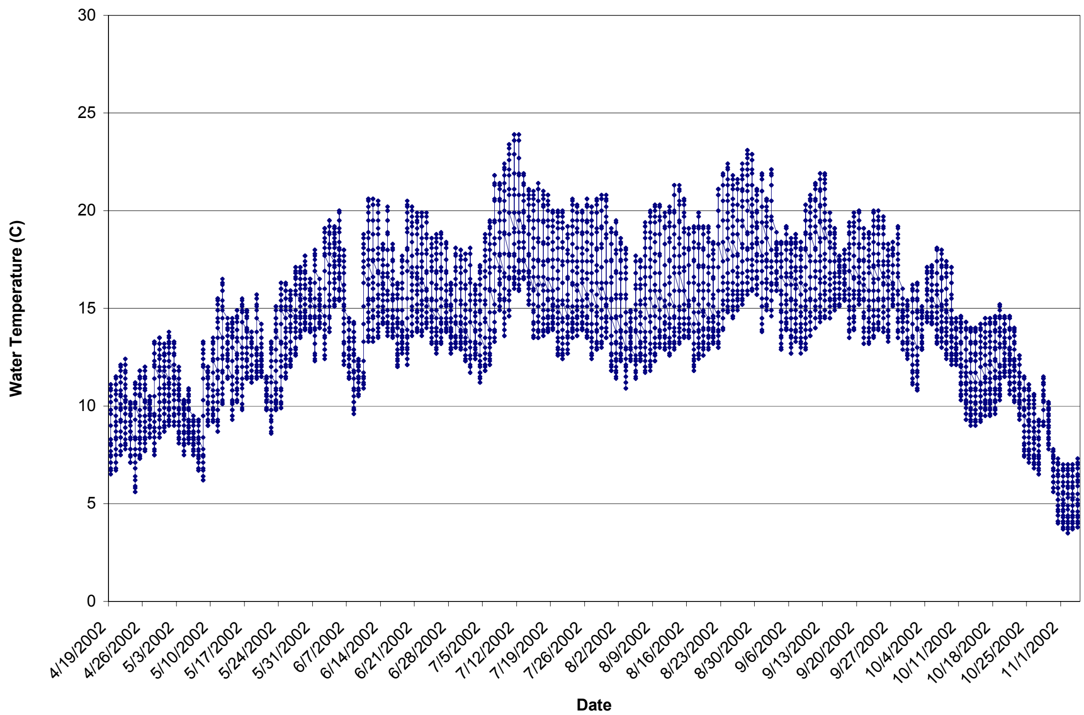

Figure 5-2 Hourly water temperature data from the Umatilla River at RM 47.5, near Coombs Canyon, April, 18 through November 4, 2002.

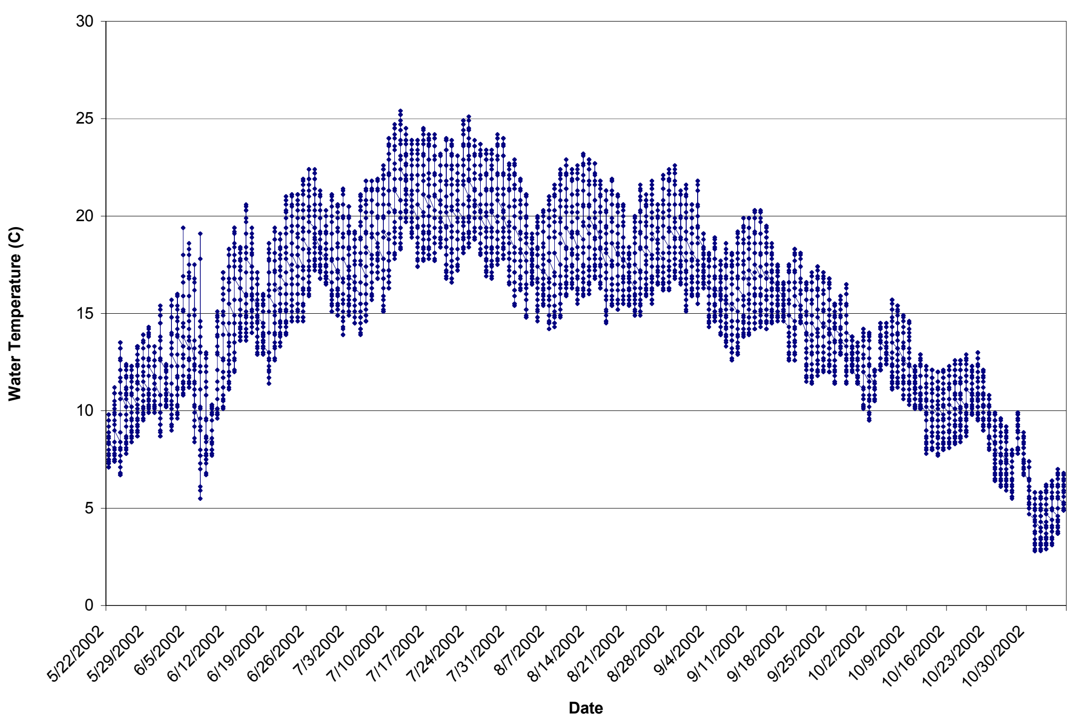

Figure 5-3 Hourly water temperature data from the Umatilla River at RM 73.1, near Thorn Hollow, May 22 through November 5, 2002.

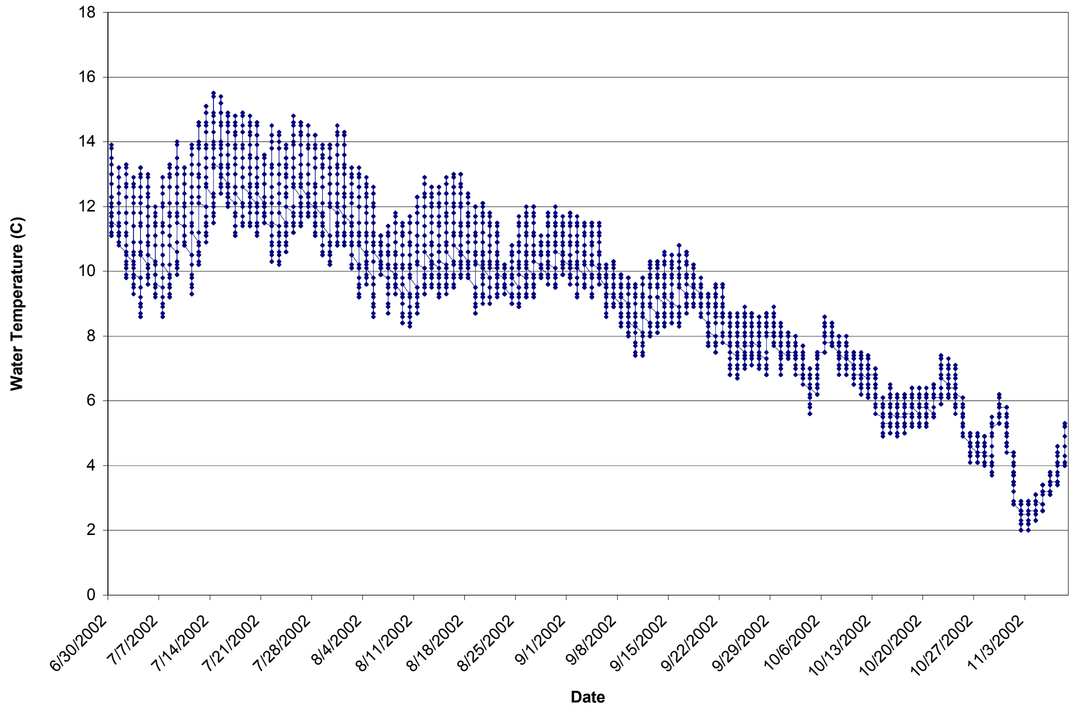

Figure 5-4 Hourly water temperature data from the N. F. Umatilla River at RM 2.7, below the mouth of Coyote Creek, June 30 through November 8, 2002

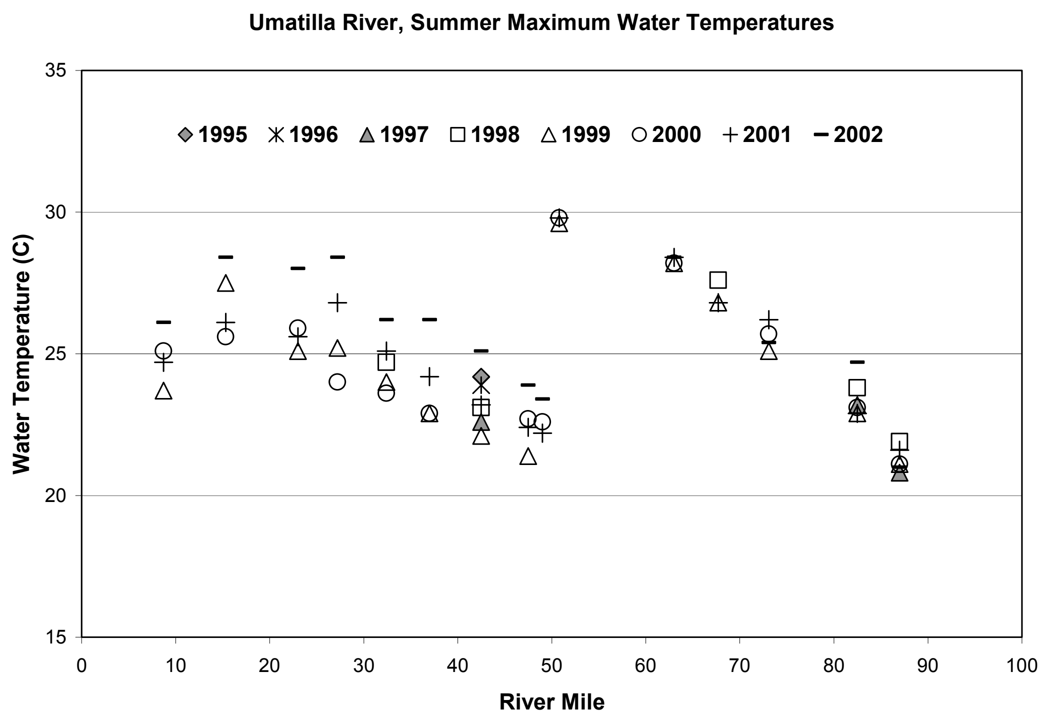

Figure 5-5 Summary of Umatilla River maximum water temperatures for June-September, 1995-2002, at selected locations from RM 8.7 to 87.5

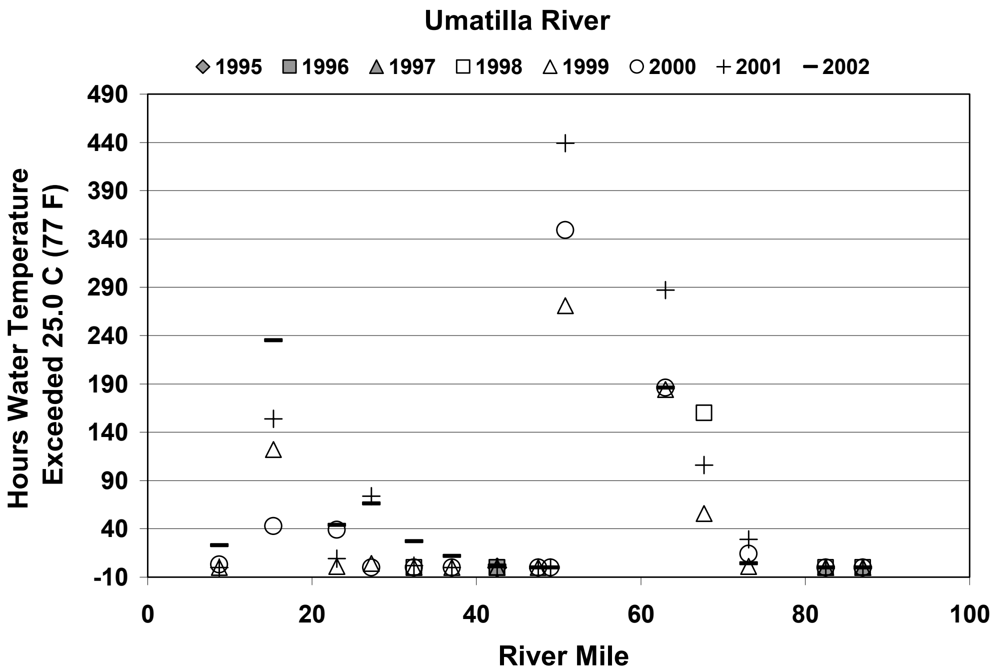

Figure 5-6 Summary of the number of hours when water temperatures exceeded 25 C, during June-September, 1995-2002, in the Umatilla River from selected locations RM 8-87

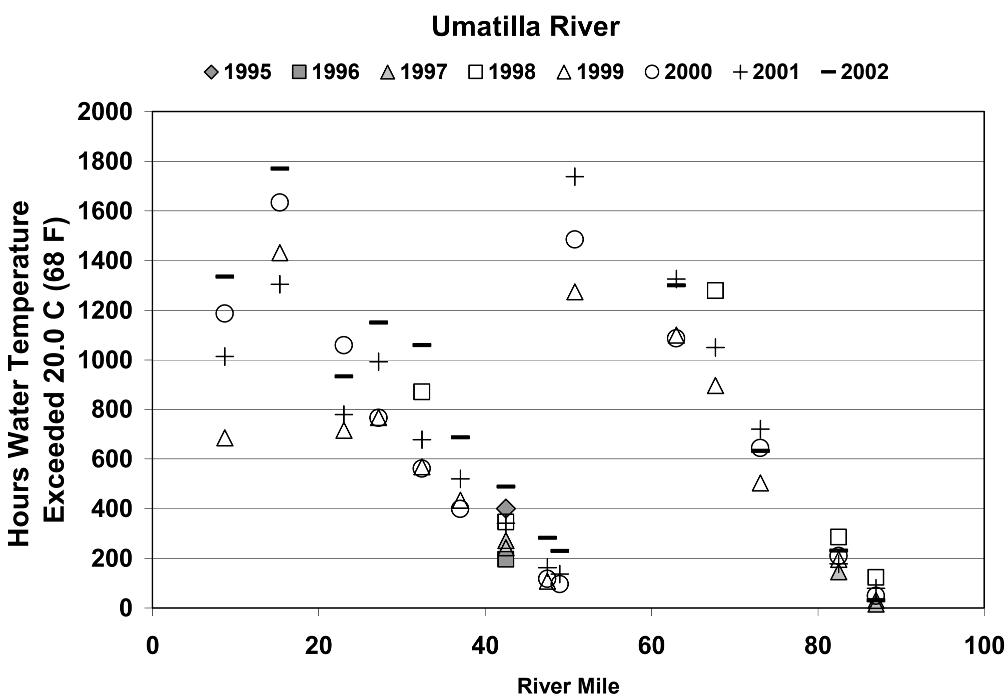

Figure 5-7 Summary of the number of hours when water temperatures exceeded 20 C, during June-September, 1995-2002, in the Umatilla River from selected locations RM 8-87

Table 5-3 Monthly maximum, mean and minimum stream temperatures (°C) from four locations in the Umatilla River Basin; the number of hours water temperatures met or exceeded listed criteria (values in column T>=25 denotes the total hours when temperatures met or exceeded 25°C for the indicated time period). WWNPME Project water temperature data are available at http://www.umatilla.nsn.us (CTUIR website).

Umatilla River Near Combs Canyon at RM 47.5								
Date 2002	**Max**	**Mean**	**Min**	**T <=5**	**T >=12.78**	**T>=17.78**	**T>=20**	**T>=25**
April 19-30	13.5	9.7	5.6	0	12	0	0	0
May	18	12.2	6.2	0	304	4	0	0
June	20.6	15.5	9.6	0	633	156	22	0
July	23.9	16.5	11.2	0	679	254	109	0
August	23.1	16.3	10.9	0	664	244	101	0
September	22.1	16.6	12.4	0	708	229	50	0
October	18.1	11.8	4	9	303	7	0	0
November 1-4	7.3	5.2	3.5	49	0	0	0	0
April 19- Nov 4	23.9	14.3	3.5	58	3303	894	282	0

Umatilla River Near Thorn Hollow at RM 73.1								
Date 2002	**Max**	**Mean**	**Min**	**T <=5**	**T >=12.78**	**T>=17.78**	**T>=20**	**T>=25**
May 22-31	15.4	10.5	6.7	0	35	0	0	0
June	22.4	15.0	5.5	0	521	178	60	0
July	25.4	19.8	13.9	0	744	584	347	4
August	23.2	18.4	14.2	0	744	409	207	0
September	21.8	15.5	11.4	0	627	122	18	0
October	15.7	10.1	2.8	21	92	0	0	0
November 1-5	7	4.8	2.8	71	0	0	0	0
May 22-Nov 5	25.4	15.1	2.8	93	2763	1293	632	0

N. F. Umatilla River Near Coyote Creek at RM 2.7								
Date 2002	**Max**	**Mean**	**Min**	**T <=5**	**T >=12.78**	**T>=17.78**	**T>=20**	**T>=25**
June-30	13.9	12.2	11.1	0	6	0	0	0
July	15.5	12.1	8.6	0	249	0	0	0
August	14.3	10.6	8.3	0	25	0	0	0
September	11.8	9.0	6.7	0	0	0	0	0
October	8.6	6.2	3.7	116	0	0	0	0
November	5.3	3.3	2	180	0	0	0	0
June 30- Nov 8	15.5	9.1	2	296	280	0	0	0

Table 5-4 Example of hourly water temperatures and exceedence values of data collected from N. F. Umatilla River at RM 2.7 from June 20 to November 4, 2002 (first 34 hours only). The complete record is available at http://www.umatilla.nsn.us (CTUIR website).

				41 F	55 F	64 F	68 F	77 F
Date	Time	C	F	Hrs<=5.0	Hrs>=12.78	Hrs>=17.78	Hrs>=20.0	Hrs>=25.0
30-Jun-02	0:49:44	11.8	53.2	0	0	0	0	0
30-Jun-02	1:49:44	11.7	53.1	0	0	0	0	0
30-Jun-02	2:49:44	11.5	52.7	0	0	0	0	0
30-Jun-02	3:49:44	11.4	52.5	0	0	0	0	0
30-Jun-02	4:49:44	11.2	52.2	0	0	0	0	0
30-Jun-02	5:49:44	11.1	52.0	0	0	0	0	0
30-Jun-02	6:49:44	11.1	52.0	0	0	0	0	0
30-Jun-02	7:49:44	11.2	52.2	0	0	0	0	0
30-Jun-02	8:49:44	11.4	52.5	0	0	0	0	0
30-Jun-02	9:49:44	11.8	53.2	0	0	0	0	0
30-Jun-02	10:49:44	12.3	54.1	0	0	0	0	0
30-Jun-02	11:49:44	12.3	54.1	0	0	0	0	0
30-Jun-02	12:49:44	13	55.4	0	1	0	0	0
30-Jun-02	13:49:44	13.5	56.3	0	1	0	0	0
30-Jun-02	14:49:44	13.9	57.0	0	1	0	0	0
30-Jun-02	15:49:44	13.8	56.8	0	1	0	0	0
30-Jun-02	16:49:44	13.3	55.9	0	1	0	0	0
30-Jun-02	17:49:44	13	55.4	0	1	0	0	0
30-Jun-02	18:49:44	12.7	54.9	0	0	0	0	0
30-Jun-02	19:49:44	12.3	54.1	0	0	0	0	0
30-Jun-02	20:49:44	12.1	53.8	0	0	0	0	0
30-Jun-02	21:49:44	12	53.6	0	0	0	0	0
30-Jun-02	22:49:44	11.7	53.1	0	0	0	0	0
30-Jun-02	23:49:44	11.5	52.7	0	0	0	0	0
01-Jul-02	0:49:44	11.4	52.5	0	0	0	0	0
01-Jul-02	1:49:44	11.4	52.5	0	0	0	0	0
01-Jul-02	2:49:44	11.2	52.2	0	0	0	0	0
01-Jul-02	3:49:44	11.2	52.2	0	0	0	0	0
01-Jul-02	4:49:44	11.1	52.0	0	0	0	0	0
01-Jul-02	5:49:44	10.9	51.6	0	0	0	0	0
01-Jul-02	6:49:44	11.1	52.0	0	0	0	0	0
01-Jul-02	7:49:44	10.9	51.6	0	0	0	0	0
01-Jul-02	8:49:44	11.1	52.0	0	0	0	0	0
01-Jul-02	9:49:44	11.2	52.2	0	0	0	0	0

Table 5-5 Example of daily water temperature summary of data collected from N. F. Umatilla River at RM 2.7 from June 20 to November 4, 2002 (first 21 days only). The complete record is available at http://www.umatilla.nsn.us (CTUIR website).

Date	Max C	Mean C	Min C	Max F	Mean F	Min F
30-Jun-02	13.9	12.2	11.1	57.0	53.9	52.0
01-Jul-02	13.2	11.7	10.8	55.8	53.1	51.4
02-Jul-02	13.3	11.3	9.8	55.9	52.3	49.6
03-Jul-02	12.9	10.8	9.3	55.2	51.5	48.7
04-Jul-02	13.2	10.7	8.6	55.8	51.3	47.5
05-Jul-02	13.0	11.1	9.6	55.4	51.9	49.3
06-Jul-02	12.0	10.4	9.2	53.6	50.7	48.6
07-Jul-02	12.9	10.6	8.6	55.2	51.0	47.5
08-Jul-02	13.3	11.1	9.2	55.9	52.0	48.6
09-Jul-02	14.0	11.7	9.9	57.2	53.0	49.8
10-Jul-02	13.2	11.7	10.8	55.8	53.0	51.4
11-Jul-02	13.9	11.5	9.3	57.0	52.7	48.7
12-Jul-02	14.6	12.2	10.2	58.3	54.0	50.4
13-Jul-02	15.1	12.9	10.9	59.2	55.3	51.6
14-Jul-02	15.5	13.4	11.5	59.9	56.1	52.7
15-Jul-02	15.4	13.6	12.4	59.7	56.5	54.3
16-Jul-02	14.9	13.2	12.0	58.8	55.8	53.6
17-Jul-02	14.8	12.8	11.1	58.6	55.0	52.0
18-Jul-02	14.9	13.0	11.4	58.8	55.5	52.5
19-Jul-02	14.8	12.9	11.4	58.6	55.2	52.5
20-Jul-02	14.6	12.8	11.1	58.3	55.0	52.0

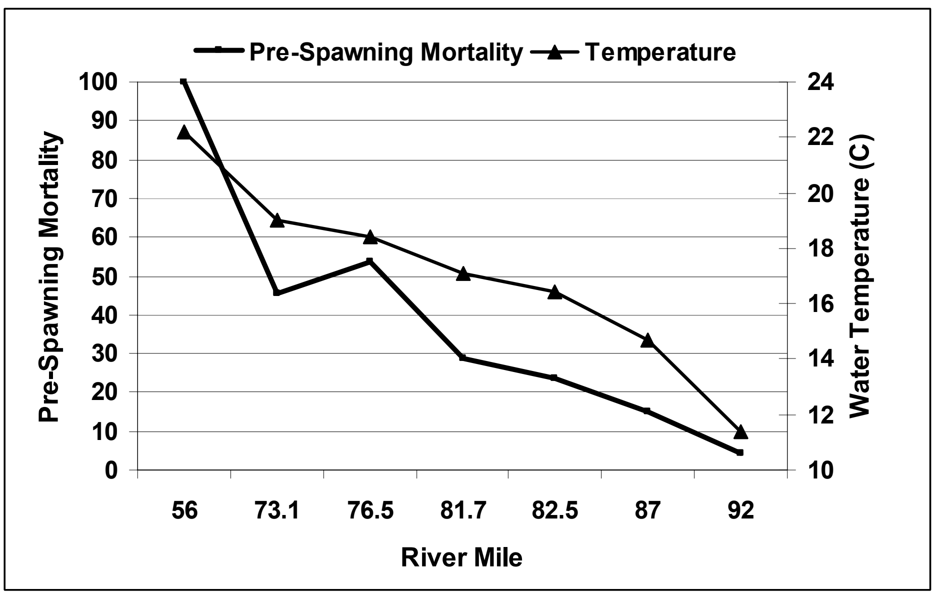

Figure 5-8 Mean prespawning mortality of spring Chinook in the Umatilla River, by River Mile, 1992-2002 and mean July 2000 water temperatures; RM 92 denotes the N. F. of the Umatilla River.

