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THE UMATILLA BASIN NATURAL PRODUCTION MONITORING AND EVALUATION PROJECT

PROGRESS REPORT
2003-2004

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List of Abbreviations

AOP-Annual Operating Plan
BOR-Bureau of Reclamation
BPA- Bonneville Power Administration
BT-Bull Trout
CBFWA-Columbia Subbasin Fish and Wildlife Authority
CPUE-Catch Per Unit Effort
CSMEP-The Collaborative System-wide Monitoring and Evaluation Project
CTUIR-Confederated Tribes of the Umatilla Indian Reservation
CWT-Coded Wire Tag
EDT-Ecosystem Diagnosis and Treatment model
EMAP-Environmental Monitoring and Assessment Program
ESA-Endangered Species Act
ISRP-Independent Scientific Review Panel
NMFS-The National Marine Fisheries Service
NOAA-National Oceanic and Atmospheric Administration
NPMEP-Natural Production Monitoring and Evaluation Project
NWPCC-Northwest Power and Conservation Council
ODFW-Oregon Department of Fish and Wildlife
PIT-Passive Integrated Transponder
PITAGIS-Central PIT tag database
PNAMP-The Pacific Northwest Aquatic Monitoring Partnership
M&E-Monitoring and Evaluation
3MFD-Three Mile Falls Dam
UMMEOC-Umatilla Management, Monitoring, and Evaluation Oversight Committee
UMEP-Umatilla Monitoring and Evaluation Program
USACOE-United States Army Corp of Engineering
USFWS-United States Fish and Wildlife Service
USGS-United States Geological Survey

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1 Introduction

The Umatilla Basin Natural Production Monitoring and Evaluation Project (UBNPMEP) is 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).

UBNPMEP is coordinated with two ODFW research projects that also monitor and evaluate the success of the Umatilla Fisheries Restoration Plan. Our project deals with the natural production component of the plan, and the ODFW projects evaluate hatchery operations (project No. 19000500, Umatilla Hatchery M & E) and smolt outmigration (project No. 198902401, Evaluation of Juvenile Salmonid Outmigration and Survival in the Lower Umatilla River). Collectively these three projects comprehensively monitor and evaluate natural and hatchery salmonid production in the Umatilla River Basin. Table 1 outlines relationships with other BPA supported projects.

Table 1. Projects related to the Umatilla Natural Production Monitoring and Evaluation Project

BPA Project Number	Project Title	Relationship to this project
198902401	Evaluation of juvenile salmonid outmigration & survival in the lower Umatilla River basin.	Monitors survival of outmigrants whose rearing status would be assessed by this project.
198710001	Umatilla River Basin Anadromous Fish Habitat Enhancement Project	Enhances habitat for juvenile and resident fish whose status would be assessed by this project.
198710002	Umatilla River Basin Fish Habitat Improvement	Improves habitat for juvenile and resident fish whose status would be assessed by this project.
198343500	Operate and Maintain Umatilla Hatchery Satellite Facilities	Acclimates and releases salmonids whose status or progeny's status would be assessed by this project.
198343600	Umatilla Basin Fish Facilities Operation and Maintenance	Maintains passage for salmonids whose rearing status would be assessed by this project.
199000500	Umatilla Fish Hatchery Monitoring and Evaluation	Monitors adult status trends from same stocks as those whose rearings status would be assessed by this project.

The need for natural production monitoring has been identified in multiple planning documents including Wy-Kan-Ush-Mi Wa-Kish-Wit Volume I, 5b-13 (CRITFC 1996), the Umatilla Hatchery Master Plan (CTUIR & ODFW 1990), the Umatilla Basin Annual Operation Plan (ODFW and CTUIR 2004), the Umatilla Subbasin Summary (CTUIR & ODFW 2001), the Subbasin Plan (CTUIR & ODFW 2004), and the Comprehensive Research, Monitoring, and Evaluation Plan (Schwartz & Cameron Under Revision). Natural production monitoring and evaluation is also consistent with Section III, Basinwide Provisions, Strategy 9 of the *2000 Columbia River Basin Fish and Wildlife Program* (NPPC 1994, NPPC 2004).