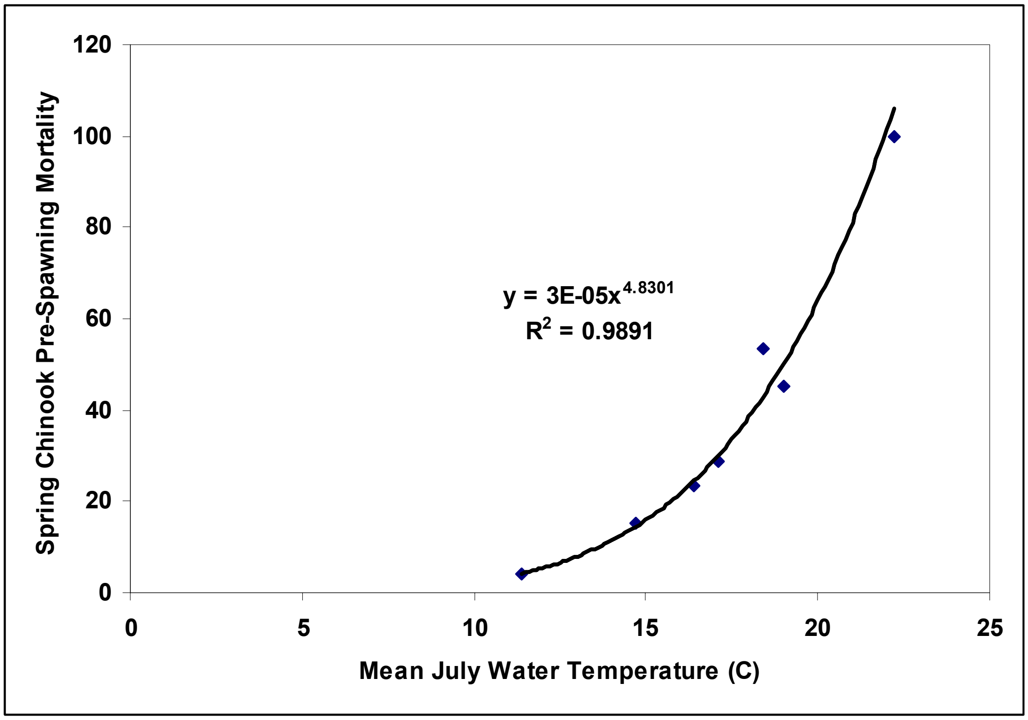

Figure 5-9 The relationship between mean prespawning mortality of spring Chinook in the Umatilla River, by reach, 1992-2002 and associated mean July 2000 water temperatures.

Flows and Water Temperatures

The relationship between water temperatures and flows has considerable variability because of the influence of other factors such as solar radiation, cloud cover, wind and air temperatures. The mean daily flow and maximum daily water temperatures at Yoakum (RM 37) during July and Augusts for 1999-2002 are plotted in Figure 5-9. A general trend is evident within the variability. When average daily flows were greater than 260 CFS, maximum daily temperatures were always below 22 ^{o}C. We plotted the monthly mean flow and the monthly maximum water temperature for both July and August to show the general influence of flows between years and the influence of solar radiation between months (Figure 5-10). Below the Mouth of McKay Creek, managers can only influence channel and riparian features and flows. Providing additional flows and restoring channel and riparian features would improve the suitability of the Umatilla River below the mouth of McKay Creek to produce salmonids.

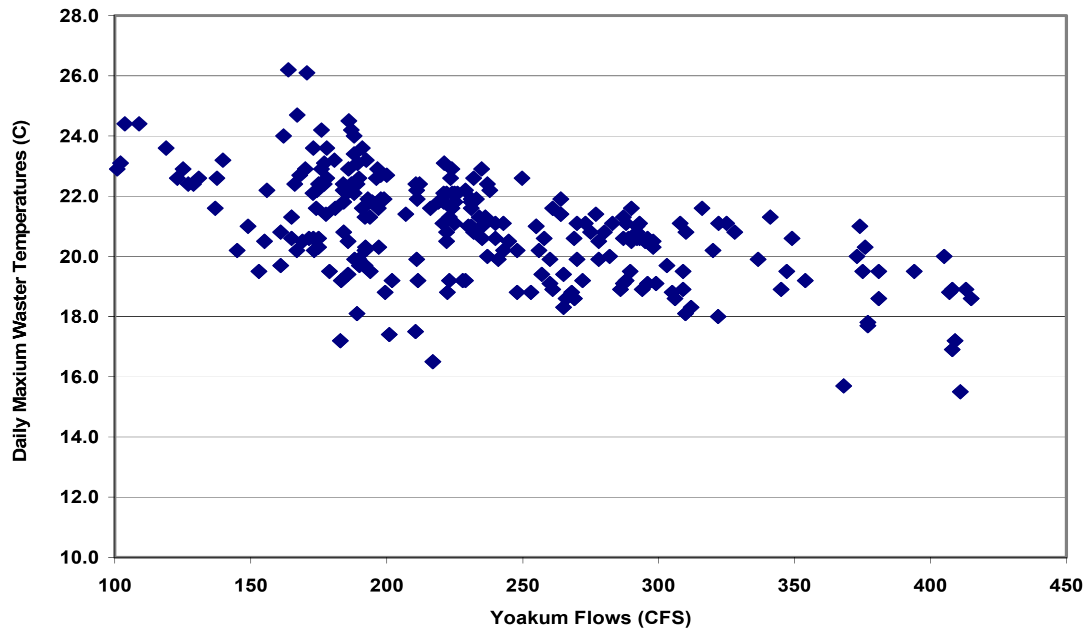

Figure 5-9 Maximum daily water temperatures (C) and daily mean flows (BOR data) in the Umatilla River at Yoakum (RM 37) during July and August 1999-2002.

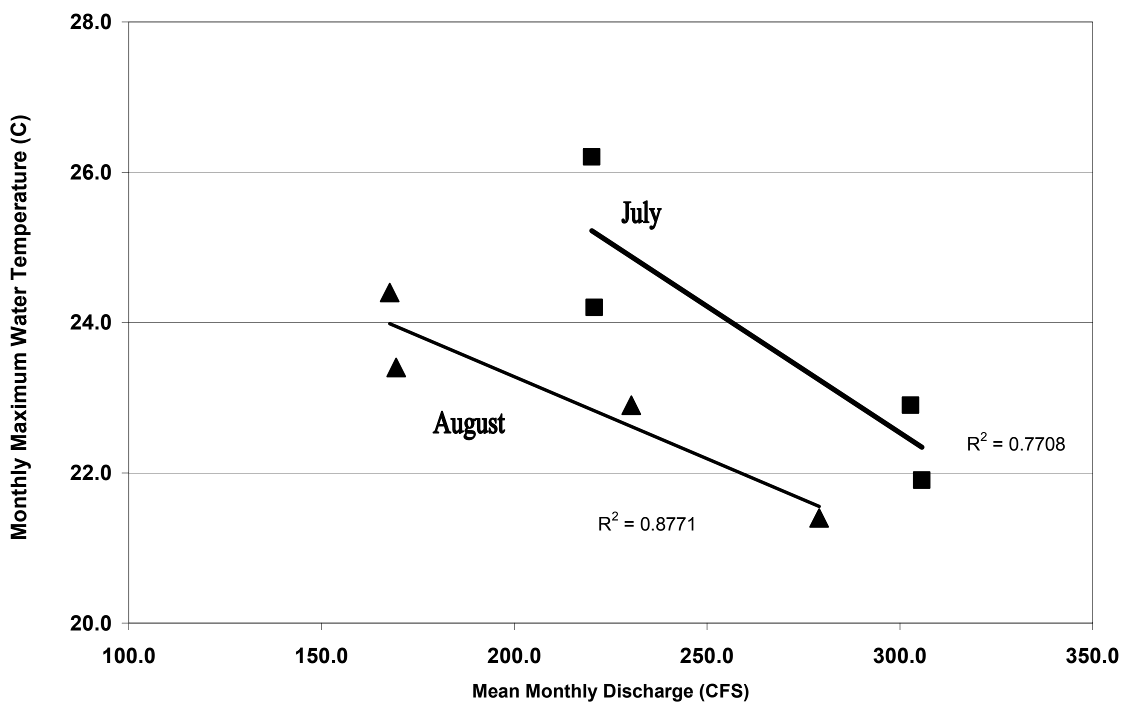

Figure 5-10 Monthly maximum water temperatures and mean monthly flows in the Umatilla River at Yoakum (RM 37) during July and August 1999-2002.

Problems with the Water Quality Standards Based on Seven Day Moving Averages
We examined the utility of the seven day rolling averages currently used as a regional standard for water quality monitoring. While this standard measurement can be useful, it is a poor monitoring tool if not used in conjunction with an absolute maximum water temperature standard. Rolling averages can mask acute lethal thermal events. A single lethal thermal event can significantly impact salmon populations and damage aquatic ecosystems. Water temperature standards should provide protection for salmonids and other aquatic organisms. The following discussion provides some background information, empirical data, and several hypothetical scenarios based on real data to illustrate how rolling averages can mask critical information.

In most naturally flowing river systems, water temperature profiles are generally consistent from day to day because flow and other related factors are fairly regular. Weather and the stream discharge affect water temperature profiles but a standard daily pattern is usually repeated with moderate variation from day to day. In general, rivers are coolest in the morning, warm throughout the day, reach a maximum temperature in the afternoon, and begin to cool again during the evening. For naturally flowing systems, a seven-day rolling average of daily maximum temperatures would be an adequate monitoring and enforcement tool for most situations.

River systems with diversions and impoundments can experience acute thermal events that would be masked by rolling averages. General management, repairs and other activities at irrigation diversions and dams occasionally cause a substantial reduction in flow for one or more days. Short-term thermal spikes can also occur when hot water is released into streams from industrial cooling systems. Theoretically, industrial plant managers could schedule thermal discharges that would kill fish and still comply with standards based on rolling averages. The loophole created by rolling averages creates a significant risk to salmonids and aquatic ecosystems.

A temperature standard that includes a daily maximum would discourage activities that could lead to short-term deleterious or lethal effects undetectable by rolling averages. Enforcement could not occur if the standards were based on rolling averages even if regulators knew of a lethal thermal event. Water quality monitoring and enforcement standards are important to Tribal interests because many streams in the ceded lands and the usual and accustomed areas support salmonids. Many of these streams are also managed with diversions or other flow control structures.

Salmonids can tolerate warm water temperatures for short time periods if the maximum temperatures are not too high. However, thermal events can be very stressful and lethal to salmonids (Bret 1952 and Black 1953). Monitoring and reporting is the only way to document and ultimately prevent management induced lethal or stressful thermal events.

To illustrate the problem of rolling averages, we need to work through several steps. First, examine the inverse relationship between summer water temperature and discharge plotted in Figure 5-11. Note how daily maximum water temperatures increased and then dropped again in early July as flows ranged from 380 to 260 and then back up to 315 CFS. The water temperature data is from the Umatilla River at Barnhart (RM 42.5) and was collected by CTUIR with a certified Vemco thermograph that recorded water temperatures each hour during July and August 2000. The flow data is from the USGS gage at Yoakum (RM 37) and is a reasonable estimate for discharge at Barnhart because there are no significant tributaries or diversions between RM 42.5 and 37.

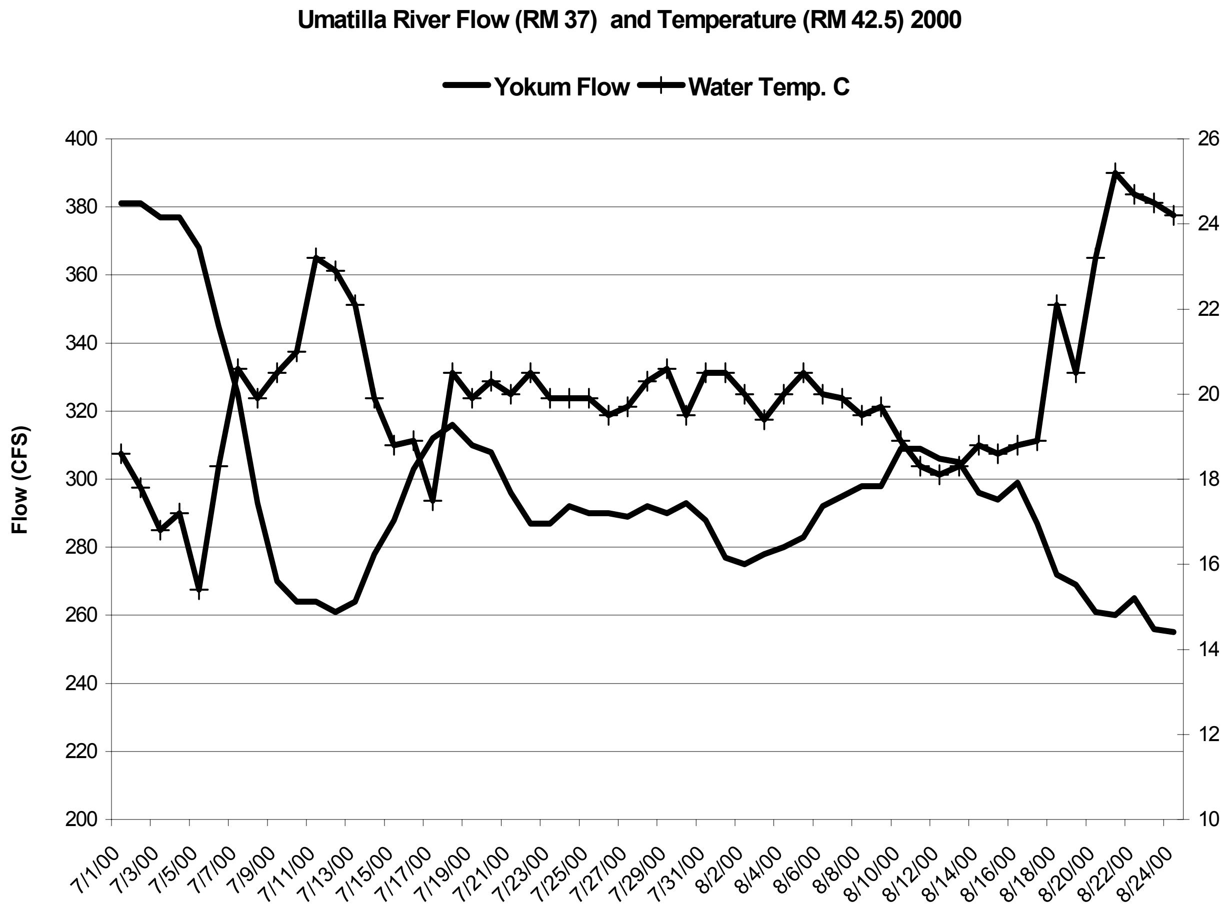

Figure 5-11. Maximum Daily Water temperatures at RM 42.5 and flows at RM 37, Umatilla River, 2000.

The second step in the examination of rolling averages involves exploring what would happen to daily maximum temperatures if flows were reduced from 290 to 50 CFS in the Umatilla River. A flow reduction to 50 CFS at Barnhart is a reasonable scenario if McKay Dam were closed. The empirical data in Figure 5-11 shows that the maximum daily water temperatures rose from 18.8 to 24.2 ^{o}C when flows were reduced from 299 CFS on August 16 to 260 CFS by August 24, 2000 (daily minimum temperatures rose from 16.6 to 21.1^{o} C).

Perhaps the best estimate of maximum July water temperatures in the Umatilla River at Barnhart (RM 42.5) at 50 CFS can be derived by examining summer flows and water temperatures at McKenna Station (RM 50.8) where flows are often near 50 CFS during July. McKenna Station is just upstream from the mouth of McKay Creek (RM 50.6). The USGS gage on the Umatilla River at the west reservation boundary (RM 58.3) recorded 50 CFS on July 29, 2000. Water temperatures at McKenna Station (RM 50.8) ranged from 21.6 ^{o}C at 7:09 AM to 29.8 ^{o}C at 5:09 PM (July 29, 2000, CTUIR, Vemco Thermograph). The USGS gage at RM 58.3 provides a good estimate for flows at RM 50.8 because there are no significant tributary contributions or irrigation diversions between the two sites during July. Based on the above data, it is highly likely that maximum water temperatures in the Umatilla River at Barnhart would be near 29 ^{o}C in July if flows were near 50 CFS.

The final step in exploring the ambiguity of rolling averages involves the comparison of daily maximum water temperatures against the seven-day rolling averages during a hypothetical scenario where flows are reduced to 50 CFS and maximum daily temperatures reach 29 ^{o}C. I used the empirical data from the Umatilla River at Barnhart (Figure 5-11) from July 20 through August 5 (Table 5-6). I then substituted actual Umatilla River water temperature data collected at the KcKenna Station site for July 29 and 30, 2000 (at 50 CFS and 29 ^{o}C, Tables 5-7 and 5-8). The McKenna Station site is appropriate because it is just above the mouth of McKay Creek. It is highly likely that water temperatures in the Umatilla River below the mouth of McKay Creek would be similar to the McKenna Station site if McKay Creek was dewatered. Table 5-6 shows actual data from the Umatilla River and actual rolling averages. Tables 5-7 and 5-8 show what the rolling averages would be if water temperatures for July 29 and 30 were changed to simulate a low flow event that would occur if McKay Dam was closed for one or two days. There was only a one or two-degree change in the rolling averages even though a lethal thermal event occurred. The rolling average masked the lethal event. The rolling averages in Tables 5-7 and 5-8 did not exceed 22.7 ^{o}C. Salmonids can survive 22.7 ^{o}C for short periods of time. The simulated daily maximum was actually 29 ^{o}C. Many salmonids would have died under this scenario. It is clear that the seven-day rolling average is a poor tool for monitoring and enforcing water temperature standards because it can mask acute lethal thermal events.

Table 5-6. The seven-day-rolling averages of maximum water temperatures using empirical data collected in the Umatilla River at RM 42.5, Barnhart, July and August 2000.

Date (2000)	Flow	Maximum Daily Temperatures	Seven-Day-Rolling Average of Maximum Temperatures
July 20	308	20.3	
July 21	296	20.0	
July 22	287	20.5	
July 23	287	19.9	20.0
July 24	292	19.9	19.9
July 25	290	19.9	20.0
July 26	290	19.5	20.0
July 27	289	19.7	19.9
July 28	292	20.3	20.0
July 29	290	20.6	20.1
July 30	293	19.5	20.2
July 31	288	20.5	20.1
Aug 1	277	20.5	20.1
Aug 2	275	20.0	20.1
Aug 3	278	19.4	
Aug 4	280	20.0	
Aug 5	283	20.5	

Table 5-7 The seven-day-rolling averages of maximum water temperatures for the Umatilla River at RM 42.5 (Barnhart) based on data from Table 1 with alterations to flow and water temperature data for July 29 to simulate the closing of McKay Dam for one day.

Date (2000)	Flow	Maximum Daily Temperatures	Seven-Day-Rolling Average of Maximum Temperatures
July 20	308	20.3	
July 21	296	20.0	
July 22	287	20.5	
July 23	287	19.9	20.0
July 24	292	19.9	19.9
July 25	290	19.9	20.0
July 26	290	19.5	21.2
July 27	289	19.7	21.1
July 28	292	20.3	21.2
July 29	50	29.0	21.3
July 30	293	19.5	21.4
July 31	288	20.5	21.3
Aug 1	277	20.5	21.3
Aug 2	275	20.0	20.1
Aug 3	278	19.4	
Aug 4	280	20.0	

Table 5-8 The seven-day-rolling averages of maximum water temperatures for the Umatilla River at RM 42.5 (Barnhart) using data from Table 1 with alterations to flow and water temperature data for July 29 and 30 to simulate the closing of McKay Dam for two days.

Date (2000)	Flow	Maximum Daily Temperatures	Seven-Day Rolling Average of Maximum Temperatures
July 20	308	20.3	
July 21	296	20.0	
July 22	287	20.5	
July 23	287	19.9	20.0
July 24	292	19.9	19.9
July 25	290	19.9	20.0
July 26	290	19.5	21.2
July 27	289	19.7	22.5
July 28	292	20.3	22.6
July 29	50	29.0	22.6
July 30	50	29.0	22.7
July 31	288	20.5	22.7
Aug 1	277	20.5	22.6
Aug 2	275	20.0	21.4
Aug 3	278	19.4	
Aug 4	280	20.0	
Aug 5	283	20.5	

Recommendations

We recommend that stream reaches above and inclusive of spring Chinook spawning areas receive additional habitat restoration efforts designed specifically to reduce summer maximum daily water temperatures. We recommend that state and national water temperature monitoring standards include daily maximum temperatures standards. We also recommend that forest, agriculture and livestock management practices include basin-wide stream and riparian protection and rehabilitation actions. The need for healthy watersheds and riparian habitats for salmonid bearing streams has been well established (Waters 1995, Stouder et al. 1994, Stroud 1992, Meehan 1991). Quality uplands and stream habitat can produce natural salmonids in abundance. Land use practices and riparian vegetation have dramatic influences on water temperatures and water quality (Brown and Krygier 1970, Brown 1983, Wang et al. 1997, Abt et al. 1992). We estimate that many streams currently providing marginal salmonid habitat could be improved and provide additional salmonid rearing habitat. For example Shaw and Sexton (2003) documented reduced water temperatures in a habitat restoration project reach of Wildhorse Creek, a tributary that converges with the Umatilla River at RM 55 (Figure 5-12). In contrast, they did not observe improvement in water temperatures in unprotected reaches above and below the project.

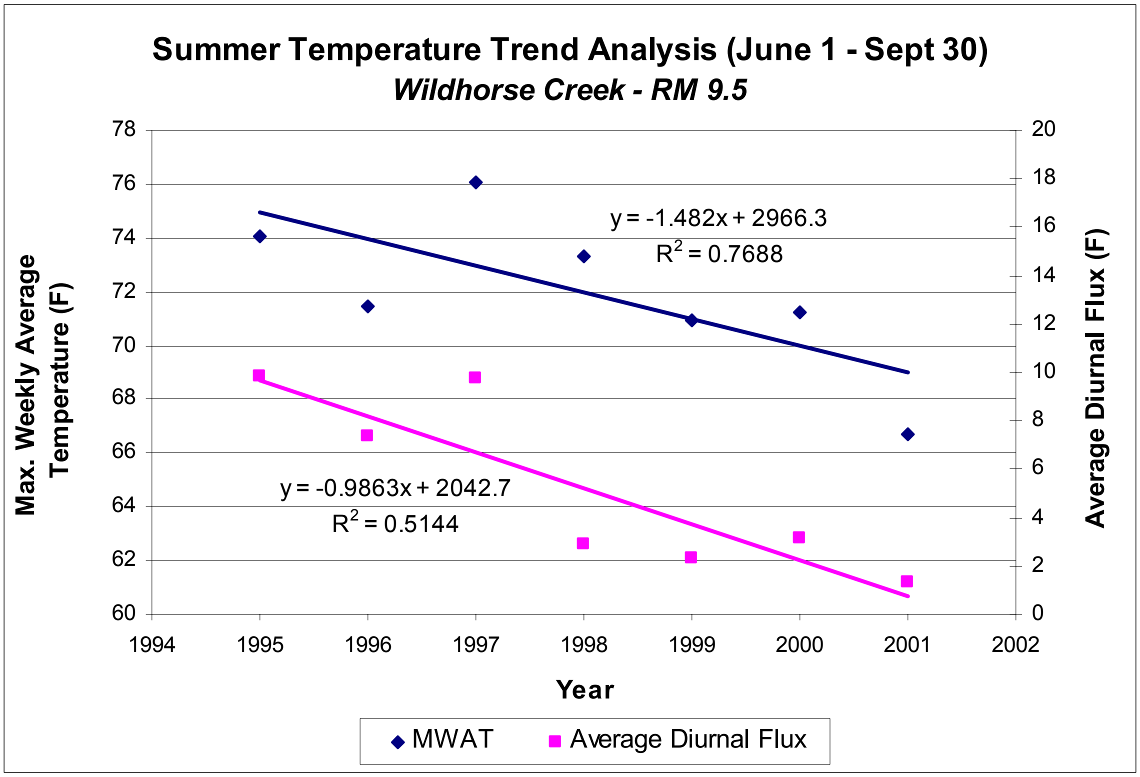

Figure 5-12 Changes in maximum weekly average temperatures and average diurnal flux in Wildhorse Creek project area at RM 9.5 (from Shaw and Sexton 2003).

Meanders and other features that optimize connectivity and interchange between instream and hyporheic flows could further improve instream water temperature profiles during the summer and winter in channelized reaches. Hyporheic and bank-storage water has been shown to be closely related to instream flows and can influence instream water temperatures (Mertes 1997, Fraser and Williams 1998, London et al. 2001, Hayashi and Rosenberry 2002, Kasahara and Wondzell 2003 and Moore et al. 2003). For example, in McCoy Creek (of the Grande Ronde Basin) water temperatures were an average of 6 °F colder in the restored meandering channel than the channelized stream segment upstream (Childs 1999). Water temperatures measured with a hand held thermometer were up to 10 °F colder in the pools and backwater habitats of the new channel in comparison to the channelized reach upstream. Childs (1999) speculates that restoring the stream back to the meandering channel enhanced the interchange between the hyporheic and in-stream waters and reduced the overall stream temperatures. In this situation, a change in total solar energy into the stream was probably not a significant factor because historic overgrazing along both the original and channelized reaches left little vegetation other than short grasses. We expect further moderation in water temperatures through riparian restoration and recovery.

Much of the mainstem Umatilla River and many of the tributaries have been channelized. Considerable improvement in salmonid habitat could be gained by naturalizing channels throughout the basin during the next 50 years.

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CHAPTER SIX: INTERAGENCY COORDINATION AND PLANNING

THE UMATILLA BASIN NATURAL PRODUCTION MONITORING AND EVALUATION PROJECT

PROGRESS REPORT
1999-2002

Prepared By

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September 30, 1998 to December 31, 2002
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September 2003

INTRODUCTION

The Umatilla Basin Natural Production Monitoring and Evaluation Project (UBNPME) was funded by Bonneville Power Administration (BPA) as directed by section 4(h) of the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (P. L. 96-501). This project is in accordance with and pursuant to measures 4.2A, 4.3C.1, 7.1A.2, 7.1C.3, 7.1C.4 and 7.1D.2 of the Northwest Power Planning Council's (NPPC) Columbia River Basin Fish and Wildlife Program (NPPC 1994). Interagency coordination and planning processes, and related activities, were conducted through the UBNPME project under Objectives 7 in the 1999, 2001 and 2002 statements of work and Objectives 8 and 9 in the 2002 statement of work. Project reports and data are available at www.umatilla.nsn.us.

Objective and Tasks
Objective G, Objective 7 in the 2001 and 2002 statements of work. Coordinate and cooperate with the regulatory and management entities involved with Umatilla Basin salmonid recovery and management. Complete the various processes, proposals, permit applications and permit reports as required by the various funding, management and regulatory agencies.

Task G.1
Complete the necessary permit applications and proposals. Attend the necessary coordination, planning and consultation meetings. Improve and update the monitoring and evaluation strategies and plans for Umatilla Basin salmonid restoration and management.

Objective H, Objective 7 in the 1999 statement of work. Collect baseline genetic data from Umatilla River endemic summer steelhead.

Task H.1
Collect tissue samples for genetic analysis from adult and juvenile summer steelhead from a variety of locations in the Umatilla River Basins.

Task H.2
Process the genetic samples according to standard protocols through contract with CRITFC geneticists at the University of Idaho's laboratory in Hagerman Idaho.

Task H.3.
Analyze interpret and summarize genetics data in a final report.

In 1999, this objective included genetic samples from summer steelhead from both the Umatilla and Walla Walla River Basins. The entire genetics report, including data from Umatilla River summer steelhead, is reported in the 1999-2002 Walla Walla Project Report, Chapter 5. The abstract from that report is provided below (Narum et al. 2003).

"The life history of Oncorhynchus mykiss is complex with the species containing both non-migrating resident and anadromous individuals existing in sympatry in numerous river systems. The extent of gene flow between the two life forms has been shown to be variable depending on the location. Sample collections of both anadromous steelhead and resident O. mykiss life forms were collected from the Walla Walla River and Columbia River basin with the intent of determining both the geographic genetic structure and the level of gene flow between the two life forms. Collections consisted of four types: adult steelhead, adult resident rainbow trout, non-indigenous resident rainbow trout stocked into the system, and mixed O. mykiss collections comprised of undetermined juvenile/adult resident rainbow and juvenile steelhead. Significant genetic population structure of resident rainbow trout was detected in decreasing intensity at three levels, out-of-basin stocks versus Walla Walla River stock (high divergence), Touchet River tributaries versus Walla Walla mainstem tributaries (intermediate divergence), and individual tributary pairwise tests (low divergence). However, populations of adult steelhead had overall low genetic divergence, particularly between Umatilla River and Snake River steelhead. While a genetic distance dendogram suggests geographic genetic structure between the two major segments of the Walla Walla

River, low F_{ST} values indicate migration among resident populations may be occurring. Tests of Hardy Weinberg equilibrium indicate steelhead reference populations are in equilibrium, but many of the mixed populations are out of equilibrium. Populations out of equilibrium appear to be mixtures of progeny from assortatively mating steelhead and resident rainbow trout, but the W. Patit Creek collection is likely out of equilibrium due to the presence of stocked out-of-basin rainbow trout. F_{ST} tests reveal slight genetic divergence between sympatric reference populations of adult steelhead and resident rainbow trout. While F_{ST} was divergent between life forms, the greatest genetic divergence was observed in W. Patit Creek containing out-of-basin resident rainbow trout. This indicates that while statistically significant genetic divergence is observed between sympatric life forms, ancestry and gene flow between life forms is more recent than resident rainbow trout from an out-of-basin stock".

Objective I, Objective 8 in the 2002 statement of work. Develop a research, monitoring and evaluation plan for fisheries of the Umatilla River Basin.

Task I.1
Work with ODFW to write a synthesis of results of past RM&E efforts in the Umatilla River Basin related to salmonid restoration and recovery.

Task I.2
Coordinate with ODFW on a draft RM&E plan for salmonid natural production monitoring in the Umatilla Basin. Develop a comprehensive RM&E plan outline.

Task I.3
Submit draft natural production RM&E plan for review by fisheries managers, funding agencies and regulatory authorities.

Task I.4 Update RM&E priorities for salmonid management, restoration and recovery efforts in the Umatilla River Basin based on input and review from BPA, NWPPC, ODFW, CTUIR, USFWS, NMFS, USFS, CRITFC, CBFWA, ISRP, ODEQ and UMMEOC.

Task I.5 Finalize natural production RM&E plan and combine with the other RM&E sections (i.e. hatchery and habitat RM&E sections) to complete final comprehensive RM&E plan for the Umatilla River Basin.

Objective J, Objective 9 in the 2002 statement of work. Summarize and report data and findings and post data and reports on a website.

Task J.1
Determine the most effective venue(s) and medium(s) to make annual reports, databases, and other significant documents available online to the public and the fisheries community in general. Examine Stream Net, the tribal website and other agency websites. Select the best options and obtain required software and training needed to post documents on the selected website(s).

Task J.2
Complete the quarterly reports and the annual progress report.

Task J.3
Make annual reports and data bases available online with Stream Net and/or a tribal website.

INTERAGENCY COORDINATION, JOINT PROJECTS AND PROCESS

This section summarizes Umatilla Basin Natural Production Monitoring and Evaluation Project (UBNPME) activities related to interagency coordination and planning. The format of this chapter deviates from the other chapters because Objective G is not a monitoring and evaluation objective. Therefore it does not have distinct methods, results and discussion sections. The following synopsis is not comprehensive but it does describe the primary activities conducted under Objective G. Below are brief summaries of our involvement with interagency coordination, joint projects and processes.

Bull Trout Recovery Process

Project personnel were involved in the development and review of bull trout recovery plans for the Umatilla Basin (USFWS 2002 and http://pacific.fws.gov/bulltrout).

Westland/Ramos Reach of the Umatilla River Engineering Feasibility Study and Preliminary Channel Design, Harza Engineering Company

Project staff reviewed the proposal and provided comments to senior staff regarding fisheries issues.

Umatilla Basin Management, Monitoring and Evaluation Oversight Committee

The committee was developed to assist with the coordination of fisheries management and RM&E activities. It also provided an avenue for management to keep abreast of M&E results. The committee's functions included:

1) Coordinate RM&E activities such as
   - Fish distribution, abundance, life histories and age and growth
   - Spawning surveys
   - Smolt out-migration
   - Habitat inventories-surveys-monitoring
   - Water temperature monitoring
   - Flow monitoring, instream flow evaluations
   - Lamprey, freshwater mollusk inventories
2) Coordinate and plan fisheries management actions
   - Harvest
   - Habitat restoration and alteration projects
   - Steelhead and salmon hatchery releases
   - Chinook Hatchery Master Plan
   - Bull trout management

UMMEOC participants included the following personnel from state, federal and tribal organizations.

BPA: Jonathan McCloud, Roy Beaty, Peter Lofy, Jay Marcotte
CTUIR: Gary James, Carl Scheeler, Brain Zimmerman, Todd Shaw, Craig Contor, Gerry Rowan
NMFS: Rob Jones
ODFW: Tim Bailey, Bill Duke, Rich Carmichael, Dale Chess, Tara White, Paul Sankovich, Scott Patterson, et al.
USFS: John Sanchez
USFWS: Michelle Eames

Umatilla Basin Watershed Council

CTUIR M&E staff attend various Watershed Council meetings.

Umatilla River Phase III Flow Augmentation Planning
This text outlines fish related flow management concepts for the benefit of salmonid rearing, fish migration and channel maintenance flows.

In the context of Phase III, the Fisheries Program of the Department of Natural Resources of the Umatilla Indian Reservation has been requested to quantify the flows needed to maintain and enhance salmonids and lamprey in the Umatilla Basin. Salmonids in the Umatilla River Basin include salmon, resident rainbow trout, anadromous rainbow trout (steelhead), bull trout and mountain whitefish. Unfortunately, we cannot quantify the best compromise between fish and other flow needs at this time. From a fisheries management perspective, the best use of the water would be to manage all of it for the production of fish. However, managing a limited resource for the best interest of a diverse group of individuals will likely require other choices. The difficulty of quantifying fish-flows, lies in the variability of the hydrological system and stream habitats of the Umatilla Basin. At this time, we cannot provide the specific flows that make a perfect compromise between the needs of fish and the other water users. However, we can provide general guidelines and an understanding of fish flow management needs in the Umatilla River Basin. Providing flows, water quality, and habitat diversity that will be suitable for salmonids, will also meet the requirements of most other biological beneficial uses because salmonids are sensitive indicator species.

Goals of Fish-flows

The goal of fisheries management is to perpetuate salmonids and lamprey at high enough rates to allow for natural production and sustainable harvest. Salmonids, lamprey and fish-food organisms need perpetual cool clean water. Salmonids have the highest survival, growth and reproductive success in complex quality habitat with abundant and diverse fish-food organisms. Flow management for fisheries values is based on providing, continual flows (at suitable temperatures and quality) to allow for the development of complex and diverse aquatic communities. An aquatic community is all the biological components of a section of stream or lake such as insects, fish, algae, plants, microbes, diatoms etc. The aquatic community in a backwater pool is different than in a riffle or in a pool. When an aquatic system has many different communities, it is described as being complex and diverse. When there are many different species and types of organisms in a community, it is described as having a high species richness. The most productive systems are those with high habitat diversity and high species richness. We suggest that the best management strategy will include monitoring and the flexibility to adapt to changing conditions. Adaptive management will require considerable coordination among the various managers when conditions deviate outside expected norms. In terms of flow management, there are three major factors necessary to achieve high a diversity of species-rich aquatic communities:

1) Sufficient flows (rearing flows) to provide adequate rearing space and suitable stream temperatures perpetually through all seasons;
2) Seasonal periods of higher flows (migration flows) that assist juvenile salmonids and lamprey to the ocean and assist adults migrating upstream over falls and rapids as they return to spawn (and recharge ground water), and
3) Peak flow events (flushing flows) to maintain channel features, flush sediment and recharge the ground water.

Rearing Flows

Flow management for fish should include contingencies for drought and avoid even short-term losses of flow. The affect of a lethal event in a stream is analogous to the effect of a fire in terrestrial habitat. With stream organisms, the damage of one lethal event can be long-term although the evidence is not easy seen from a terrestrial perspective. It is a mistake to think that once water is back in the channel that all is well. Many stream organisms and communities cannot withstand even brief lethal events. It is true that the some species such as algae and the larvae of biting flies etc. will survive and recolonize quickly, but the most productive fish producing parts of the stream community take longer to rebound. Many of the important fish-food organisms such as caddis flies, stoneflies and mayflies are sensitive to high temperatures, sediment and dewatering. Some of the most important fish-food organisms also have multiyear life cycles so it takes more time to recolonize the habitat than. This is also true for steelhead because their lifecycle includes multiple years in fresh and saltwater. The success of adult steelhead returns from the ocean is directly tied to the survival, growth and well being of fish in freshwater. Without abundant adults returning to spawn, the production of juveniles is reduced. A lethal event in 1990 could affect juvenile production in 1990, 1991, 1992 and the number of returning adults in 1994 through 1998 and the production of their progeny into the next decade (although compensatory and other factors can compensate). A single lethal could affect the number of adult returns for more than a decade. If lethal events such as high temperatures or channel dewatering occur even once each decade, the steelhead population and aquatic fish-food organisms could be in a constant state of rebuilding and never achieve optimum productivity. Repeated disturbance also reduces stream organism diversity and keeps more of the primary production in forms less usable by salmonids (i.e. algae instead of trout flies).

Flows released from McKay Reservoir for irrigation uses in the Echo area often provide adequate flows and temperatures for the rearing of salmon, steelhead and trout from the mouth of McKay Creek to Westland Dam. However, these flows are subject to irrigation needs. Phase III should include plans to augment these flows early in the summer before irrigation flows are released from McKay. These early summer augmentation flows are critical to the survival of fall Chinook[4] fry, coho fry and any steelhead or trout utilizing the lower river. Rearing flows are also needed in late summer after irrigation flows are reduced. Otherwise the river heats up and lethal conditions occur within one or two days. The exact amount of water to be released could be determined by flow/temperature modeling and real time monitoring. Riparian and flood plain rehabilitation could reduce flow needs gradually through time. In this way "fish water" could be conserved and utilized most efficiently. It is important to manage the "fish water" such that the cool waters of McKay Reservoir (hypolimnion) are not completely used before temperatures cool down in the fall (monitor volume of the hypolimnion). Otherwise warm water would be released from McKay and lethal conditions could result even with higher flows.

The management of "fish water" during drought years is critical. During water shortages, it is better to maintain lower flows and provide adequate temperatures for a shorter section of river. The river heats up as it flows downstream. The lower the flows, the faster it heats up and the shorter the reach is that has suitable temperatures for salmonids. Providing higher flows and adequate temperatures for only part of the summer damages the entire aquatic community in the end. In a drought year, it is much better to maintain a shorter section all year than maintain a longer reach for only part of the year.

Phase III planning should consider extending suitable flows in the Umatilla River (year around) from the mouth of McKay Creek to the mouth at Umatilla. The benefit would be the production of fall Chinook, coho, steelhead and trout in additional 26 river miles below Westland. The exact flow needed could be estimated by flow/temperature modeling with existing and rehabilitated riparian areas (probably in the 250 cfs range). The exact number of additional salmon and steelhead that would be reared is difficult to predict. Electrofishing surveys during the summer at low flows (45-50 cfs) estimated that there were about 9,000-10,000 juvenile salmon and steelhead per mile in the Umatilla River above the mouth of Meacham Creek in 1986 (RM 80-89, Contor et al. 1998). The Umatilla River below Westland would be much larger (250 cfs) than above RM 80 and might produce more fish/mile (if temperatures and other habitat features were suitable). At 10,000 fish/mile, the 26-mile reach would rear about 260,000 fish. The actual production potential of the reach would not be known until sampling could verify populations after full seeding was combined with suitable habitat features in addition to suitable flows and water temperatures .

Migration Flows

Migration flows are necessary for adults to find the mouth of the Umatilla River (attraction flows) and to migrate up through the channel and rocky reaches (passage flows). Migration flows also assist juvenile salmon smolts moving out of the system and into the Columbia. In general, the higher the flow the better the attraction, migration and survival (up to some undetermined level from ¾ bank full to bank full). Migration flows include moderately higher flows that persist throughout a migration season. Currently flows are augmented for spring Chinook adult passage through the middle of June. Juvenile fall Chinook migrate through the lower Umatilla into the middle of July when water temperatures and flows are frequently not suitable. Water is also released in the fall to assist the upstream migration of adult fall Chinook and coho salmon, and summer steelhead.

[4] In this report Chinook is capitalized in recognition of the Chinook Tribe. While the American Fisheries Society does not capitalize Chinook, they do capitalize Apache trout, Gila trout, Paiute sculpin and Umatilla dace. These fish all bear the names of tribes and are capitalized. We also capitalize Chinook salmon to be consistent with English language dictionaries and standard conventions

Flushing Flows

Flow management for fish should also include shorter periods of higher flows. High flows are important in the formation of pools and other channel maintenance functions that create stream habitat diversity required by salmonids. The flushing flows are different from migration flows in that they involve short but high peaks in flow. The goals of the high flow events are to form pools, create backwater areas, recruit large woody debris, flush fine sediment and recharge the ground water table.

Hydrologists report that channel maintenance flows need to occur about every other year and should be near the bank full stage. Flushing flows do not include flood flows that cause extensive damage, completely move the channel and take out large sections of riparian vegetation. Our observations indicate that high flows are usually not the problem. The problem appears to come from land use practices that not only increase runoff from the uplands but affect channel stability. Land use on the flood plain often reduces the ability of the flood plain to spread the flood flows out and disperse the erosive power of the stream. Straightening the channel and trying to contain flood flows within the channel increases stream power (velocity times the mass of the water = stream power) and greatly enhances the erosion damage of a flood.

Streams with stable banks and developed riparian vegetation tend to form narrower and deeper channels. Erosive power of flood waters are turned from the banks and diverted to create deep holes and undercut banks. Thick riparian vegetation slows over-bank flows and reduces water velocity and stream power. These lower velocity flows spread out over the flood plane and drop silts and organic debris that build and enhance flood plain soils. Flood waters seep into the flood plain during over-the-bank flow events. Later, the water stored in the flood plain slowly trickles back into the river along the bank and stream bottom. This bank-storage can be an important component of the summer base-flow and can reduce stream temperatures during the summer.

The Umatilla River above the mouth of McKay Creek

The river above the mouth of McKay Creek (RM 50.5 to 79) is very different than below the mouth (RM 0.0 to 50.5). This reach does not have the benefit cold water releases from a reservoir during the summer. Natural flows in the Umatilla (RM 50.5-79) are too low and warm for significant salmonid production during parts of June and September and all of July and August. The fish habitat related problems of this reach are complex but can be greatly oversimplified into several main factors. These factors include flow, temperature, channel morphology, sediment, and riparian condition. The complex part of these factors is how they all interact.

To produce salmonids at reasonable densities in the Umatilla (RM 50.5 to 79), in its current condition, more flows and cooler waters is needed than naturally occurs during June through September. Flow is not the only consideration. For example, small streams with much less flow can produce salmonids because channel configuration, abundant pools, heavy shade, undercut banks and other factors provide the necessary cool water temperatures and physical habitat.

Considerations for the Management of McKay Reservoir and McKay Creek

McKay Reservoir

Cold water released from McKay Reservoir for irrigation needs during the summer months benefit fish. During drought years, McKay Reservoir does not have enough cold water in the hypolimnion. The cold water is used up before the end of the hot season. Releasing warm water in to the Umatilla could create lethal conditions below the Mouth of McKay and affect fish production in that reach for a number of years. For McKay reservoir to be used most effectively it needs more storage space and a larger hypolimnion that could be carried-over for drought years. In addition, it would be best if water could be released from multiple levels to optimize the conservation of the cold water and optimize river temperatures (and fish growth). This would require some modeling and real time monitoring throughout the lower river. Changing the existing irrigation storage over to fish storage would probably not make much difference in the river above Westland Dam. However, if the water stayed cool and were allowed to flow all the way to the Columbia it would greatly enhance the salmonid production capacity of the Basin.

McKay Creek

During the second week of November, 2000, the Bureau of Reclamation (BOR) ramped down flows below McKay Creek Dam from about 150 to 10 cubic feet per second (cfs) over a four day period to reduce the chance of stranding fish in lower McKay Creek (RM 0-6, Figure 6-1). Since that time at least 10 cfs (approximately) has been maintained below McKay Dam to benefit salmonids and the aquatic ecosystem (9.17 to 11.15 cfs, BOR Hydromet data). During previous years, flow management did not include provisions for salmonids in lower McKay Creek. Fortunately, no salvage operations have been needed with the new flows scenario. It was apparent that the shallow ground water in the flood plain fed McKay Creek at diminishing levels for the first week or two until a new equilibrium was reached. In the future, additional flows, cover, pools and habitat complexity, and less fine sediment could greatly enhance the fisheries potential of lower McKay Creek.

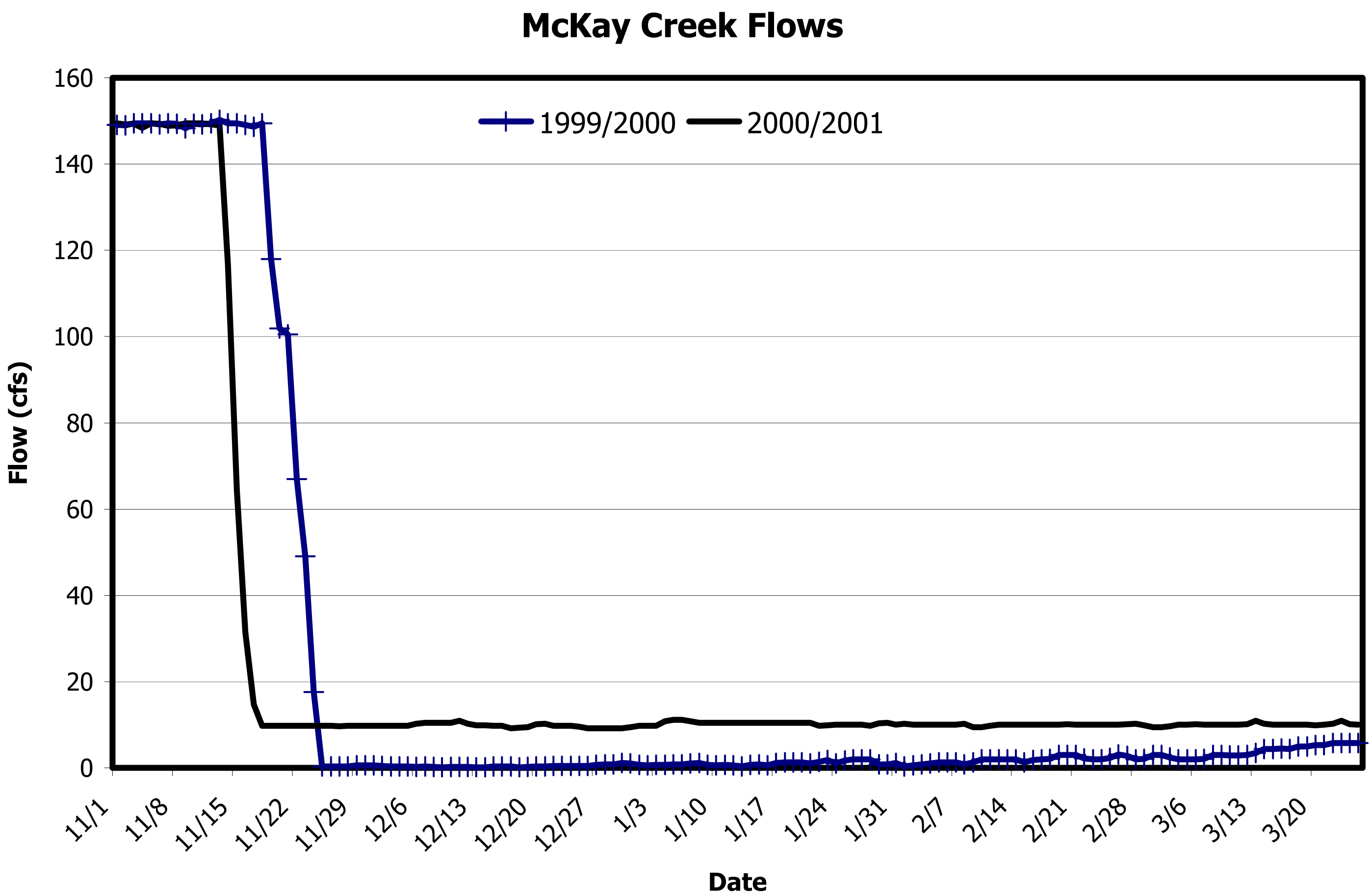

Figure 6-1, McKay Creek flows measured below McKay Dam and reported on the Bureau of Reclamation's Hydromet web site (November 11 to March 27 1999-2000 and 2000-2001).

Tribal members report that spring Chinook salmon and summer steelhead were present in McKay Creek in high abundance prior to the construction of McKay Dam which began in 1922 and was completed in 1926 (Bill Quaempts, CTUIR tribal member, March 29, 2001, personal communication). The earthen dam is 165 feet high, 2700 feet long and creates a reservoir with 65,534 acre-feet of usable storage (BOR Hydromet). The usable storage is for flood control, irrigation and fish flows. From 1926 to 1999, lower McKay Creek was left dry during the winter to fill the reservoir. It has also been dry during the early summer and fall depending on the demand for water for irrigation and/or fish passage flows. Depending on fill curves, water may be released occasionally from McKay Dam during the winter and spring for flood control. Guidelines established for how fast McKay Reservoir can fill (fill curves) are based on the date, remaining storage volume, snow pack, watershed size and other factors. Fill curves ensure that storage space in the reservoir is reserved to catch flood flows that could damage property and threaten lives of individuals living within the flood plain. Water is released from McKay Dam when runoff from upstream is filling the reservoir faster than prescribed by the fill curve.

A fish weir was constructed during the winter of 1995-1996 at the mouth of McKay Creek to prevent adult salmon and steelhead from straying out of the Umatilla River and into McKay Creek (Torretta, 2000). In the summer, cool water is released from the bottom of McKay Reservoir and is much more attractive to salmonids than the warmer Umatilla water (Table 6-1). The weir prevented most adults from straying into McKay Creek and being killed later when the stream was dewatered. Now that McKay Creek has perennial flows, the weir is maintained in order to encourage spawners to move into the headwaters. Occasionally the weir is pushed down by debris and allows some adults to pass upstream. Juvenile salmonids have been frequently collected above the weir and apparently come from upstream or move up between the weir grates and rear in McKay Creek.

Table 6-1. Summary of water temperature (^{o}C) records from McKay Creek and the Umatilla River above and below the mouth of McKay Creek during June, July and August, 1999 (Umatilla above McKay, RM 50.5; Umatilla below McKay, RM 47.2)

1999	McKay Creek RM 6			McKay Creek RM 0.1			Umatilla above McKay			Umatilla below McKay		
Month	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min
June	11.5	8.1	7.1	22.8	10.4	6.8	24.8	16.9	9.4	20	14.4	9.8
July	10.2	9.2	8.3	14.8	10.7	8.3	29.3	21.3	12.9	20.6	14.6	10.1
Aug	13.2	11.2	9.8	17.0	12.6	9.8	29.6	22.3	12.4	21.1	16.0	12.1

Fish Collections in McKay Creek

In 1999, CTUIR conducted salvage operations below McKay Dam and found a large number of salmonids including more than a thousand juvenile steelhead and two bull trout (Table 6-2). During the salvage operations in 1999, lower McKay Creek was dry except for some flow that leaked from the dam near RM 6 and some isolated pools scattered from RM 2 to 5. In the lower ¾ of a mile of McKay Creek, several springs provide approximately 0.5-2 cfs of flow. Because both steelhead and bull trout are listed species under ESA, these findings prompted discussions regarding continuous minimum flows. In the fall of 2000, after the irrigation and "fish-water" releases ended, a minimum flow of 10 cfs was left in the lower McKay Creek to benefit salmonids and the aquatic communities that support salmonids.

Table 6-2. Summaries of catch from CTUIR's salvage operations in McKay Creek, fall 1999, RM 0.1 to 6.

Date	12/7/99	12/8/99	12/9/99	12/13/99	12/14/99	12/21/99	12/22/99	Total
Site Location RM	5.8-6.1	5.8-6.1	5.5-5.7	4.0-4.2	1.9-2.1 & 3.1	0.1-0.3	2.4-2.6	
Natural Coho	250	300	250	250	450	425	375	2300
Natural Steelhead	75	75	125	75	150	350	250	1100
Bull Trout	0	0	1	1	0	0	0	2
Mountain Whitefish	5	20	25	15	160	175	200	600
Adult Salmon	0	0	0	0	8	1	1	10
Total	80	95	151	91	310	525	450	4012

During the summer of 2000, CTUIR crews sampled lower McKay Creek and found juvenile salmonids throughout the reach. Fish were mostly age 0+ coho and steelhead (40-80 mm) with a few age 1+ steelhead and several age 0+ Chinook (probably fall Chinook). Crews sampled at RM 6, 5.5, 2.0, and 0.1 on June 27, July 18 and July 24. Salmonids observed during these surveys were large (for their age) and in good condition indicating lower McKay Creek has the potential to be a productive fishery as commonly occurs below reservoirs.

Umatilla Tribal Fisheries personnel sampled McKay Creek again in November and December, 2000 after flows were reduced to 10 cfs (Table 6-3). Instream flows were very low and some fish were isolated in a few areas but no mortalities were observed. Observations in 2000 contrasted from salvage efforts during December of 1999 where crews salvaged approximately 4000 salmonids from McKay Creek including two bull trout and observed hundreds of mortalities (Table 6-2). In 2000, crews found fewer fish overall and the 10 cfs minimum flow met the immediate objective of providing sufficient flow to avoid fish kills and salvage operations.

Table 6-3. Summary of CTUIR electrofishing catch and PIT tagging data from McKay Creek, fall 2000, RM 0.1 to 5.8.

Tagging Date	Capture, Tagging and Release Site	Capture Method	Number of Wild Fish Tagged			Total Fish PIT Tagged
			Chinook	Steelhead	Coho	
11/28/00	McKay Creek	Electrofishing			23	23
11/30/00	McKay Creek	Electrofishing			109	109
12/1/00	McKay Creek	Electrofishing	1	30	26	57
12/6/00	McKay Creek	Electrofishing		16	77	93
Total Fish Pit Tagged			1	46	235	282

Tribal biologists sampled a 190 x 4 m section (760 m^2) of McKay Creek on March 27, 2001, at RM 1.9 and captured 27 rainbow trout (88 to 327 mm), 5 mountain whitefish (276 to 308mm), and 6 naturally produced juvenile coho salmon (124 to 187 mm). All salmonids were robust and in excellent condition. Sculpin, dace, redside shiners, suckers and pike minnow were also observed in good abundance. Tribal crews sampled a second section (190 x 6 m, 1140 m^2) of McKay Creek on March 30, 2001 at RM 5.9 near the flow gage. Crews captured 40 rainbow trout (84 to 160 mm) and 4 juvenile coho salmon (137 to 146 mm). Fish were in excellent condition but larger resident trout and many of the other non-salmonids observed in the lower site were absent. Sculpin were the only non-salmonid observed at the upper site.

Passage in McKay Creek

Passage conditions at 10 cfs appear unfavorable for both juvenile and adult salmonids. We measured the deepest part of the shallowest riffles on March 8, 2001, at RM 2, 3, 4.3 and 6 to assess conditions for juvenile and adult salmonid migration. Assuming fish used the deepest water available when passing over riffles, they would have only 8 cm of water at RM 2, 10 cm at RM 3 and 4.3 and 15 cm at RM 6 and 0.1. Water was shallower across most of the riffles with depths frequently ranging from 0.5 to 5 cm.

Reducing flows gradually is an important flow management tool, which should allow juveniles a chance to move out of backwater areas and downstream to the Umatilla River in necessary. The observations of only few adult salmon and redds observed in 2000 are probably associated with increased efforts to keep debris from pushing the weir down and allowing adults to pass over the weir.

Ice

Originally there was some concern about the potential for ice buildup in McKay Creek at low flow during the winter associated with the new 10 cfs minimum. To date, lower McKay Creek has not had any icing problems. The weather has not been particularly cold but there was a period in December 2000 when air temperatures were around -15^{o} C for a number of days (Figures 6-2 through 6-4). Mild winter temperatures common to the Pendleton area in conjunction with the relatively warm water discharged from the bottom of McKay Reservoir reduce the likelihood of icing. The influence of springs and the exchange of instream and hyporheic flows further reduce the probability of icing. However, there remains a small chance that large ice dams could form and cause minor flooding of residential areas during unusually cold periods, even though icing has not been a problem in the surrounding areas.

Figure 6-2. McKay Creek (RM 2), Pendleton Community Park, above Kirk Ave. Bridge, 10.2 cfs, 12-12-2000

Figure 6-3. McKay Creek, (RM 4.3), just above Meadow Lane Bridge, 10.2 cfs, 12-12-2000

Figure 6-4. McKay Creek (RM 6), just below McKay Dam, 10.2 cfs, 12-12-2000

Current McKay Creek Flows

Digital images were taken at a number of locations to provide a visual record of flows throughout the lower six miles of McKay Creek. Prior to initiating minimum flows, it was unknown how much of the 10 cfs would contribute to live flow and how much would be lost to hyporheic flow. We considered taking detailed flow measurements at several strategic locations to monitor flow at potential gaining and losing reaches. Limitations in suitable equipment and available personnel precluded detailed flow monitoring. Based on observations to date, instream flows appear to be fairly stable throughout the six mile reach and at the flow gage at RM 5.9 (Figure 6-1). Figures 6-2 through 6-4 show three of the locations where we collected digital images at flows of 10.2 cfs. Figure 6-5 shows McKay Creek at 126 cfs (RM 6) in contrast to 10.2 cfs (Figure 6-4). Figures 6-6 and 6-7 show McKay Creek at 5.3 and 20 cfs respectively for a visual comparison of the same site at 10.2 cfs (Figure 6-2).

Additional Instream Flow

Additional flows in McKay Creek would make it much more suitable for over-wintering salmonids. Securing additional water to maintain a minimum flow in McKay Creek of 15 to 25 cfs should be considered. At 10 cfs fish are concentrated in pools and be subject to increased risks of predation. The shallow riffles make migration difficult. The water surface is very smooth in pools, water depth is often minimal and cover is sparse.

Figure 6-5. McKay Creek (RM 6), just below McKay Dam, 126 cfs, 9-12-2000**.**

Figure 6-6. McKay Creek (RM 2), Pendleton Community Park, just above Kirk Avenue Bridge, 5.3 cfs, 6-7-2000

Figure 6-7. McKay Creek (RM 2), Pendleton Community Park, just above Kirk Avenue Bridge, 20 cfs, 5-9-2000

McKay Creek Instream Habitat Diversity and Structure

Much of the creek has been channelized, the pool to riffle ratio is low, and many of the pools are small and lack structural complexity. Salmonids would benefit from more cover, as well as increased meanders, pools, channel depth and structure. Consideration should be given to the merits of active channel and riparian habitat rehabilitation to offset the effects of past channelization and the removal and alteration of riparian areas.

Sewage Treatment

The discharge from the City of Pendleton's sewage treatment plant enters McKay Creek at RM 0.1. The effluent reportedly meets standards but there is a slight appearance of water quality impact to lower McKay Creek based on observations of surface scum, unsanitary color of the water and the smell of sewage and detergent.

We suggest managers consider upgrading facilities and adding additional treatment systems including a managed wetland complex. Water quality standards should be applied to McKay Creek itself and not rely on the large mixing zone in the Umatilla River. The water quality in the lower section of McKay Creek is important because poor water quality could negatively affect salmonid health and/or their movement into and out of the system.

Fish Weir

We suggest managers consider removing the fish weir at the mouth of McKay Creek once flows and habitat are improved and maintained. Water in McKay Creek is released from the bottom of McKay Reservoir and does not have the large fluctuations in temperature recorded in the Umatilla River (Table 6-1). This tailrace effect provides a cool refuge for juvenile and adult salmonids including bull trout during the hot summer months. In the winter the benefits of the relatively warmer water coming from the bottom of McKay Reservoir are often more favorable than in the Umatilla River. Removing the weir and maintaining continuous adequate flows would greatly expand the size and utility of this thermal refuge. Removing the weir would eliminate the need for heavy equipment to be operated in the stream regularly to remove gravel deposits near the weir. Without the weir, an urban fishery could be developed in McKay Creek that would provide a new opportunity for anglers to harvest salmon and steelhead. Natural spawning and rearing of salmon and steelhead in lower McKay Creek would be valuable in terms of production and could also increase public awareness and appreciation for salmon.

Fine Sediment

Fine sediment transported into and then out of McKay Reservoir continues to be a problem. Solutions to the sediment problem of McKay Reservoir need to be developed and considered. Fine sediments impact both McKay Creek and the Umatilla River. Large mud flats in the upper end of the reservoir are deposited as the reservoir fills. Sediment is stored in the reservoir until the water level drops and inflow cuts into the fine sediment deposits. Sediment is then transported downstream to the Umatilla River. Much of the sediment is very fine and can remain entrained in the water column for miles. This sediment contributes to the fine sediment load in the Umatilla River where coho salmon and fall Chinook salmon spawn annually. In the future, lower McKay Creek could become an important salmonid spawning area that would also benefit from higher quality water. Fine sediment in the water column and in the substrate can be a limiting factor for salmonid production. Egg and embryo mortalities increase as the percent of fine sediment in redds increase (up to 100% mortality, Bjornn and Reiser, 1991, Waters 1995).

Coordinated Management Approach

Additional management considerations and coordination are needed for McKay Creek now that it supports salmonids all year. Residents and officials from the City of Pendleton, Umatilla County, the State of Oregon and federal agencies need to be advised that some past practices are no longer appropriate. Lower McKay Creek is now a perennial stream and rearing habitat for listed salmonids. For example, regular disturbance of the stream channel should be stopped. There was heavy equipment in the channel pushing gravel around during February of 2001 at Pendleton Community Park (John Germond, ODFW, 2001, personal communication). In addition, landowners and others have cleared riparian vegetation and used McKay Creek to dispose of yard trash. On March 8, 2001, CTUIR personnel observed and photographed ten or more trees that had recently been cut down within just a few meters of McKay Creek just below the dam near the high-water mark. These practices need to be changed so that they are in line with current best management practices for water quality and fish habitat.

Potential management options that will require coordination of multiple agencies include expanding the water storage and/or exchange program (Phase III), improving sewage treatment facilities, restoring anadromous fish above McKay Dam, and installing a multi-level discharge structure at McKay Dam. The ability to select the elevation where water is drawn from McKay Reservoir could be used in many ways to enhance the water temperature profiles in lower McKay Creek and in the Umatilla River.

McCoy Creek Salvage Operations

Project staff assisted Allen Childs (1999) in salvage efforts in the Grande Ronde River Basin in associated with the restoration of McCoy Creek into its original sinuous channel.

Endangered Species Act and Cooperation with USFWS and NMFS

In addition to working on the bull trout recovery plan, CTUIR personnel also worked with the services to obtain collecting permits and complete annual permit reports in order to continue RM&E activities. CTUIR staff completed all the necessary permit applications and activity reports related to the steelhead and bull trout listing and associated oversight by USFWS and NMFS (Contor 1999, 2000, 2001 and Mahoney 2002, 2003a 2003b).

Columbia River Inter-Tribal Fisheries Commission

Project personnel work with CRITFC on a variety of salmonid restoration issues related to the Umatilla River Basin. The genetics work conducted by Narum et al (2003) is an example. CTUIR and CRITFC researches also work together on issues related to natural production and supplementation, kelt reconditioning, steelhead population dynamics, and monitoring and evaluation techniques and strategies.

Oregon Department of Transportation

Research biologists routinely provide data and discuss salmonid distribution and life histories with ODOT personnel that are developing biological assessments for road repair and construction activities.

Chinook Hatchery Master Plan

Project biologists work with other CTUIR staff to develop the master plan for the Tribes Umatilla spring Chinook restoration initiatives as well as improvements to exiting programs.

Sub-Basin Planning
Project personnel were significantly involved with providing data, text, and review for the fisheries status section of the Umatilla Subbasin Summary Plan (James et al. 2001).

Project Administrative Processes
Considerable project resources and efforts are expended on administrative processes such as hiring, training, scheduling, planning, and employee evaluations. Additional administrative efforts include tracking expenditures, budgeting, purchasing, inventory, maintenance, repair etc

BPA, ISRP, Northwest Power Planning Council
During the 1999-2002 contract years WWNPME staff have developed multiple versions of project proposals, reviews, statements of work and budgets. .

Umatilla Basin Salmonid Monitoring and Evaluation Plan

This Research, Monitoring and Evaluation plan was developed with Bonneville Power Administration (BPA) funds through the Umatilla Basin Natural Production Monitoring and Evaluation Project (UBNPME, Project Number 1990-005-01). The task of writing this plan was proposed in Objective 8 of the 2002 statement of work and was formalized through a contract dated November 11, 2002. Considerable improvements to this plan are expected when the Project Leader vacancy is filled. Prior to 2003, natural production related RM&E activities followed the plan developed by Lichatowich (1992) and reported by CTUIR (1994) and Contor et al. (1995, 1996, 1997, 1998, and 2000). Lichatowich's original M&E plan had been modified through the years through co-manager coordination during Umatilla Basin Annual Operations Plan development meetings and the Umatilla Basin Management and Monitoring Oversight Committee meetings. Hatchery monitoring activities in the basin have been planned and executed by ODFW (Carmichael, 1990, Keefe et al. 1993, 1994, Hayes 1996, 1996, 1998, Focher et al. 1998). In the past, M&E planning for natural production and hatchery evaluation activities were separate. This plan will eventually contain sections on all fish related RM&E activities. There are extensive efforts through various agencies and research groups that were not included in this RM&E plan listed below because they are not directly related to salmonid recovery. However, the land-use activities that terrestrial RM&E projects evaluate (wildlife, agricultural, grazing and logging) can have significant and important influences to watersheds and associated aquatic ecosystems.

During 2003, this RM&E plan should be considered premature and a working document. Current adaptive management forums and processes will continually modify RM&E needs through the coordination of local managers at the UMMEOC meetings and during the AOP processes. We also expect additional regional review of this plan and the associated modifications that will follow after we receive additional information from ISRP, BPA, ODFW, USFWS, and NMFS et al. Given the wide spectrum of salmonid management philosophies and restoration objectives, we anticipate considerable differences of opinion in the recommendation of fundamental management information needs (MIN) and priorities. We look forward to developing a RM&E plan that will guide cost effective and statistically robust evaluations that satisfy both local and regional MIN. This document should provide a useful mechanism for review and constructive criticism leading to the development of subsequent RM&E plans.

Regional RM&E Standards and Guidelines
This section summarizes the various regional RM&E standards, guidelines and frameworks mandated or recommended by various regulatory, management and/or funding agencies and groups.

The Northwest Power Planning Council (NPPC) and the Independent Scientific Review Panel (ISRP) developed standards and guidelines for research, monitoring and evaluation projects. They state that projects must have measurable, quantitative and biological objectives. Projects must either collect or identify data that are appropriate for measuring the biological outcomes identified in the objectives. Projects that collect their own data for evaluation must make this data and accompanying metadata available to the region in electronic form. Data and reports developed with Bonneville funds are considered public information. Data and metadata must be submitted within six months of their collection. The methods and protocols used in data collection must be consistent with guidelines approved by the council.

The NPPC and ISRP have also formulated standards and guidelines for planning monitoring and evaluation efforts. They state that the RM&E plan must relate and identify monitoring and evaluation tasks associated with each objective. The plans must identify the individual researchers and the schedules of evaluation efforts. RM&E plans must document independent review of the plans if primary participants in planning are also the primary participants in the monitoring and evaluation effort. Plans must include a budget for the proposed monitoring and evaluation work. Local monitoring efforts should provide information that is suitable for evaluations on the subbasin and regional scales.

Regional Assessment of Supplementation Programs (RASP) provided a monitoring and evaluation framework for supplementation efforts. They recommended that projects monitor in-hatchery performance, post releases survival, reproductive success, long-term fitness and ecological interactions.

In December 2002, National Marine Fisheries Service (NMFS) defined key research, monitoring and evaluation components and a framework (Draft NMFS 2002) for their reasonable and prudent alternatives (RPA) for their Biological Opinion (BiOp) (NMFS 2000) Endangered Species Act-Section 7 Consultation for the Federal Columbia River Power System (FCRPS). NMFS identified 199 RPA actions in the 2000 FCRPS BiOp of which actions 158-162 and 179-199 are specifically RM&E related. NMFS RM&E framework includes: 1) population and environmental status monitoring including the status and trends of fish populations, survival rates, and environmental attributes; 2) action effectiveness research; 3) critical uncertainty research, such as relative hatchery spawner reproductive success etc.; 4) implementation and compliance monitoring; 5) data management, regional data storage and access, and 6) regional coordination.

The Columbia Basin Fish and Wildlife Administration (CBFWA) has proposed a system-wide monitoring and evaluation program to integrate local and regional fisheries RM&E efforts and to address the NMFS and the USFWS BiOps and Recovery Plans as well as the NPPC Fish and Wildlife Program. The CBFWA program will work collaboratively to integrate RM&E efforts by: 1) gathering and integrating regional data from local subbasins; 2) assessing the strengths and deficiencies of existing RM&E efforts in addressing key questions related to fish population monitoring and the evaluation of management actions, and 3) design improved RM&E projects with consistent performance standards and protocols to meet local and regional informational needs and fully address critical uncertainties.

The CBFWA proposal outlines the following three levels of RM&E activities: Tier 1, Coarse monitoring; assess current and historical spatial distributions of fish and conditions of their habitats; examine associations between habitat and fish distributions, and identify subbasins or watersheds that may serve as references or controls for Tier 3 effectiveness evaluations. Tier 2, Annual monitoring; assess status and trends of fish populations and their habitat using statistically robust and regionally consistent sampling designs and protocols; assess fish abundance and trends; determine survival rates of various life histories; determine measures of habitat best related to fish populations abundance and survival; asses status and trend of key habitat measures, and assess changes in fish distribution and relate to key habitat measures. Tier 3, Explicit experiments; evaluate the effectiveness of specific recovery actions using fish based response measures, and reference and control conditions; evaluate habitat restoration efforts and other management actions designed to increase fish abundance and/or survival; utilize recent statistical design work and evaluation methods in the design, implementation and evaluation phases of studies examining habitat restoration efforts and other management actions, and evaluate harvest and harvest management effects on listed stocks

Summary of Management Goals and Objectives for Umatilla River Salmon, Steelhead and Trout

Historically, native Chinook salmon, coho salmon, and summer steelhead were present in the Umatilla River Basin. All anadromous species except summer steelhead were extirpated by agricultural development in the basin in the early 1900's (BOR 1988). The most notable events were the construction and operation of Three Mile Falls Dam (TMD) and other irrigation projects. The Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and the Oregon Department of Fish and Wildlife (ODFW) developed the Umatilla Hatchery Master Plan to restore salmon to the basin (CTUIR 1984 and ODFW 1986).

The Master Plan was completed in 1990 and included the following objectives:
1) Establish hatchery and natural runs of Chinook and coho salmon.
2) Enhance existing summer steelhead populations through a hatchery program.
3) Provide sustainable tribal and non-tribal harvest of salmon and steelhead.
4) Maintain the genetic character of salmonids native to and re-established in the Umatilla River Basin.
5) Produce almost 48,000 adult returns to TMD annually. The goals were reviewed in 1999 and were changed to 31,500 adult salmon and steelhead returns (Table 6-4).

Table 6-4, Current natural and artificial production goals for the Umatilla River Basin as redefined in 1999 by the Confederated Tribes of the Umatilla Indian Reservation and the Oregon Department of Fish and Wildlife.

Species/Race	Hatchery Production	Natural Production	Total
Adult Spring Chinook	6,000	2,000	8,000
Adult Fall Chinook	6,000	6,000	12,000
Adult Summer Steelhead	1,500	4,000	5,500
Adult Coho Salmon	6,000	Undetermined	6,000
Total			31,500

Preliminary List of Prioritized Management Informational Needs
Managers made a recent review of their informational needs related to monitoring, evaluation and research for salmon and steelhead. Managers responded with a preliminary assessment and prioritization of management information needs (MIN). In some instances they also suggested the frequency and duration of RM&E efforts that address these questions and uncertainties. Priority rankings should be considered preliminary because we had not completed the estimated consequences of not addressing MIN or the estimated costs for each Study Action Item (SAI). Managers expressed concerns about the premature schedule of this plan given current processes that will provide information and direction to modify this document. ODFW research staff did not participate in the development of this RM&E plan or the prioritization exercise because they were in the middle of a ten year review and synthesis of Umatilla Basin Monitoring and Evaluation efforts. It was untimely to participate in the development of this plan until they could complete their examination of past findings in detail (Rich Carmichael, ODFW, personal communication). We agreed with the ODFW strategy, especially in light of multiple ongoing (and unresolved) regional RM&E planning and standardization efforts. However, we were still committed to develop this initial plan to start the process and fulfill a contract obligation with BPA. This RM&E plan is preliminary and only began formally in November 2002. We expect considerable modifications and changes in MIN prioritization and SAI approaches once ODFW, NMFS and USFWS staff begin to contribute to the planning process (and review by ISRP, BPA, et al.). The ongoing regional RM&E standardization efforts (CBFWA 2002) will precipitate additional modifications through time. We expect to incorporate local and regional recommendations in ways that minimize the disruption of existing databases.

The MIN are organized into three basic categories: monitoring, evaluation and research. While the separation between these categories can be unclear, there are general differences in intensity, duration and approach used to address information needs and critical uncertainties in each category. Priority rankings (1-10) are denoted numerically within brackets [9] with noted qualifiers. A ranking of 10 denotes the highest priority.

The MIN listed under basic monitoring generally require longer-term data collections and relate mostly to basic accounting, trend analysis and general population status monitoring of both hatchery and natural salmonids. Data sets developed by these actions are frequently requested for a variety of reasons by a number of groups and agencies including Universities, NMFS, USFWS, ISRP, NPPC, BPA, ODEQ, ODOT, BOR, and USFS. This information is important for adaptive management and the development and updating of biological opinions, HGMPs, master-plans, annual operations plans and subbasin plans.

The MIN-listed under the evaluation category can frequently be addressed periodically by using the data generated through routine efforts listed in the basic monitoring category. Other evaluation efforts in this category may require three to five year projects and include more intensive study designs, field sampling efforts, data analysis and reporting. The products from these evaluation efforts include annual reports, formal presentations, and published articles in refereed journals.

The MIN-listed under the research category frequently require the assistance of experts and specialized equipment, facilities and methods. Research projects in this category normally require complex study designs, rigorous statistical analysis and innovative techniques including advanced modeling. The products from these evaluation efforts include annual reports, formal presentations, and published articles in refereed journals.

<u>Basic Monitoring Questions</u>

Priority rankings are denoted numerically within brackets [9] with noted qualifiers in various places depending on the scope and range of the qualifier. MIN are ranked from 1 to 10, with 1 denoting low priority.

MIN-1 Adult Returns/Population Estimates: For this MIN, higher priority was given to steelhead than spring Chinook. Low priority was given to fall Chinook and Coho.

- MIN-1.1 [10] How many adult salmon and steelhead return each year to Three Mile Falls Dam (TMD) by species and stock; and how many bull trout are observed, if any?
- MIN-1.2 [8] What is the run timing of each species and stock for each year?
- MIN-1.3 [9] What are the sizes and ages of salmonids observed at TMD?

MIN-2 [9] What is the final disposition of adult steelhead and salmon observed at TMD?

MIN-3 Spawning Surveys: highest priorities were for bull trout, steelhead and spring Chinook.

- MIN-3.1 [10] What is the distribution and abundance of adults and redds in the Umatilla River Basin each year for hatchery and natural fall Chinook salmon, spring Chinook salmon, coho salmon, steelhead, rainbow trout and bull trout?
- MIN-3.2 [8] What is the spawn timing of each species and stock for each year?
- MIN-3.3 [7] What proportion of redds were made by hatchery reared female adults for each species and stock for each year and reach?
- MIN-3.4 [4] What is the actual spawning contribution of jack salmon for each species and stock for each year?
- MIN-3.5 [7] What proportion of the steelhead/rainbow and bull trout spawners had resident, fluvial or anadromous life histories each year?
- MIN-3.6 [8] What is the size and age of spawning salmon, steelhead, bull trout and rainbow trout spawning naturally in the Umatilla River Basin?

MIN-4 Carcass Surveys: Highest priority for spring Chinook, lower priority for coho and fall Chinook, not practical for steelhead and bull trout.

- MIN-4.1 [9 What proportion of the carcasses were hatchery adults for each year and reach?
- MIN-4.2 [9] What was the proportion of pre-spawn mortalities, by species and stock for each year and reach?
- MIN-4.3 [9] What tags were recovered from carcasses during spawning surveys to assist in hatchery program evaluations questions?
- MIN-4.4 [9] What scales, otoliths and tissue samples were collected to assist evaluations of age and growth, life histories, genetics, parent origin, and diseases?

MIN-5 Kelt Surveys/Collections: this is for steelhead.

- MIN-5.1 [8] What are the sizes, ages, sex ratios, distributions, abundances, movements and dispositions of steelhead?
- MIN-5.2 [5] What is the origin of hatchery reared kelts? Coded wire tags and PIT tags recovered from kelts could also assist hatchery effectiveness RM&E.
- MIN-5.3 [5] What are the ages, sizes, life histories, origin as well as the genetic and disease characteristics of kelts?

MIN-6 Juvenile and Resident Salmonid Abundance Surveys

MIN-6.1 [9] What is the relative abundance and distribution of salmonids, by species and stock, seasonally, throughout the basin?

MIN-6.2 [9] What are the summer densities of salmonids, by species and stock, throughout the basin?

MIN-6.3 [9] What are the sizes, age and growth rates of salmonids, by species and stock, throughout the basin?

MIN-7 Smolt and Parr Outmigration Monitoring

MIN-7.1 [8] What is the timing of parr and smolt outmigrations, by species and stock?

MIN-7.2 [10] What is the total abundance of salmonid outmigrants, by species and stock?

MIN-7.3 [9] What is the survival of salmonid outmigrants to TMD and the lower Columbia River, by species and stock?

MIN-8 [5] Fish Habitat Surveys. What are the conditions, trends, quantities and connectivity of various salmonid habitat types in the basin? A higher ranking was given if habitat surveys were conducted once every 10 years.

MIN-9 Water Temperatures: This MIN was ranked higher if linked to specific actions such as in SAI-16, 23 and 24. While given a relatively low priority by local managers, temperature data are the most frequently requested RM&E products.

MIN-9.1 [7] What are the water temperatures in the basin from the mouth to the headwaters, May through October?

MIN-9.2 [5] What are the water temperatures in the Umatilla River Basin during the winter?

MIN-10 Harvest: This MIN is ranked high for steelhead, coho and spring Chinook, with a lower ranking for fall Chinook.

MIN-10.1 [9] What was the annual sport harvest of salmon, trout and steelhead in the Umatilla River Basin?

MIN-10.2 [9] What was the annual tribal harvest of salmon, trout and steelhead in the Umatilla River Basin?

MIN-10.3 [9] What was the annual out-of basin harvest of Umatilla Basin origin salmon and steelhead?

MIN-11 Straying; This MIN is ranked higher for fall Chinook than for the other species.

MIN-11.1 [8] What are the stray rates of Umatilla Basin salmon and steelhead into other basins, by species and stock, each year?

MIN-11.2 [8] How many salmon and steelhead stray into the Umatilla Basin each year from other basins, by species and stock, each year?

MIN-12 Hatchery Program Monitoring: Highest priority was given to steelhead, then spring Chinook and then to fall Chinook and Coho.

MIN-12.1 [9] How many broodstock were collected, where, when and how, including sizes and condition, by species and stock for each year?

MIN-12.2 [9] How, where and when were adult broodstock held prior to spawning, including numbers, sizes and condition of each species and stock for each year?

MIN-12.3 [9] How, where and when were broodstock artificial spawned, including numbers, sizes and condition of each species and stock for each year?

MIN-12.4 [9] How, where and when were eggs incubated, including numbers of each species, stock and group for each year?

MIN-12.5 [9] How, where and when were fry and parr reared, including numbers, sizes and condition by species, stock and group for each year?

MIN-12.6 [9] How, where and when were parr and smolts acclimated and/or liberated, including numbers, sizes, and condition, by species, stock and group for each year?

MIN-12.7) [9] What was the disease and treatment history of each life history stage for each species, stock and group for each year?

Evaluation Questions:

MIN-13 Adult Migration Evaluations: Current priority is lower, due to competed studies in the Umatilla River Basin. However, there are significant remaining concerns at Feed Canal Dam on the Umatilla River, RM 28.2 (also called Cold Springs Dam).

MIN-13.1 [8] How well do upstream migrants, by species and stock, negotiate the passage facilities, especially Cold Springs Dam?
MIN-13.2 [8] Are there delays at passage facilities, and if so, how many, where, when and under what conditions?
MIN-13.3 [5] What is the average passage time, by species and stock, at each passage facility and between facility reaches?
MIN-13.4 [8] What are the migratory patterns, distributions and maximum upstream ranges of migrants (regarding steelhead and bull trout primarily)?
MIN-13.5 [5] What is the average daily movement by species, stock, month and reach?
MIN-13.6 [5] How do flows, temperatures, seasons, facility operation and other factors affect adult migration for each species and stock?
MIN-13.7 [8] What are the primary causes of prespawning mortality in the basin?

MIN-14 Juvenile passage facility evaluations. Current priority is lower, due to competed studies in the Umatilla River Basin.

MIN-14.1 [5] How well do downstream migrants negotiate the passage facilities (by species and stock)?
MIN-14.2 [5] Are there delays, injuries and mortalities at passage facilities, and if so, how many, where, when and under what conditions?
MIN-14.3 [5] What are the passage times, injury rates and mortality rates, by species and stock, at each passage facility and between facility reaches?
MIN-14.4 [5] What is the average daily downstream movement by species, stock, month and reach?
MIN-14.5 [5] How are migratory patterns influenced by flows, temperatures, seasons, facility operation and other factors (for each species and stock)?
MIN-14.6 [8] When does trap and haul procedures become most advantageous for survival.

MIN-15. Salmonid Productivity, Fitness and Survival Rates

MIN-15.1 [9] What are the primary factors that influence adult to adult production and survival rates by species, stock and group?
MIN-15.2 [9] What are the primary factors that influence the egg to smolt (or parr) survival rates for each species, stock and group?
MIN-15.3 [9] What are the primary factors that influence smolt (or parr) to adult survival rates for each species, stock and group?
MIN-15.4 [9] What is the natural production capacity for each sub-watershed in the Umatilla Basin?
MIN-15.5 [9] What is the optimum adult escapement for natural production of steelhead?
MIN 15.6 [6] How does salmonid natural productivity and capacity in the Umatilla River Basin compare to neighboring basins?

MIN-16 Interactions Between Fish and Habitat

MIN-16.1 [8] What are the primary physical, chemical, and climatic factors and relationships that influence survival, productivity, condition, abundance and distribution of each species, stock and life history stage?
MIN-16.2 [8] How effective are various physical habitat management and restoration actions and strategies (such as Shaw 2001 and Shaw and Sexton 2003) in improving survival, productivity, condition, abundance and distribution of each species and stock, by life history stage and reach? Actions include but are not restricted to grazing reduction and exclusion, re-vegetation, meander restoration, artificial restoration of instream complexity, buffer strips, and wetland creation and other sediment reduction techniques, etc.
MIN-16.3 [8] What habitats are the most important to rehabilitate, maintain and preserve?
MIN-16.4 [6] What are the most cost effective and most reliable management actions that restore and preserve critical habitats?
MIN-16.5 [6] What and where are the landscape scale problems affecting fish habitat?

MIN-17 Optimal Hatchery Practices (these questions may have different answers depending on the management objectives and whether the questions are in regard to hatchery efficiency or related to reducing perceived and documented risks to natural stocks, etc.). Some MIN were ranked low because of several studies completed during the last 15 years. Other MIN are related to ongoing evaluations in neighboring basins that reduce the urgency of similar studies in the Umatilla Basin programs.

- MIN-17.1 [9] What are the processes, standards and criteria needed to develop hatchery practices that balance the needs to be efficient, cost effective and minimize ecological and genetic risks to natural and hatchery stocks?
- MIN-17.2 [4] What are the best stocks to use for each species for the hatchery programs?
- MIN-17.3 [4] What are the best strategies and methods to collect broodstock for hatchery programs for each species and stock?
- MIN-17.3 [6] What are the best methods to hold and spawn broodstock for each species and stock?
- MIN-17.4 [7] What are the optimal breeding practices for each species and stock (emphasis on steelhead)?
- MIN-17.5 [8] What are the optimal incubation practices for each species and stock?
- MIN-17.6 [8] What are the optimal rearing methods for each species, stock and life history stage?
- MIN-17.7 [8] What are the optimal growth and feeding rates for each species, stock and life history stage?
- MIN-17.8 [6] What are the optimal times, methods, and protocols for tagging hatchery reared fish for each species and stock?
- MIN-17. 9 [8] What are the optimal sizes, times, locations and conditions to liberate hatchery reared fish into the Umatilla River Basin.
- MIN-17.10 [6] For each relevant disease, what are the best disease management practices for the prevention and treatment of each species, stock and life history stage?

MIN-18 Evaluate Similarities and Differences between Hatchery and Natural Fish. High priority was given to steelhead for this MIN and a lower priority for the other stocks.

- MIN-18.1 [8] What are the similarities and differences in the sex ratio, fecundity, run timing and spawning time of adult hatchery and natural fish for each species and stock?
- MIN-18.2 [8] What are the similarities and differences in size, age, migration timing, migration survival and smoltification of hatchery and natural fish for each species and stock?
- MIN-18.3 [8] What are the similarities and differences in genetic characteristics of hatchery and natural fish for each species and stock?
- MIN-18.4 [6] What are the similarities and differences in the types, incidence and severity of diseases in hatchery and natural fish for each species and stock?

MIN-19 Harvest Related Evaluations

- MIN-19.1 [7] What are the cumulative affects of harvest management on each species and stock?
- MIN-19.2 [5] What is the effect of catch and release and other types of harassment by sport and tribal anglers on the survival and reproductive success of fish not harvested for each species and stock?
- MIN-19.3 [4] What is the net reduction in subsequent smolt and adult production from the harvest of adults in the ocean, Columbia and subbasin fisheries (this is a complex issue because of delayed mortality, partial and full seeding variables, and carrying capacity issues as well as independent and dependent mortality concepts)?
- MIN-19.4 [6] What are the most cost effective and statistically robust harvest monitoring strategies and protocols for the sport and tribal fishing seasons?

MIN-20 Kelt Reconditioning for Hatchery Broodstock and/or Out-planting. These MIN were ranked lower for this basin. However, the technique was recognized as a potentially important tool for specific stocks in other basins.

- MIN-20.1 [4] What is the most effective way to collect and reconditions kelts in the Umatilla River Basin?
- MIN-20.2 [4] Could kelt reconditioning improve the effective population size and genetic diversity of endemic hatchery stocks without extracting additional natural spawners from adult returns.
- MIN-20.3 [4] Would out-planting ripe, reconditioned, kelts (of natural origin) efficiently provide naturally production to vacant and under utilized suitable habitat?
- MIN-20.4 [4] Would reconditioned kelts have unmanageable disease prevalence that could jeopardize their progeny and other populations?

Research Questions

MIN-21. Develop and Utilize a Progeny Mark to Examine the Relative Reproductive Success of Hatchery Females Spawning Naturally

MIN-21.1 [9] What is the most effective benign delivery agent and method of administrating a marking agent to female salmonids prior to spawning such that the marker is incorporated into the otoliths of their progeny?

MIN-21.2 [9] What is the variability and range of the various marker candidates in control specimens?

MIN-21.3 [9] What is the variability and range of the various markers and concentrations of markers in the progeny when applied to adult female broodstock?

MIN-21.4 [9] What are the treatment effects of the marker on the broodstock maturation, survival, fecundity and fertility rates?

MIN-21.5 [9] What are the treatment effects of the marker on progeny incubation, development, survival and growth?

MIN-21.6 [9] How effective is the progeny marker in evaluating the relative reproductive contribution of hatchery reared female adult salmonids spawning naturally in the wild?

MIN-21.7 [9] What is the relative reproductive success of endemic adult hatchery reared female steelhead spawning naturally in the Umatilla River (relative to wild steelhead)?

MIN-22 Genetic Studies: These MIN were given high ranks in regard to steelhead.

MIN-22.1 [9] What are the general genetic characteristics and geographic stock structures of each salmonid stock in the Umatilla and surrounding subbasins?

MIN-22.2 [9] What is the rate of change in the genetic characteristics of each salmonid stock through time?

MIN-22.3 [7] How variable are changes in genetic characteristics and what are the magnitudes, frequencies and permanence of the changes?

MIN-22.4 [9] Are there negative or deleterious changes (based on current genetic theory) to the genetic characteristics in supplemented and reintroduced salmon and steelhead stocks?

MIN-22.5 [6] How are management actions, population dynamics, straying and other factors related to changes in the genetic characteristics of each salmonid stock?

MIN-22.6 [9] How do changes in the genetic characteristics of local hatchery and wild salmon and steelhead stocks compare with changes observed in stocks throughout the region?

MIN-22.7 [9] What is the relative reproductive success of naturally spawning hatchery adults in producing F1 and F2 spawning adults?

MIN-22.8 [6] Are the genetic characteristics of successfully reproducing hatchery salmon in the North Fork Umatilla River indicating divergence from the original hatchery stock?

MIN-23 [9] Develop and Test Phase II and Phase III Flow Augmentation Models.

What are the optimal flow management scenarios and strategies to maximize salmonid adults passage, smolt outmigration and juvenile rearing in the lower Umatilla River given the variation of annual natural flows, river water temperatures, climatic conditions, McKay Reservoir storage, hypolimnetic volume and temperatures, irrigation water delivery schedules, and progress with stream and riparian habitat restoration and associated reduction in river heating factors?

MIN-24 Ecological Interactions: Higher priority was given to these MIN in regard to coho and steelhead interactions than for other between-species interactions.

MIN-24.1 [7] Are there significant behavioral or other ecological interactions between natural and hatchery salmonids within and between species that may be deleterious to the growth, abundance and distribution of natural salmonids?

MIN-24.3 [7] What are the significant deleterious affects of exotic fish species on native salmonids including behavior, growth, abundance, survival and distribution?

MIN-24.4 [7] Are there significant deleterious disease-related interactions between natural and hatchery fish within and between species?

MIN-24.5 [4] On a holistic ecosystem scale, what are the significant functional relationships in stream reaches with either traditional land-use practices or protected and restorative management; including uplands, riparian areas, streams, invertebrates, fish, plants, fish and wildlife?

Salmonid Related Research, Monitoring and Evaluation Action Items (SAI)
RM&E activities are developed to answer a prioritized set of information needs and critical uncertainties outlined above. Managers prioritized the questions to best assist with the adaptive management of salmonid restoration and recovery programs in the Umatilla River Basin. RM&E teams develop plans, approaches, experimental designs, objectives, tasks, methods, protocols, work statements, budgets, schedules, performance standards, reports, presentations, and publications to address critical uncertainties. RM&E teams endeavor to utilize reasonable and cost-effective approaches and protocols to answer management questions with sufficient accuracy and precision. This section documents the salmonid related RM&E activities conducted, planned and conceptualized by managers and RM&E staff in the Umatilla River Basin.

There are a number of RM&E questions that are examined directly through Umatilla Basin RM&E programs. However, other questions have been differed based on priority as well as coordination to avoid unnecessary duplication of effort. Extensive research and evaluations are currently being conducted in adjacent basins and have reduced the priorities of some of the questions listed above. For example, the Yakima and Nez Perce Tribes both have ongoing "natures rearing" research. Until those studies have progressed further, questions related to those issues in the Umatilla Basin programs can be differed until a rearing strategy change is implemented locally. While managers may give such questions high priority on a regional scale, current efforts by others may reduce the priority for local programs. In contrast, some questions are more specific to a subbasin or a unique site (such as the evaluation of a specific passage facility). In these cases, an evaluation of the specific site may be required even if similar work is being conducted at another site or in an adjacent subbasin.

Given the large number of high priority MIN, we suggest that the MIN be re-prioritized by a broader range of managers and with greater scrutiny during future revisions of this plan. Recent ISRP comments suggest that priority rankings would be considerably different if ISRP ranked the MIN. We also suggest that each MIN be ranked with and without consideration of the cost and duration of Study Action Items (SAI). Some MIN can be addressed through staggered and/or rotating SAI. Research teams could work through these SAI in 3-5 year cycles. Some SAI could be repeated every 9 to 15 years depending on priority. Some SAI will occur once, others will be continuous. Advantages of staggered and rotating SAI would be to keep costs down and to maintain quality staff. The cost of hiring and training new staff for concurrent SAI is considerable given the inefficiencies of learning how to navigate through the current administrative landscapes and logistic constraints.

Basic Monitoring SAI.

SAI-1, 1.1-1.3. Determine the number, run timing, size and age of adult salmon and steelhead returns to TMD.

SAI-1 is a basic ongoing monitoring activity and addresses MIN-1.1-1.3 which managers gave priority rankings of 10, 8 and 8 respectively (section 4.1). SAI-1.1 through 1.3 document how well adult return goals are being met in terms of numbers, and whether run timing, size and age characteristics of each stock are changing over time.

Consequences of ending SAI-1: Without SAI-1.1-1.3 managers will not know the numbers, run timing, sizes or age characteristics of adult salmon and steelhead returning to the Umatilla River Basin. They could not evaluate salmonid restoration efforts in the Umatilla River Basin, or changes in run timing, size and age characteristics of each stock. Without SAI-1 data, we could not evaluate how well broodstock collections represented the entire return.

MPSM: Related Management Performance Standards and Measures (MPSM) for MIN-1.1-1.3 are the adult return goals for each species (48,000 adult salmonids combined, Table 6-4). There are no specific size or age standards but there is a goal to maintain general run timing, and size and age structures through time.

Past Efforts: Monitoring for SAI-1 has been conducted each year since 1989 by CTUIR and ODFW through the BPA funded Fish Passage Operations Project (FPO , project number 198802200) and the Umatilla Basin Natural Production Monitoring and Evaluation Project (UBNPME, project number 1990-005-01). ODFW estimated adult returns prior to 1989 at the old TMD facilities. The run counts obtained after 1988 are more accurate than the older facilities would allow.

SAI-1 Goal and Approach: The goal is to enumerate every salmonid passing TMD each day and categorize each one by species, sex and age group. The approach is to operate a trap when collecting broodstock and to video tape fish passing the ladder when the trap is not operated. UBNPME project uses scale and length data collected from spawners to estimate size and age information for the entire run for steelhead and spring Chinook salmon each year. Another UBNPME goal for Chinook salmon and steelhead is to assign adult returns to their natal brood-year. These data allow the estimation of adult to adult productivity (MIN-15). Detailed size and age information for fall Chinook and coho salmon are only examined occasionally because of prioritization and limitations in available man-hours. Detailed age and length data is used to establish species specific length categories to classify the ages of salmon and steelhead returns to TMD.

Methods and Protocol:

Enumeration of returning salmon and steelhead adults in the Umatilla River began in 1966 at Three Mile Dam (TMD). Adults were enumerated by electronic counter and/or mark recapture from 1966-1987. A contemporary trapping and handling facility at TMD has been operated since the fall of 1987. Salmon primarily return within one calendar year so their return years coincide with calendar years. Occasionally a coho salmon is observed at TMD in January and these are enumerated with the previous years return. For summer steelhead, the return-year runs from August to July. For fish returning from August 1987 to May of 1988 would have spawned in February through June of 1988. In June and July of some run-years, a few summer steelhead were observed that would not spawn until the following year. Because of increased numbers of early fish observed during the last several years (always less than 10), these fish have been recorded in the following run-year. From 1992 to 1999 adult salmon and steelhead were all captured, anesthetized with buffered carbon dioxide and enumerated and categorized by gender, ocean age and fin clip (Zimmerman and Duke, 2002). Since 2000, the adult return has been enumerated and categorized by a combination of capturing, anesthetizing and handling, alternating with video taping without capture (alternating approximately every 7-10 days). Adult salmon and steelhead enumerated from video tapes were apportioned (ocean age, sex, fin clip) by determining the percentage of the known fish in the immediate periods before and after video taping and using that percentage to expand the unknown fish from the video taping period (Dale Chess, ODFW Hermiston, personal communication).

Adult steelhead enumerated at TMD were categorized as having spent one or two years in the ocean based on fork length. A fish 659 mm or less was assigned ocean age one and 660 mm or greater ocean age two. Adjustments to TMD fork length data vs. ocean age were necessary for both natural and hatchery summer steelhead because of an overall 6.3% error in ocean age of natural fish and a 7.0% error in ocean age of hatchery fish based only on length. All adjustments were done by return year because of annual variation in fork length versus age. The adjusted TMD fork length data vs. ocean age was then utilized to expand freshwater ages of natural adult summer steelhead as they spend from one to four years in freshwater. Freshwater ages were apportioned from annual samples collected during brood stock collection. Almost all hatchery summer steelhead adults spent one year in freshwater as juveniles while most naturally produced salmonids spent two years in freshwater. Similar age and length relationships have been developed for each salmon stock.

Gender was determined by external sexual characteristics. Fin clips were observed and recorded and from 50 to 150 of the coded wire tagged returns from hatchery steelhead, coho and fall Chinook releases were sacrificed annually for research objectives. CWT tags from salmon are also collected from broodstock and from spawning grounds. Sufficient CWT collections from spring Chinook broodstock and carcass surveys preclude the need for additional research sacrifices at TMD.

Estimates of Umatilla River hatchery summer steelhead harvest below TMD, based on coded wire tag recoveries were provided by Oregon Department of Fish and Wildlife (Will Cameron, personal communication). Because of non-retention in sport fisheries of summer steelhead with adipose fins, harvest of natural Umatilla summer steelhead occurred only in the Tribal gillnet fishery. Harvest for six brood years was insignificant (16-101) if similar to the hatchery estimates of harvest. Thus, harvest of natural summer steelhead below TMD was not considered in development of brood tables. Natural returns to TMD were considered in the total return figures.

Salmon and steelhead adult scales were taken in the preferred area, two rows above the lateral line in a diagonal line between the posterior edge of the dorsal fin and the anterior edge of the anal fin on the left side of the fish. Additional scales were taken above and below the lateral line and on the right side of the fish in and near the preferred area because of the high degree of regeneration of salmon and steelhead scales in the Umatilla River. Scales were mounted on gum cards and pressed into cellulose acetate. Scales were examined under a microfiche reader at a magnification of 42x and/or 72x. Age designation utilized the European method. For example an adult steelhead returning in the 2000-2001 run-year at age 2.2 was spawned and emerged from the gravel in 1996, migrated to the ocean in the spring of 1998, returned to freshwater in the summer or fall of 2000 and spawned in the spring of 2001 at age 5.

Much of the data for adult salmon are collected during harvest, spawning and carcass surveys. Methods for these efforts are detailed in SAI-3, 4 and 10 below.

Study Performance Standards and Measures (SPSM): not yet developed.

Reporting: Because this is primarily an accounting effort, statistical analysis is limited to descriptive statistics. Findings are discussed in relation to MIN-1, the adult return goals which are the MPSMs, and adult returns to adjacent basins. Data generated by this project are used in other evaluations but the specific methods and reporting for those efforts are discussed separately.

Potential Problems: Potential problems are minimal with SAI-1 because this monitoring effort has been ongoing for many years without difficulty.

Probability of success in completing SAI-1 is high, based on the historical record. However, success also depends on SAI 3, 4 and 12.

Man Days Needed for SAI-1: Staff needed for spawning surveys, operating the trap and viewing-window at TMD, reading tapes, and completing reports is approximately 890 man days/year. However, the tasks associated with SAI-1 are integrated with other management actions and SAI and it is difficult to split out man hours needed for this specific action.

SAI-1 Schedule: TMD is monitored 365 days each year. Spawning surveys begin in late February for Steelhead and continue through May. Spring Chinook spawning and carcass surveys occur from July through September. Fall Chinook and coho spawning surveys begin in late October and continue through December. Data analysis includes reading video tapes and scales. Reporting takes additional man hours and is generally completed in April of each year.

Special Equipment Needed for this SAI: All special equipment needed for SAI-1 exists including trapping facilities and video taping and editing equipment at TMD as well as scale presses and readers.

SAI-2 Determine the Final disposition of Adult Steelhead and Spring Chinook Salmon Observed at TMD?

SAI-2 addresses MIN-2 which has a priority rank of 9. SAI-2 is a basic monitoring activity summarizing everything known about adult spring Chinook salmon and steelhead that returned to TMD (for example Table 6-5). SAI-2 summarizes information collected from SAI 1, 3, 4 and 10-12 which includes return data from TMD, spawning surveys, carcass surveys, broodstock collections, CWT information, and harvest surveys.

Consequences of ending SAI-2: Most of the information would remain scattered in various reports assuming the other SAI continued. Some information would not be reported and would either not be collected or remain on raw data sheets and eventually lost.

Related MPSM: This is an accounting activity and there are no specific management performance standards associated with this SAI. Specific MPSM are detailed with SAI-1, 3, 4 and 10-12.

Summary of Past Efforts for SAI -2: We have steelhead disposition information beginning with the 1987-88 return year through 2002 (Table 6-5). Spring Chinook salmon disposition information begins in1989.

Goal, Approach and Method for SAI-2: The goal is to summarize all known information regarding adult steelhead and spring Chinook salmon returning to TMD. The approach and general method is to collect, review and summarize information from SAI-1, 3, 4 and 10-12. Specific objectives, methods and SPSM are detailed in the associated SAI section.

Reporting: Because this is primarily an accounting effort, statistical analysis is limited to descriptive statistics. Findings are discussed in relation to MIN-1, the adult return goals which are the MPSMs, and adult returns to adjacent basins. Data generated by this project are used in evaluations but the specific methods and results of analysis for those efforts are discussed separately

Potential Problems, Probability of Success: Provided SAI-1, 3, 4 and 10-12 continue, there should be no difficulty in successfully completing SAI-2 each year.

Man Days Needed: In addition to the substantial efforts required by SAI-1, 3, 4 and 10-12, this action can be completed in one or two man-days/year.

Schedule: Information from the previous year is usually available during February and March when annual reports are being written. However, CWT data generally takes an extra year or two.

Special Equipment Needed: none.

Table 6-5 Summer steelhead adult returns, disposition, harvest, and escapement for the Umatilla River 1987-2002

RUN YEAR	1987 1988	1988 1989	1989 1990	1990 1991	1991 1992	1992 1993	1993 1994	1994 1995	1995 1996	1996 1997	1997 1998	1998 1999	1999 2000	2000 2001	2001 2002
Summer Steelhead (STS) Enumerated at TMD	2480	2474	1667	1111	2769	1914	1290	1531	2081	2477	1765	1886	2892	3662	5520
Natural STS Enumerated at Three Mile Dam (TMD)	2315	2104	1422	724	2247	1298	945	875	1296	1014	862	1135	2160	2596	3562
Hatchery STS Enumerated at TMD	165	370	245	387	522	616	345	656	785	1463	903	751	732	1066	1958
Hatchery STS Harvested below TMD						15	14	40	35	67	89	54	74	87	147
Estimated # of nonendemic STS strays to TMD						187	35	121	120	174	177	49	60		
Harvest or straying to other areas															
TMD+sport below TMD+other areas-%strays															
Natural Female STS Enumerated at TMD						942	688	645	922	742	593	774	1355	1776	2180
Hatchery Female STS Enumerated at TMD						364	251	342	447	720	529	478	377	643	965
Natural Male STS Enumerated at TMD						356	257	230	374	272	269	361	805	797	1382
Hatchery Male STS Enumerated at TMD						252	94	314	338	743	374	273	355	446	993
Natural STS Sacrificed or Mortalities at TMD	20	12	25	2	3	0	0	0	8	5	2	1	0	2	1
Hatchery STS Sacrificed or Mortalities at TMD	5	17	143	50	112	70	51	33	73	95	70	75	42	97	49
Natural STS Taken for Brood Stock	151	160	106	99	237	125	92	86	105	97	86	111	115	106	100
Natural STS Spawned	62	84	53	85	172	95	79	59	63	75	68	76			
Hatchery STS Taken for Brood Stock	0	0	0	103	95	91	42	68	26	10	30	15	15	10	10
Hatchery STS Spawned	0	0	0	42	0	3	17	22	21	3	21	4		7	
Natural Females Released above TMD	1436	1232			1193	878	641	602	863	687	549	718	1317	1721	2129
Natural Males Released above TMD	708	702			814	292	211	187	323	222	225	306	728	744	1332
Natural STS Released above TMD	2144	1934	1290	623	2007	1170	852	789	1186	909	774	1024	2045	2465	3461
Hatchery Females Released above TMD	114	216			161	266	183	289	376	669	475	427	351	583	939
Hatchery Males Released above TMD	46	137			154	188	69	266	305	689	328	234	324	399	960
Hatchery STS Released above TMD	160	353	102	234	315	454	252	555	681	1358	803	661	675	982	1899
Natural STS Harvested above TMD-CTUIR						5	5	5	0	0	5	5	0	0	*
Hatchery STS Harvested above TMD-CTUIR						25	20	20	39	33	33	39	99	84	*
Natural STS Harvested above TMD-ODFW								0	0	0	0	0		0	0
Hatchery STS Harvested above TMD-ODFW						22	5	21	25	24	12	47	4	3	57
Natural Female STS Potentially Available to Spawn	1436*	1232*			1193*	875	638	599	863	687	547	715	1317	1721	2129
Hatchery Female STS Potentially Available to Spawn	114*	216*			161*	242	170	268	344	640	453	384	301	539	911
Total Female STS Potentially Available to Spawn	1550*	1448*			1354*	1117	808	862	1207	1327	1000	1099	1618	2260	3040
Natural Male STS Potentially Available to Spawn	708*	702*			814*	290	209	185	323	222	222	304	728	744	1332
Hatchery Male STS Potentially Available to Spawn	46*	137*			154*	165	57	246	273	661	306	191	273	356	931
Total Male STS Potentially Available to Spawn	754*														2263
Natural STS Potentially Available to Spawn	2144	1934	1290	623	2007	1165	847	784	1186	909	769	1019	2045	2465	3461
Hatchery STS Potentially Available to Spawn	160	353	102	234	315	407	227	514	617	1301	758	575	574	895	1842
Total STS Available to Spawn	2304	2287	1392	857	2322	1572	1074	1298	1803	2210	1527	1594	2619	3360	5303
STS Redds Observed in Index Reaches	138	77	HW	HW	135	HW	64	74	119	138	126	218	238	383	347
Total STS Redds Observed	275	128	HW	HW	300	HW	224	126	150	149	217	293	523	n/a	n/a
Index Reaches Miles Surveyed	18.5	20	HW	HW	21.4	HW	21.4	21.4	21.4	21.4	21.4	21.4	21.4	21.4	19.4
Total Redds Per Mile in Index Reaches	7.5	3.9	HW	HW	6.3	HW	3.0	3.5	5.6	6.4	5.9	10.2	11.1	17.9	17.9
Total Miles Surveyed in Umatilla River	61.0	50.2	HW	HW	67.2	HW	65.8	35.0	34.4	24.6	38.0	37.2	47.6	n/a	n/a
Redds Per Mile in all Areas Surveyed	4.5	2.5	HW	HW	4.5	HW	3.4	3.6	4.4	6.1	5.7	7.9	11.0	n/a	n/a

Notes: Index reaches are in Squaw, N. F. Meacham, Buckaroo, Camp, and Boston Canyon Creeks and the S. F. Umatilla River.
Notes: We assumed that harvest was 50% females and 50% males. No adjustments made for catch and release mortality

SAI-3, 3.1-3.6, Determine natural spawning success, spawning habitat utilization, prespawning mortality, and redds per adult spring Chinook salmon passed above Three Mile Falls Dam. Determine spawning distribution, success, timing and numbers of summer steelhead and bull trout.

SAI-3 addresses MIN-3.1-3.6, which were given priority rankings of 10, 8, 7, 4, 7 and 8 respectively. SAI-3 is a basic monitoring effort to record the number of redds produced each year. Highest priority was for bull trout, steelhead and spring Chinook.

Related Management Goal and MPSM: The Umatilla Basin Fisheries Restoration Plan (CTUIR 1984) included natural production goals. Current spawning goals include the escapement of 3000 spring Chinook salmon to spawn naturally with the intent that natural spawning will produced 2000 adults. Total spring Chinook return goal is 8000 with 2000 being from natural production and 6000 from the hatchery program. Manager's plan for the 8000 returning adults is to allow 3000 to spawn naturally, harvest 4000 and use 1000 for broodstock. When returns are below 8,000, management has a sliding scale that allows for harvest and natural spawning. Goals for the natural production of steelhead and fall Chinook salmon is 4,000 and 6,000 respectively. The coho natural production goal is undetermined. Spawning surveys document spawning performance, timing, distribution and abundance of hatchery and natural adults and how those measures change.

Consequences of not addressing this MIN can be summarized by a general lack of information regarding natural spawning activities. For bull trout, spawning surveys are the only consistent source of information for population abundance. Spawning surveys are not as important for steelhead and spring Chinook salmon in the Umatilla River Basin because of quality estimates of adult returns at TMD. However, CTUIR and ODFW managers ranked spawning surveys high for both steelhead and spring Chinook. Steelhead are endemic and the hatchery program includes a natural production component. Steelhead surveys provide information beyond TMD counts about how and where hatchery fish spawn naturally. Considerable information about the spring Chinook program is generated by SAI-3 and 4 including CWT recoveries, age, length, and pre-spawning mortality data. Spawning survey data is also the primary monitoring tool used in most Columbia subbasins to monitor adult returns. Spawning surveys provide a more comparable data set for the region than TMD counts.

Summary of Past Efforts for SAI-3: Spawning surveys have been conduced since 1985 for steelhead and since1989 for spring Chinook by CTUIR. Bull trout spawning surveys have been conducted by ODFW with some assistance from CTUIR and USFWS since 1994.

Goal and General Approach: The goal is to enumerate bull trout, steelhead and spring Chinook salmon redds in a consistent manner throughout the respective spawning seasons. For bull trout and spring Chinook, most of the spawning habitat localized and is surveyed entirely each week. Steelhead spawning is spread across the basin and past surveys concentrated on selected index reaches. We propose to adopt a sampling strategy that combines an unbiased sample design across the basin with existing index sites. A core group of existing index sites will be monitored for three years to avoid serious interruption of long term data sets. The goal of the new survey design is to provide the best coverage with the least cost. Modifying the current spawning survey design to follow work by Firman and Jacobs (2001) will improve our monitoring efforts and is consistent with the latest ISRP recommendations (for additional experimental design strategies see also Solazzi, et al 2001, Jacobs et al. 2001, Susac and Jacobs 1999, Riggers 1999 and Jacobs and Nickelson 1998). One main benefit to this approach is that data will be directly comparable (and nest into) regional data sets that use similar designs. This is an important consideration, because our goal is to make all our RM&E products compatible with both local and regional MIN.

Methods: We will work with ODFW to randomly pre-select sites and alternates according to protocol developed by Don Stevens, Tony Olsen, Phil Larsen and Tom Kincaid of the U.S. Environmental Protection Agency, Corvallis, Oregon (see Firman and Jacobs, 2001). We will produce a master list of pre-selected sites and alternates. During the winter (Dec- Mar), we will contact landowners, visit and mark survey areas, use pre-selected alternates for sites where landowner permission is denied or otherwise unsuitable, and train staff. Bull tout and spring Chinook spawning are both located in a relatively small area so stratified random sampling is not required.

We will conduct spawning surveys and document the number and location of redds and examine carcasses in the index and random sites as conditions and landowners allow. Crews will estimate survival to spawning and total egg deposition for steelhead and spring Chinook; collect and record length, sex, pre and post-spawn mortality data, coded wire tags, marks, fin clips, kidney samples and scales from the appropriate spring Chinook carcasses examined on the spawning grounds; summarize the data and vital statistics of bull trout, spring Chinook and summer steelhead in table and text report format, and submit coded wire tags, associated data and other information collected for ODFW and Pacific States Marine Fisheries Commission (PSMFC)

During the traditional spawning ground surveys, crews walk three to four stream miles each day along established index sites. The new protocol will require crews to walk one to four one-mile reaches each day, spread out over a larger area. Some of the more remote sites will require a full day to access and sample. Crews will walk alone along the margins of the smaller tributaries or in pairs on opposite banks of larger streams. Surveyors will wear polarized glasses to assist observation. To minimize stress on prespawning salmonids, we will not probe debris jams or throw rocks into holding pools. Poor water conditions or landowners may prevent surveys at certain times and locations.

Redds are judged to be complete based on redd size and depth, location, and amount and size of rock moved. All redds are reviewed by our most experienced surveyors for consistency. Orange flagging is tied to trees nearby to mark redds. The flagging is labeled with the date, location, species and number of males and females observed on or near the redds. Crews also record information in data books or data loggers. For each redd, surveyors record the stream name, location, date when the redd was first observed, sex and number of fish observed on or near the redd, carcasses sampled in the areas, and habitat type. Carcasses found during the survey are measured from the middle of the eye to the hypural plate (MEHP). Fork length is also recorded if severe caudal fin erosion has not occurred. We describe obvious injuries and attempt to determine the cause of death in prespawning salmonids. We cut open carcasses to determine egg retention of the females and spawning success of the males. Prespawning mortality is defined as death of a fish before spawning. Females with egg retention estimated near 100% and males with full gonads are classified as prespawning mortalities. Tails of sampled fish are removed at the caudal peduncle to prevent re-sampling.

We collect snouts from salmon and steelhead with coded wire tags (based on fin clips). The snout is removed by cutting through the head from behind the orbit and down to the mouth. Snouts are placed in plastic bags and given an individual snout number for identification. Snouts and accompanying biological data are sent to ODFW's Mark Process Center in Clackamas for coded wire tag extraction and reading. If requested by ODFW, kidney samples are collected on the spawning grounds from spring Chinook salmon that have been dead for less than 48 hours. Samples are frozen and taken to the ODFW pathology laboratory in La Grande, Oregon for analysis and reporting.

Study Performance Standards and Measures (SPSM): 1) Sample each site every 7 to 10 days during the spawning season; 2) Accurately and completely record all required information on data sheets for each visit to each site and make daily backup copies of each data sheet; 3) Maintain errors of spawning abundance estimates within 20%.

Reporting: Prepare data summaries and report findings. Examine if SPSM were met and discuss all spawning survey data in relation to MIN, MPSM, past data and results from neighboring basins.

Potential Problems and Probability of Success: There are few problems associated with spring Chinook and bull trout spawning surveys. While work can be physically challenging due to terrain and climatic conditions, potential problems are minimal and success is highly probable. Most spawning areas of both species are readily accessible with very few landowner issues. Consistency in redd classification can be problematic between surveyors. Currently, Paul Kissner, CTUIR's most experienced surveyor, reviews all redds to maintain the consistency of the data.

Steelhead spawning surveys have a number of potential problems that frequently postpone and limit data collection. Steelhead spawn in headwater tributaries as well as the mainstem of the Umatilla River. High flows and associated turbidity often prevent spawning surveys in the tributaries and especially on the mainstem. Access to private land is also a problem, because steelhead spawning distribution is broad. Steelhead spawning survey conditions can be highly variable and freshets can easily hide redds.

Man Days Needed: We estimate that SAI-3 will require approximately 295 man days each year. Current spring Chinook spawning surveys in the Umatilla Basin require 45 man-days in the field for full coverage. Past steelhead spawning surveys required 70 field days for full coverage of selected index sites. It is unknown how many field days the new study design will require because it will depend on site locations. Some sites will require an entire day to access and survey. Where access is nearby and the terrain is gentle, four sites can be surveyed in a day. We expect that the new method will require 170 days in the field each year. Additional effort will be required to contact landowners, find the sites, and mark them prior to spawning surveys. Bull trout spawning surveys in the Umatilla Basin require 15 man days in the field.

Schedule**:** Establish randomized sample sites based on the rotating panel design, contact landowners and train crews (December to March). Conduct summer steelhead spawning surveys March through June (CTUIR). Conduct spring Chinook spawning surveys during August and September (CTUIR). Conduct bull trout spawning surveys from September through November (ODFW and USFWS). Digitize and summarize data within 60 days of collection. Complete the spawning survey section of the annual report by and post online by April of the following year. Deliver coded wire tag data, mark data, pathological samples, and other information to the appropriate agency with 60 days of collection.

Special Equipment Needed: None

SAI 4 Carcass Surveys: Examine spring Chinook carcasses on spawning grounds. Carcass surveys may also include fall Chinook and coho salmon.

SAI-4 is an ongoing monitoring activity and addresses MIN-4.1-4.4. It was given a priority rank of 9 (for spring Chinook) and is needed for MIN-1, 2, 13.7, 15, 17, 18 and 22. This action has a lower priority for fall Chinook and coho and is not practical for steelhead and bull trout as few carcasses are observed. From carcasses we can collect pre-spawning/post spawning information, egg retention, samples for ODFW pathology lab, CWT, marks, lengths, scales and genetic samples.

Related CTUIR management goals include the restoration of naturally producing salmon in Umatilla River Basin. It is important to note that natural production is not the primary goal for fall Chinook and coho salmon. For spring Chinook, natural reproduction is an important goal but does not supersede harvest goals.

Consequences of ending carcass surveys would be significant for spring Chinook related MIN. Data collected from spring Chinook carcasses is needed for SAI 1, 2, 13.7, 15, 17, 18 and 22 and related MIN. There would be few consequences if the fall Chinook and coho salmon carcass surveys stopped. Managers have consistently given fall Chinook and coho salmon related MIN low priority rankings. The only information lost would be the pre-spawn/post-spawn mortality information. After ten years of data, pre-spawning mortality relates have generally been very consistent from year to year and from reach to reach (in contrast to spring Chinook). In addition, fluctuations in late fall flows and associated turbidity frequently make carcass surveys inefficient for fall Chinook and coho.

Related Management Performance Standards and Measures (MPSM):

Summary of Past Efforts for Carcass Surveys: CTUIR, with assistance from ODFW, has conducted carcass surveys in the Umatilla Basin since 1989 for all three salmon stocks. From 1991 until 1998 spring Chinook carcasses were surveyed from June through September to document early prespawning mortality in each index reach. Currently carcasses are surveyed during August and September. When carcass numbers are high, we organize crews specifically to process carcasses, otherwise it can take over 15 hours for redd survey personnel to work through a single three mile reach. When carcass are few they are processed by spawning surveyors.

Goal and General Approach for the SAI: The goal for spring Chinook is to examine as many carcasses as possible to determine spawning success by reach and to recover CWT, scales, lengths and other data. We try to examine 50% of the adults released above TMD. However, sport and tribal anglers harvest significant numbers during some years. Bears are now routinely seen and they have been taking more and more carcasses each year.

Methods: The carcass survey related details in the spawning survey methods and protocols (SAI-3) are the same for this SAI.

Study Performance Standards and Measures (SPSM): Sample carcasses from each reach every 7 days from August through September.

Reporting: Prepare data summaries and report findings each April. Examine if SPSM were met and discuss all spawning survey data in relation to MIN, MPSM, past data and results from neighboring basins.

Potential Problems, Probability of Success: Carcass surveys for spring Chinook present very few problems. Probability of success is high. Carcass surveys can require considerable effort, during peak spawning on heavy return years. Sometimes double crews are required to meet performance standards. Bears can also be abundant, remove large numbers of carcasses, and can be perceived as a threat by some surveyors.

Schedule and Man Days Needed: Spring Chinook carcass surveys from August through September require form 45-110 man day/year depending on the run size. Carcass surveys for fall Chinook and coho salmon require 75-90 man day/year for consistent coverage. Abbreviated surveys can require as little as 8-10 man days but also provide abbreviated information.

Special Equipment Needed: A drift boat or raft is needed for fall Chinook and coho carcass surveys.

SAI-5 Kelt Surveys and Collections: MIN-5 ranked low in priority. There was greater interest in the movement and distribution of adult steelhead and bull trout after spawning (MIN-5.1), which can be addressed with radio telemetry (SAI-13). Managers recognized that kelts may be an important tool for salmonid restoration. However, there was no perceived benefit in the Umatilla Basin given the current run sizes. SAI-5 was not developed because of its current ranking.

SAI-6 Juvenile and Resident Salmonid Abundance Surveys:

SAI-6 was an ongoing monitoring activity until 2003 and addressed MIN-6.1-6.4 which ranked 9 in priority in all four subsections. Primary interest in this action is related to trends in abundance, distribution and species composition but also includes interest in carrying capacity, seeding rates, interactions between species, and natural production goals for reintroduced salmon and endemic steelhead. SAI-6 provides data for SAI-15, 16, 18 and 24. The existing design and protocol need modification. The primary change would be from fixed index site sample design to a stratified-random panel design as described by Rodgers (2000).

Consequences of ending SAI-6: Surveying juvenile salmonids through time provides inference to the natural reproductive success of reintroduced salmonids and documents the expansion and contraction of suitable habitat associated with changes in land-use, riparian features and climate. The documentation of juvenile salmonids produced by hatchery reared salmon is a key step in understanding the potential and limitations of this strategy. Monitoring juvenile salmonids is also important in evaluating the response of endemic steelhead juveniles to the reintroduction of salmon fry and parr in natural rearing areas.

Related Management Performance Standards and Measures (MPSM)

Summary of Past Juvenile Abundance Survey Efforts: CTUIR began seasonal presence/absence surveys and more intensive density surveys associated with habitat surveys in 1993. During fall and spring surveys, salmonids were found to use ephemeral streams and explore previously dewatered reaches and channels. From 1993 through 2001, index sites were developed and sampled annually during the summer when conditions and distributions are most limiting. Presence/absence and detailed density surveys continued throughout the basin through 2001. Compiling information gathered from these sampling efforts has provided managers with detailed utilization maps and charts for each species. Surveys also determined many life history characteristics through length and age data collected throughout the basin. In 2002, ISRP recommended the abandonment of existing sampling strategies and the adoption of methods described by Rodgers (2000). Rodgers methods are superior for certain RM&E questions but are in adequate for others. Under the direction of BPA staff, CTUIR sampled several sites throughout the Umatilla and Walla Walla Basin using the old techniques and the techniques recommended by ISRP as described by Rodgers (2000). There were advantages and problems associated with both methods. Methods developed by Glen Mendel (2002), combined with those used by CTUIR and Rodgers will likely provide the most effective methods and maintain consistency between watersheds and across state lines.

Early in the development of the UBNPME project, CTUIR examined stratified random sampling and dismissed it because of a host of problems that would bias the design. For example, landowners sometimes prevent us from sampling in large areas, so obtaining a true unbiased sample design is impossible. Furthermore, we knew that each sampling technique had its own biases and effectiveness in different habitat types. We estimated that a smaller bias and uncertainty could be obtained by holding the methods and locations constant. This seemed reasonable because we were more interested in year to year variation associated with adult spawners and climatic conditions than we were in annual estimates of juvenile production basin-wide. Because fish abundance can change dramatically with habitat features on both large and small scales, CTUIR selected permanent sites at more stable areas for the fixed index sites. Additional presence/absence surveys documented fish distributions seasonally.

CTUIR did not give up on estimating total abundance and production potential of the basin. We used ODFW habitat survey methods to stratify reaches into individual habitat features. We then used a modified Hankin and Reeves (1988) approach and estimated salmonid densities in 5-20 % of each habitat type. We then expanded the estimate based on the quantity of each habitat type. This was done for 160 miles of mainstem and tributary habitat. Population estimates were calculated for each reach (CTUIR 1994, Contor et al. 1995, 1996, 1997, 1998, 2000).

Goal and General Approach:

The primary goal is to document abundance, densities, distributions, species composition in a statistically robust, reliable and cost effective manner.

CTUIR has used a number of methods to examine juvenile salmonid abundance and distribution over the years throughout the Umatilla Basin (presence/absence, modified Hankin and Reeves, CPUE index sites, and density index sites). In 2000, ISRP found CTUIR methods unsuitable during the last provincial review process. During the summer of 2002, we documented that CTUIR methods (Contor et al. 2000) and those described by Rodgers (2000) were both inadequate in assessing juvenile steelhead abundance across different habitat types.

Useful annual basin-wide salmonid abundance estimates require a number of key components. A primary requirement is an unbiased sample design. Theoretically, there will always be some bias in every sample design in the real world; however certain designs are more effective at minimizing or at least randomize that bias. This is the goal of ISRP in recommending the stratified-random design and methods described by Rodgers (2000). A second primary requirement is that each site is sampled in an equal manner and results reflect true abundance or at least have similar biases. The effectiveness and bias of every sampling method is variable between different habitat types. Rodgers (2000) solved the problem of assessing abundance in various habitats by ignoring all but one class of habitat. His methods only samples pools greater than 40 cm deep. Hankin (1984, 1986) solved the problem another way by stratifying by individual habitat type. CTUIR used Hankin's method when estimating population abundance in large stream reaches associated with physical habitat surveys (Contor et al. 1994, 1995, 1996, 1997, 1998, 2000). However, this method was labor intensive and impossible to conduct on a basin-wide scale every year without significant modification.

Only snorkeling selected pools in Umatilla and Walla Walla Basin streams as described by Rodgers (2000) does not appear to be an effective technique for O. mykiss. Juvenile steelhead and rainbow trout can be very abundant in fast water habitats, (Contor et al. 1995, 1996, 1997) they conceal themselves during the day (Mullen et al 1992). They may also move into and out of pools to feed. Furthermore, may of the stream reaches in this area lack pools greater than 40 cm deep. Often we see a few larger rainbows dominating pools. Many of the younger age classes are found outside of the deeper pool habitat.

Other monitoring projects in the region have tried different approaches. For example; Glen Mendel (2002) of WDFW conducted juvenile abundance monitoring in the Washington portion of the Walla Walla Basin. Mendel used snorkeling and electrofishing based on habitat features. Pheadra Budy et al. of the USFWS utilized body tags and visual recapture techniques during snorkeling. CTUIR suggests that each approach has valuable components that should be synthesized into a standardized methodology that would be effective in a broad range of habitat types.

The problem with a synthesis of techniques lies in the original problem of differences in effectiveness and biases of each method. However, as single methods may be most effective with a certain set or class of habitat types. Mendel's concept (2002) of using separate methods where they are most effective expands Rodgers design of a single method for a single habitat type (Rodgers 2000). Taking Mendel's concept a bit further and melding it with the traditional Hankin and Reeves concept would provide three or four standardized fish sampling methods that would be utilized based on habitat criteria. Site selection would be developed using a stratified-random design in a rotating panel schedule as described by Firman and Jacobs (2001). After an initial habitat survey, crews would sample salmonids from several habitat types found in each 1000 m site depending on exiting habitat and detailed criteria. This approach will require additional testing, development and standardization. There are several ongoing regional processes that may also develop sampling strategies and protocols. Until further progress is made regarding juvenile sampling protocols, CTUIR will use snorkeling as the primarily with electrofishing only for fast water habitat types, turbid streams and very low flow conditions.

Study Performance Standards and Measures (SPSM): not yet developed

Reporting: Findings will be examined and discussed in relation to MIN-6 as well as MIN-15, 16, 18 and 24. Trends from multiple years will be examined in relation to adult spawners, relative abundance, climatic conditions, flow, temperatures, and physical habitat condition. Data generated by this SAI are used in other evaluations but the specific methods and results of analysis for those efforts are discussed separately

Potential Problems, Probability of Success: It will be difficult to develop a sampling strategy and protocol that will be approved by ISRP, BPA, ODFW, CTUIR and WDFW so that a consistent approach can be deployed in the region.

Man Days Needed: This is dependant on the sample design, including the number, size and location of sites including the methodology used. Interim monitoring requires approximately 115-120 man days/year if automated data entry tools are used in the field. An additional 10 man days are needed if data is entered by hand from field data sheets.

Schedule: This is also dependant on the final sample design. If seasonal distribution and abundance information is required, sampling could occur during three or four seasons. Interim monitoring will be conducted during July and August.

Special Equipment Needed: electrofishers, dry suits, masks, snorkels, handheld data loggers etc.

SAI-7 Smolt and Parr Outmigration Monitoring:

SAI-7 monitors parr and smolts leaving the Umatilla Basin and addresses MIN 7.1-7.3 regarding their timing, abundance and survival which were ranked 8, 10 and 9 respectively. High priority was placed on abundance estimates for total smolt abundance by species because it is a key life history stage. Once smolt production is know for each year, estimates of adult to egg, egg to smolt and smolt to adult survival can be calculated. These estimates can be used to develop a better understanding of limiting factors and how flow augmentation, passage facility operations and other factors influence salmonid survival at different life history stages. Salmonid production and life history modeling also requires this information and is frequently used to predict effects of proposed management implications.

Consequences of not evaluating smolt out-migrations would require managers to work with adult to adult survival and it would preclude their ability to separate the different life history stages to see where bottlenecks and other problems may exist. Multiple years are required for these types of evaluations because limiting factors can be variable from year to year in association with different flows, weather, management actions etc. This SAI is related to goals for adult returns and natural production. Understanding out-migration abundance, timing, and survival of parr and smolts from the headwaters to TMD and the lower Columbia River will assist managers in optimizing instream flow augmentation, passage facility operations and other management actions.

Related Management Performance Standards and Measures (MPSM): not yet developed.

Summary of Past Efforts:

CTUIR and ODFW collected and marked out-migrants beginning in 1993. PIT tags were not utilized until 1999 because of delays in the installation of mainstem detectors. Prior to PIT tags, we used fin clips for trap efficiency estimates and brands and color injection dyes to mark fish for recapture and lower river sites. Flood flows and trap repairs prevented traps from operating during key periods. Releases of hatchery fish inundated the traps and also required crews to pull trap and neglect key time periods when naturally produced smolts were migrating past the trap. Extracting the trap impacted not only the immediate day but also the trap efficiency estimates for several days.

We attempted to use mark recapture efforts to estimate total smolt out-migration. We planned to tag naturally produced smolts upstream and examine the ratio of tagged to untagged natural smolts at TMD. However, ODFW could not examine enough natural smolts by hand to produce quality estimate. Extra staff could be deployed but that would require the handling of thousands and thousands of hatchery fish to recapture enough natural smolts to make an out-migration estimate.

Goal and General Approach for the SAI: The goal is to estimate salmonid outmigration abundance for each species and stock for hatchery and naturally produced smolts. Currently, at TMD, ODFW staff sub-sample outmigrants, mark both hatchery and wild fish, and generate outmigration estimates by multiplying total catch by the inverse of the trap efficiency estimate for relatively uniform time blocks. Combining the estimates for each time block generates the season abundance estimate.

Methods: Crews capture and PIT tag salmonids at smolt traps. Catch data and trap efficiency rates for each species are used to estimate abundance, migration timing and relative survival of out-migrating parr and smolts. Crews PIT tag juvenile Chinook and coho salmon greater-than 75 mm and steelhead with smolt or partial smolt characteristics (primarily 2+). Fish are anesthetized with MS222 (tricaine methane-sulfonate) and tagged by hand with sterile syringes. PIT tagged fish are measured, held for observation and released. The appropriate tagging and release files are submitted to PTAGIS according to the procedures detailed in the most recent PIT tag specification document. CTUIR coordinates and assists ODFW's PIT tagging project and provides PIT tags for naturally produced fish collected at TMD. After the out-migration year is completed, crews extract detection data from the PTAGIS database and examine survival and arrival times to the different detection facilities for each tag group.

Originally, we planned to estimate total smolt out-migration by examining the ratio of tagged to untagged natural smolts at TMD collected by ODFW. However, because of the large number of hatchery smolts, ODFW cannot examine enough natural smolts by hand to provide a quality estimate without handling thousands and thousands of fish. In an effort to reduce handling stress this method was stopped. Abundance is estimated by multiplying total catch by the inverse of the trap efficiency estimate for relatively uniform time blocks and then combining the estimates for each sub-set for the over all abundance estimate.

Estimates for minimum smolt survival from tagging to detection at TMD and at John Day, The Dalles and Bonneville Dam are based on PIT tag detections and overall detection rates at each dam. If adult returns are adequate, smolt to adult survival rate (SAR) of natural spring Chinook and steelhead will be estimated with the following formula:

$$SAR = \left[\frac{T}{\frac{R-1}{C}}\right](TRR)$$

Where T = Number of PIT tagged individuals released.

R = Number of unique PIT tagged adults (Umatilla origin) observed returning at either the Columbia River dams and at TMD.

C = Total number of tagged and untagged natural adults observed at TMD.

TRR = Mean tag retention rate.

We assume that most of the tags will be retained and function at the lower river detection sites even though only a small proportion may be detected. We will use a compilation of the most recent PIT tag retention studies as the assumed tag retention rate for adult salmon. For a functional estimate of smolt to adult survival, we need at least 20 adult detections but more detections would improve the estimate. If smolt to adult survival were 1%, we would need to tag at least 2000 smolts. If natural production and trapping activities provide additional smolts and tagging opportunities, we will increase the number of tagged smolts to well over 3000 because smolt to adult survival rates of naturally produced fish will likely be lower than 1%. After we obtain initial results, we will determine the utility of this evaluation technique and make appropriate adjustments.

Study Performance Standards and Measures (SPSM):

Reporting: Findings will be examined and discussed in relation to MIN-7. Trends from multiple years will be examined in relation to adult spawners, relative abundance, climatic conditions, flow, temperatures, and physical habitat condition. Data generated by this SAI are used in other evaluations but the specific methods and results of analysis for those efforts are discussed separately.

Potential Problems, Probability of Success: It is difficult to meet standards required for quality mark recapture estimates more than half of the time. There are generally large uncertainties related to the outmigration estimates and estimates of confidence intervals. It is often difficult to recapture enough parr during both high and low flow events to produce reliable estimates for those times. This is also true at the beginning and end of the outmigration season. Problems also occur during icing, low flow and floods when debris loads are heavy.

Man Days Needed: 300 man days/year for trapping and tagging for both CTUIR and ODFW traps. 30-45 man day/year for data summarization.

Schedule: Trap below the mouth of Birch Creek from November through May. Assist ODFW with fish handling and tagging with passive integrated transponder (PIT) tags at Three Mile Dam and Westland during the juvenile out-migration season (March-June). Digitize and summarize data within 10 days of collection. Submit data to PSMFC's PIT Tag Information System (PTAGIS) within 15 days of collection. Retrieve detection files and collate data by September 2003. Complete results and discussion portions of the annual report by the following April.

Special Equipment Needed: Smolt traps, PIT tagging equipment and detectors, laptop computer, PTAGIS software, internet service and PIT tags.

SAI-8 Fish Habitat Inventories:

Fish habitat inventories were ranked 5. There may be greater interest if habitat surveys are combined with the juvenile monitoring surveys (stratified random design, basin-wide). However, there does not appear to be much support for the traditional intensive habitat surveys that were conducted in the Umatilla River Basin from 1993-1998. Managers recognize the importance of quality aquatic habitat for salmonids and have a fairly good understanding about the condition of aquatic habitats throughout the Umatilla Basin. SAI-8 was not developed because of its current ranking. If SAI-8 were developed, work would follow the latest standards should regional methods and protocols be developed through ongoing processes (see Johnson et al. 2001 and CBFWA 2002).

SAI-9 Water Temperature Monitoring:

SAI-9 is a basic monitoring activity and it is addresses MIN-9.1 and 9.2 which were ranked 7 and 5 respectively. Managers expressed more interest in water temperature monitoring if directly related to specific actions.

Related Management Goal: Water temperature monitoring is related to basin-wide TMDL goals and habitat enhancement efforts including the management of Phase II and proposed Phase III flow augmentation projects (SAI-23).

Consequences of not monitoring water temperatures: CTUIR temperature data is the most frequently requested data type. Managers placed a high priority on the causes of prespawning mortality of spring Chinook salmon. Much of the summer habitat in the Umatilla River Basin lacks salmonids because of water temperatures. By monitoring water temperatures we can determine if restoration actions are effective in increased the area of suitable salmonid rearing and spawning habitat. Habitat restoration projects include measures to improve stream temperature profiles (riparian vegetation for shading, back stability and to narrow streams wetted widths). Monitoring documents how well these programs are working in regard to temperature performance standards.

Related Management Performance Standards and Measures (MPSM): ODEQ water quality benchmarks 55, 64, and 68 F for various salmonids and life history stages.

Summary of Past Efforts: CTUIR, ODFW and USFS have monitored water temperatures throughout the basin for years. More intensive monitoring began in the early 1990s and now includes over 70 temperature monitoring sites.

Goal and General Approach: The goal is to accurately monitor water temperatures throughout the basin and make the data available online for general and specific research and management needs.

Methods: see Chapter 5

Study Performance Standards and Measures (SPSM): See methods in Chapter 5.

Reporting: Findings will be summarized and placed on the web. Data generated by SAI-9 are used in other evaluations but the specific methods and results of analysis for those efforts are discussed separately

Potential Problems: Problems are generally minimal but data can be corrupted or lost from individual units. Data corruption occurs when a unit fails, is improperly deployed, or when the unit is buried, dewatered, or taken out of flowing water. Floods, animals and humans can all corrupt temperature data. CTUIR generally secures and hides thermographs but occasionally one will be displaced or stolen.

Probability of Success: High

Man Days Needed: This is highly variable depending on the number and location of thermographs. A technician can easily deploy 10-15 units at convenient locations in a day. Back country sites can require and entire day. Currently UBNPME project deploys 27 thermographs. Field work and associated data summaries require approximately 32 man-days/year.

Schedule: Thermographs are tested in March, deployed in May, checked each month from April through October, recovered in November, tested in December and processed in January.

Special Equipment Needed: Thermographs, computer interface, and software.

SAI-10, Harvest Monitoring:

Harvest monitoring addresses MIN-10.1-10.3 which were each ranked 9.

Related Management Goal: Harvest opportunities have always been important management goal for salmonid restoration efforts in the Umatilla River Basin.

Consequences of not addressing MIN-10: Monitoring is an essential element in documenting the benefit of Umatilla River programs and with keeping harvest within management guidelines outlined in the Master Plan (CTUIR 1984). Spring Chinook harvest estimates are normally calculated and reported weekly so that managers can extend or close fisheries depending on harvested rates and established quotas. Harvest estimates are also important in estimating spawning escapement. We subtract catch estimates from the number of adults above TMD to estimate adults available for spawning (SAI-2).

Related Management Performance Standards and Measures (MPSM): Managers have adult return goals and harvest goals for each salmon and steelhead stock. Harvest goals are on a sliding scale when adult returns are below goals.

Summary of Past Efforts: CTUIR and ODFW have monitored harvest from 1993 through 2002 as summarized in Table 6-6. Out of basin harvest estimates are based on CWT returns (Table 6-7).

Table 6-6. Summary of Estimated Tribal and Sport Harvest (ODFW data) of Summer Steelhead and Spring Chinook Salmon from 1993 through 2000.

Year	Summer Steelhead Caught				Spring Chinook Salmon Harvested		
	Tribal* Harvest	Sport Harvest	Sport Released	Total Kept	Tribal	Sport	Total
1993	35	37	140	72	176	18	194
1994	25	19	44	49	0	0	0
1995	30	61	196	91	0	0	0
1996	39	60	172	99	167	206	373
1997	33	91	205	123	184	31	215
1998	38	101	281	141	0	0	0
1999	44	101	303	145	110	10	120
2000	99	78	476	177	678	584	1262
2001	84	90	205	174	247	543	790
2002	**	204	789	**	245	749	994

* Estimated Tribal harvest includes some wild fish.
** Incomplete Survey

Table 6-7. Summary of Estimated Harvest Outside of the Umatilla River Basin for Hatchery Summer Steelhead and Hatchery Spring Chinook Salmon Adults Returning from Releases in the Umatilla River.

Year of Release	Summer Steelhead			Spring Chinook
	Canada and Idaho Catch	Columbia River Catch (Nets)	Columbia River Sport Catch	Ocean and other Columbia Basin Catch
1988	2	88	15	366
1989	0	0	6	107
1990	0	136	74	301
1991	0	119	64	48
1992	0	48	4	12
1993	0	30	56	0
1994	0	42	157	73
1995	0	100	75	32
1996*	0	26	28	0
1997*	0	16	2	0
1998*				
1999*				
2000*				
Total	2	605	481	939

* all data from coded wire tags not yet available

Goal and General Approach: The goal is to provide accurate harvest estimates and low costs. The variability from year to year of the tribal angling seasons and locations often requires significant modifications of survey designs. CTUIR employed a non-uniform probability roving creel surveys designed after Malvestuto (1983). Tribal steelhead fisheries begin in February and extend to April 15, 2003. Fishing pressure is often minimal and steelhead creel surveys do not yield sufficient data to calculate angler effort, catch rates, and total harvest. Surveying anglers via telephone or direct off-stream interviews provide additional information about tribal fishing effort and catch. We propose to improve the telephone surveys by using a more statistically robust survey design patterned after ODFW's big game harvest surveys they conduct statewide

Study Performance Standards and Measures (SPSM):

Reporting:

Potential Problems:

Man Days Needed: Staffing needs are seasonally dependant but can range from 6 to 90 man days/year. Tribal spring Chinook salmon fisheries were originally only open on weekends for three or four weeks. During the 2001 and 2002 spring Chinook fisheries, were opened every day for several months. Steelhead surveys require 28 man days/year. Telephone surveys require 20 man days/year.

Schedule: Monitor anglers from February through April 15 for the steelhead fishery, and from May through July for the spring Chinook fishery. Conduct telephone surveys in August after the closure of the both fisheries

Special Equipment Needed: None

SAI-11 Adult Salmon and Steelhead Straying: Associated MIN ranked 8, ODFW addresses this SAI through their hatchery M&E project.

SAI-12 Hatchery Program Monitoring: The associated MIN 12.1-12.7 all ranked 9 regarding steelhead. ODFW addresses these SAI through their hatchery M&E project.

<u>Evaluation SAI</u>

SAI-13 Adult Migration Evaluations: The MIN received moderate ranks primarily because CTUIR completed SAI-13 during 1993-1996 (Contor et al. 1997). However some questions remain. Passage was suitable for all species under most conditions at all passage facilities except Feed Canal Dam (sometimes called Cold Spring Dam on the Umatilla River at RM 28.2). Feed Canal Dam continues to be a problem when gravel and coble is deposited between the ladder and the main channel. The nature of and location of the dam is not suitable for passage. While several proposals have been developed, no solutions have been funded.

SAI-14 Juvenile Salmonid Passage Evaluations: The associated MIN ranked low primarily because ODFW completed SAI-14 during 1990-1996 (Knapp et al. 1996, 1998 and 1999). Juvenile passage facilities were found to be adequate however some grate designs and facility operations were changed.

SAI-15 Salmonid Productivity, Fitness and Survival Rates: The associate MIN 15.1-15.6 ranked 9,9,9,9,9and 6 respectively. This SAI has not been adequately addressed or developed. ODFW and CTUIR have work in progress that will begin to address some of these issues but a SAI plan has not been formally developed.

SAI-16 Interactions between Fish and Habitat: The associate MIN 16.1-16.5 ranked 8,8,8,6 and 6 respectively. This SAI has not been adequately addressed or developed yet was ranked moderately high. CTUIR has conducted some habitat restoration efficacy evaluations (Childs 2002). CTUIR is currently proposing a habitat restoration project of Patawa and Tutuilla Creeks. The proposal currently includes extensive hydraulic and fisheries monitoring in control and treatment sites.

SAI-17 Determine Optimal Hatchery Practices: The associated MIN 17.1-17.10 ranked from 4 to 9. ODFW will need to address the higher priority SAI through their hatchery M&E project. ODFW has addressed some of these SAI, Other SAI-17 sub items are being addressed in neighboring hatchery programs ("nature's rearing") and it is premature to begin similar evaluation until ongoing evaluations generate findings. The high cost of retrofitting hatcheries for "nature's rearing" plays a role in the decision to wait for more results.

SAI-18 Evaluating Similarities and Differences between Hatchery and Natural Fish: The associated MIN 18.1-18.4 ranked fairly high, 8, 8, 8 and 6 respectively. ODFW will need to address this SAI through their hatchery M&E project. Considerable interest and controversy remains region wide about the roll of hatchery supplementation for restoration of anadromous salmonid stock (Waples et al 2001, Cuenco 1993). Supplementation evaluation related SAI (1-7, 11, 15, 18, 21, 22 and 24) examine specific portions of supplementation issues.

SAI-19 Harvest Related Evaluations: The associated MIN 19.1 -19.4 ranked low, 7, 5, 4 and 6, respectively. This SAI has not been addressed or developed

SAI-20 Kelt Reconditioning Evaluations: The associated MIN all ranked low , 4,4,4 and 4 so this SAI was not developed. Current regional proposals aim to address this issue with field work that may or may not include the Umatilla River.

Research SAI

SAI-21 Develop and Utilize Progeny Mark: The associated MIN 21.1-21.7 were all ranked 9.

Related Management Goal: CTUIR managers assume that endemic hatchery reared steelhead returning to the Umatilla River successfully spawn naturally and their natural progeny contribute to subsequent adult returns. This SAI and SAI 22.7 would test current assumptions about the natural reproductive success of hatchery spawners. This is a critical uncertainty identified by NMFS RPA

Summary of Past Efforts: CTUIR M&E staff proposed to develop the progeny marker in 1994-1995 but there was little interest in the concept until the need to understand the reproductive success of hatchery fish spawning in natural habitat was identified at the regional scale in 2001. Preliminary results form CTUIR's initial trials at OSU will be available in December of 2003.

Goal and General Approach: Develop and test a delivery agent and methodology to incorporate a marker into the otoliths of the progeny of female salmonids prior to spawning.

A progeny mark would assess the relative reproductive success of hatchery and wild steelhead spawning naturally. The Umatilla River Summer Steelhead Program artificially supplements Umatilla steelhead using wild endemic broodstock to prevent domestication. Hatchery reared steelhead are the progeny of about 115 wild parents taken annually from a cross section of the run. Historically, hatchery steelhead comprised from 10 to 60 percent of the adult returns (from 1986 to 1998; James et al., 2001). From 1999-2002 hatchery fish represented 25 to 40% of the run. Hatchery reared endemic summer steelhead are frequently observed digging redds and spawning naturally during spawning surveys (Contor et al. 1998, and Chapter 4).

The current management goal and assumption is that returning hatchery-reared steelhead reproduce successfully and enhance natural production. However, because the supplementation program uses endemic steelhead for broodstock, there remains an inability to evaluate the reproductive success of hatchery fish using genetic markers. Pedigree analysis is a relatively new genetic technique that matches parents to progeny (Wilson and Ferguson 2002). However, on a basin-wide scale, with as many adults and progeny as we have in the Umatilla Basin, pedigree analysis was originally thought to be too expensive and complex for such a large population with multiple life history types.

This project will evaluate how well strontium concentrations can be elevated in the progeny of female trout injected prior to spawning. For the progeny mark to be successful, eggs must absorb the strontium before spawning and incorporate it into boney tissues during the first stages of growth. Past studies have shown that erythromycin phosphate can pass from maturing females into the developing ova and resultant embryos (Haukenes and Moffitt, 1999). Strontium is a likely candidate for marking otoliths because strontium can act as a substitute for calcium in the calcium carbonate matrix of the otolith. Normally, boney structures contain strontium at levels relative to background concentrations in the environment (Kalish, 1990). Strontium is ideal because its binding characteristics are similar to calcium (i.e. similar ionic radius and identical valence).

The elemental composition of fish bony structures, such as fin rays, scales and otoliths, provide a natural record of the chemical composition of environments experienced by individual fish (Gallahar and Kingsford, 1996; Wells et al., 2000). The concentration of strontium is greater in seawater than most fresh water habitats. Therefore, analysis of Sr: Ca ratios across the otolith of a fish can describe the anadromous history of that fish. Further comparison of Sr:Ca ratios in the primordia (core region) and freshwater growth region can be used to determine maternal life histories (resident or anadromous). Rieman (et al, 1994) analyzed otolith microchemistry to determine whether adult spawners were the progeny of migratory sockeye salmon or non-migratory kokanee. Zimmerman and Reeves (2000 and 2002) repeated similar findings with steelhead and rainbow trout (see Figure 6-8).

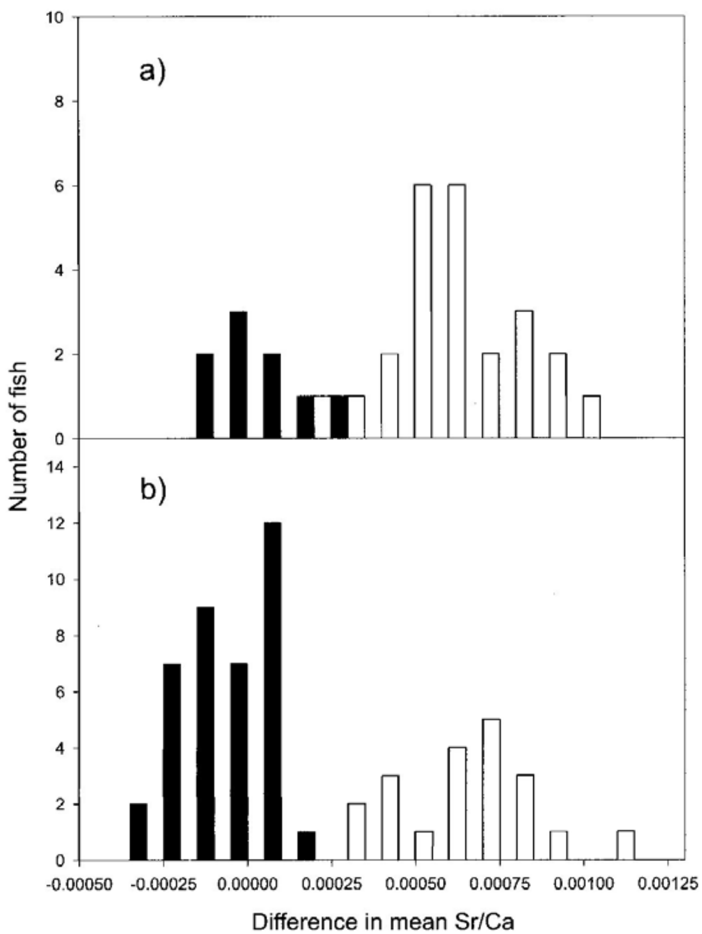

Figure 6-8. Frequency distribution of the difference between mean primordia Sr: Ca ratios and mean freshwater growth region Sr: Ca rations for resident rainbow trout (solid bars) and steelhead (open bars) in the Babine River, British Columbia (a), and the Deschutes River, Oregon (b). (Reproduced from Zimmerman and Reeves, 2000)

Researchers artificially increased chemicals such as strontium in otoliths, scales, vertebrae and/or dorsal spines of fish directly (Schroder et al. 1995, Behrens-Yamada and Mulligan 1982, Snyder et al., 1992, and Pollard et al., 1999). We hypothesize that we can mark the otoliths of juvenile rainbow trout by administering the marking agent to their female parents. We expect fish to mobilize stable strontium within the blood plasma by the yolk precursor vitellogenin, and into the developing ova. Ultimately, progeny will incorporate strontium (at small but elevated rates) into the primordia of developing otoliths because fish substitute small amounts of strontium for calcium in bony structures (Kalish 1990). Some ion exchange occurs between the female and her eggs in the period before spawning and such exchange may continue to influence the yolk content prior to spawning (Alderdice 1988). Continuing ion exchange late in the development stage of eggs prior to spawning should provide elevated strontium concentrations in the otoliths of the progeny.

The primordia of salmonid otoliths are the first calcified structures to form in the developing embryo and are present at least several weeks before hatching (Rieman and Myers, 1994). We do not expect to find elevated levels of strontium in scales or fin rays because those boney structures develop much later than otoliths. However, because researchers have artificially increased strontium in bony structures of fish through direct methods (Behrens-Yamada and Mulligan 1982, Snyder et al.1992, Pollard et al., 1999), we will conduct some additional strontium testing on scales and fin rays of marked progeny to determine if non-lethal sampling alternatives would be practical.

Researchers have proven radioactive isotopes to be effective markers of fish. However, marking fish with stable salts such as strontium chloride has many advantages over radioactive tagging. Radioactive materials are comparatively expensive, environmentally unattractive, and a potential threat to human health. The threat to human health is an important concern with radioactive isotopes because anglers may catch and consume the steelhead that would receive the proposed marker.

Guillou and de la Noue (1987) suggested using strontium to mark farm-reared brook trout destined for human consumption. In fact, fish artificially marked with strontium in that particular study did not demonstrate any abnormal increase in strontium content of muscle or skin tissue. We will be introducing strontium in the fish in a different manner (injected into the peritoneum or dorsal sinus); therefore, we will examine the concentrations of strontium in muscle and skin tissues to ensure there is no over-accumulation of strontium.

After developing and testing the marker, CTUIR will inject hatchery steelhead (identified by a fin clip) with the marker medium at the Three Mile Dam Trap on the Umatilla River. The marked adults released at Three Mile Dam will spawn naturally and surviving progeny would carry the mark throughout their lives. The chemical composition of otoliths primordia from a sample of naturally produced progeny would indicate the ratios of progeny from marked (hatchery reared) and unmarked (wild) females. This would provide a means of evaluating the relative reproductive success of the endemic hatchery-raised females that spawn naturally.

Methods:

A literature review will be conducted to update the existing bibliography and expand the search to include more aspects of the research project (from micro-probe techniques to the recommended strontium concentrations for the marker solution).

CTUIR will use information from published research papers in consultation with OSU staff to determine the strontium solutions for the initial trial. Past research shows that a strontium salt (such as strontium chloride) may work effectively in a similar manner that erythromycin phosphate worked to carry erythromycin into the ova of maturing females (Schroder et al. 1995, Haukenes and Moffitt 1999).

CTUIR and OSU staff will spawn 60-80 steelhead at Smith's Fish Farm where there is lab space and circular tanks to hold the progeny separately for the control and treatment groups. CTUIR and OSU staff will care for the 100 broodstock held at the OSU facility. Females will be divided and marked into in two treatment and one control group. Treatment groups will receive their respective concentrations of strontium based solutions as determined in the final experimental design. The control and treatment groups will each contain 20 fish with six or seven alternates (to allow for pre-spawn mortality, see Figure 6-9).

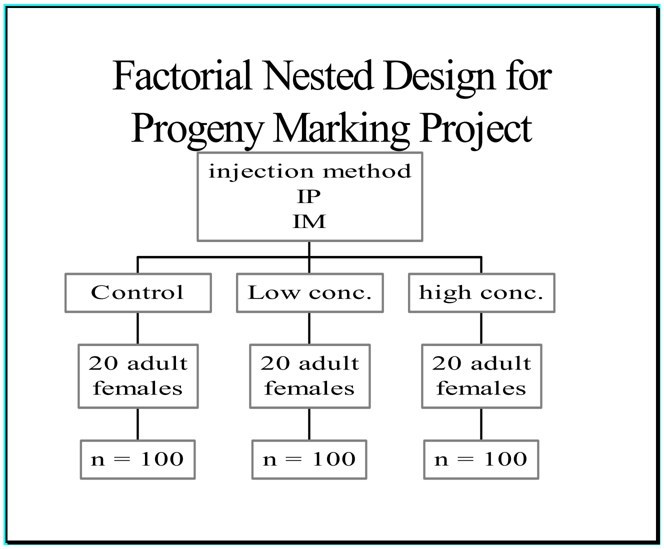

Figure 6-9: A factorial nested design for the progeny marking study

CTUIR and OSU staff will artificially spawn 20 females from each treatment group and keep approximately 200 eggs from each female. Eggs will be held separately from each treatment group through incubation. If space and dividers are available, we will hold progeny from each female separately so we can test strontium concentrations of progeny from both within and between females and from within and between treatments.

CTUIR staff will incubate the eggs and rear the progeny at the OSU hatchery. CTUIR staff will care for juveniles including cleaning and keep detailed records of survival, feeding and growth for each group to document any observable effects of the treatments. The flesh and skin of marked will be tested adults to ensure that strontium concentrations in fish flesh do not pose a risk to fish or humans consuming treated fish.

Otoliths will be extracted from 300 progeny (100 from each group), carefully labeled and prepared for elemental analysis using the methodology outlined in Zimmerman and Reeves (2000)

Staff will mount one otolith from each fish, with sulcus side down, with Crystal Bond 509 on a microscope cover slip attached to a standard microscope slide. CTUIR staff will grind the otolith down to expose the primordia in preparation for elemental analysis with a wavelength dispersive microprobe. We will select additional fish randomly from each treatment group if sample sizes need to be enlarged or if mistakes are made during preparation or sampling.

Strontium to calcium ratios within otoliths will be determined with a wavelength dispersive microprobe using a 15-kV, 50-nA, 7 μm diameter beam to sample all primordia and several transects of adjacent growth regions.

Data obtained from spawning, fertilization rates, early rearing survival, and strontium-calcium rations in the otolith will be summarized. Factorial nested ANOVA will be used to test for significant differences between treatment and control groups.

Reporting: Work accomplishments will be summarized in monthly reports. Annual report will summarize the project including background, methods, results, discussion and literature cited. Other reports include BPA-required Progress Report on Reasonable and Prudent Alternatives (RPAs) in compliance with the 2002 Federal Columbia River Power System (FCRPS) Biological Opinion (BiOp). Year-end or more frequent accounting accrual projections that BPA will use to more closely monitor projected expenditures (similar to all BPA funded projects).

Potential Problems: High variation of the marker in otoliths would be a potential problem as would lethal or debilitating affects of the marker on parent or progeny.

Probability of Success: High.

Man Days Needed: During implementation, this project requires one full time biologist, one month of a project leader and six months of technician time; 410 man day/year.

Schedule: Marker development and testing begin October 2002 and is scheduled through November of 2004.

Provided the progeny marker is successfully developed and tested, we plan to mark adult hatchery female steelhead returning to the Umatilla River Basin starting in the spring of 2005. The application of the progeny mark in the Umatilla River will need to continue for at least five years to evaluate the variability of the reproductive success of hatchery steelhead spawning naturally. The progeny of females of the 2009 brood year may return as adults as late as 2014. We plan to complete this project by 2014 if we use adult returns for the final evaluation of reproductive success of hatchery spawners. Otherwise, we could complete this project by 2011 if we base the estimates of reproductive success on smolt production and exclude the older, age 3+, smolts (we would prefer to look at smolts and adults). ESA restrictions may prevent the extraction of otoliths from naturally produced smolts. In this case, we would extract otoliths from adult returns (primarily hatchery broodstock of natural origin) and not complete the final evaluation until 2014 at the earliest.

Special Equipment Needed: Specialized equipment is available at OSU.

SAI-22 Genetic Studies:

Genetic related MIN 22.1-22.8 ranked high to moderate 9, 9, 7, 9, 6, 9, 9 and 6. High ranks were specific to steelhead and not related to other salmonids in the basin. This SAI has not been developed.

Related Management Goal: CTUIR and ODFW have management goal specifically stating that Maintain the genetic character of salmonids native to and re-established in the Umatilla River Basin. (CTUIR 1984 and ODFW 1986).

Summary of Past Efforts: Currens and Schreck (1993 and 1995) evaluated Umatilla Basin steelhead and rainbow trout in 1992 and 1994. They found broad heterogeneity without consistent geographic pattern. Narum et al. (2003) examined naturally produced Umatilla steelhead adults and found close relationships with Snake River steelhead sampled at Lyons Ferry Hatchery.

Goal and General Approach: There are two main goals, the first goal it to address MIN-22.1-22.8. and compare to findings of surrounding areas (Ruzycki et al.) The second goal it to assemble a genetic data archive for the Umatilla Basin steelhead and bull trout. The concept is to collect samples annually with standardized sample designs and protocols. The tissue archive will be used to provide materials for current evaluations as well as future genetic research questions that have not yet been identified or formally developed. Annual steelhead samples will be taken from 1) all steelhead broodstock, 2) 100 naturally produced smolts at TMD and 3) 100 adult steelhead returning to TMD. Samples will include date, location, age, sex, length, origin and distinctive features. Bull trout samples will be taken only when bull trout are captured incidentally until formal studies are developed and approved through NMFS.

SAI-23, Develop and Test Phase II and Phase III Flow Augmentation Models: This was given a high priority ranking (9).

Related Management Goal: Utilize irrigation and designated fish-water stored in McKay Reservoir to maximize salmonid benefits under a wide array of conditions. Flow augmentation and management was a large part of the original basin restoration plan. Modeling would allow managers to explore "what if "questions more realistically especially during droughts.

Consequences of not addressing this MIN: Reduction in potential salmonid benefits in lower McKay Creek and in the lower Umatilla River.

Summary of Past Efforts for this SAI: CTUIR collects base line temperature data for this SAI. The TMDL process in the Umatilla Basin generated a Umatilla River temperature model with CTUIR (et al.) temperature data. BOR has developed a model for McKay Reservoir and McKay Creek with CTUIR and BOR data. While the precursors are in place the associated SAI have not been adequately developed.

Goal and General Approach: The goal is to develop a tool for managers to optimize the benefits of Phase I –III of the flow augmentation projects. The approach is to modify and link existing models and examine benefits of flow management as well as riparian and channel restoration options.

SAI-24: Ecological Interactions: The associated MIN 24.1-24.4 were given low ranks, 7, 7, 7 and 4 respectively. Because of the low ranks this SAI has not been developed.

RM&E Coordination Framework on Local, Province and Regional Scales
Coordination at multiple scales requires willingness and cooperation of many agencies and groups. We plan to incorporate as many willing partners in to the RM&E planning process as possible through the AOP and UMMEOC at the local level. The coordination framework at the Province and Regional Scales will come through mandates of both funding (BPA) and regulatory agencies (USFWS, NMFS). CTUIR hopes to blend the Provincial and Regional management information needs with the needs of local managers. We plan to adapt our standard monitoring methods, protocols, data management formats and reporting standards to the recommendations developed through the ongoing CBFWA, NMFS, USFWS and ISRP processes.

Data Management and Reporting
Until regional formats are developed, we will manage existing data bases with our current formats and develop reports using MS Word. We will continue to post the data and reports on the CTUIR web site and forward electronic and hard copies of the reports to BPA annually. We will use regional reporting and data management formats and standards once they are developed and adopted provided they are reasonable and prudent.

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