The need for monitoring the natural production of salmonids in the Umatilla River Basin developed with the efforts to restore natural populations of spring and fall Chinook salmon, (*Oncorhynchus tshawytsha)* coho salmon and (*O. kisutch*) and enhance summer steelhead (*O. mykiss*). The need for restoration began with agricultural development in the early 1900's that extirpated salmon and reduced steelhead runs (BOR 1988). The most notable development was the construction and operation of Three-Mile Falls Dam (3MD) and other irrigation projects that dewatered the Umatilla River during salmon migrations. 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 the historical fisheries in the basin. The 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 characteristics of salmonids in the Umatilla River Basin.
5) Produce almost 48,000 adult returns to Three-Mile Falls Dam. The goals were reviewed in 1999 and were changed to 31,500 adult salmon and steelhead returns (Table 2).

Table 2. Current natural and artificial production goals for the Umatilla River Basin as established 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	1,500	4,000	5,500
Steelhead	6,000	Undetermined	6,000
Adult Coho Salmon	6,000	Undetermined	6,000
Total			31,500

We conduct core long-term monitoring activities each year as well as two and three-year projects that address special needs for adaptive management. Examples of these projects include adult passage evaluations (Contor et al. 1995, Contor et al. 1996, Contor et al. 1997, Contor et al. 1998), genetic monitoring (Currens & Schreck 1995, Narum et al. 2004), and habitat assessment surveys (Contor et al. 1995, Contor et al. 1996, Contor et al. 1997, Contor et al. 1998). Our project goal is to provide quality information to managers and researchers working to restore anadromous salmonids to the Umatilla River Basin. This is the only project that monitors the restoration of naturally producing salmon and steelhead in the basin. For the 2003-2004 contract period UBNPMEP was tasked with the following objectives:

Objective 1 (Section 3). Monitor spawning activities of hatchery and natural adult spring Chinook, and summer steelhead in the Umatilla River Basin.

Objective 2 (Section 4.3). Estimate tribal harvest of adult salmon and steelhead returning to the Umatilla River Basin using the same telephone and field survey techniques that were used in 2004.

Objective 3 (Section 4.2). Monitor water temperatures in the Umatilla River Basin in cooperation with other monitoring agencies.

Objective 4 (Section 3). Determine age, origin and life history characteristics of adult spring Chinook salmon and summer steelhead in the Umatilla River Basin.

Objective 5 (Section 4.4). Meet the required administration processes of BPA, GSA, ESA, USFWS, USFS, NMFS, Columbia River Inter-Tribal Fisheries Commission (CRITFC), CBFWA, ISRP, NPPC, ODFW, WDFW, ODEQ, 3MDL, watershed assessments, master plans, subbasin plan reviews, UMMEOC and AOP.

Objective 6 (Section 4.4). Coordinate with ODFW and various regulatory, management and funding agencies to finalize a comprehensive RM&E Plan for salmonids in the Umatilla River Basin. The plan will guide RM&E efforts regarding salmonid hatchery production, steelhead supplementation issues, genetic issues, habitat restoration, and salmon and steelhead harvest monitoring.

Objective 7 (Section 4.4). Convert project statement of work from 2004 format to PISCES format.

A brief summary of conditions in the Umatilla Subbasin is presented in Section 2. Methods for field activities are described in section 3. Results and a discussion of potential management implications based on the 2003-2004 contract period are discussed in Sections 4. Future work is described in Section 5.

2 The Umatilla Subbasin

The Umatilla River originates in the west slopes of the Blue Mountains near Pendleton, Oregon and drains an area of approximately 2,290 square miles. Elevations in the subbasin range from about 260 to 5,800 feet above sea level (Figure 1). The mouth of the Umatilla River is located 3 miles below McNary Dam at river mile (RM) 289 of the Columbia River. The Umatilla River mainstem length is 89.5 miles and can be delineated into eleven management watersheds (Figure 2). Length, drainage area, and location of these eleven watersheds are shown in Table 1. Mean annual precipitation ranges from 10 to 50 in/yr across the lower to upper subbasin, respectively. Precipitation mainly occurs between late-fall and early-spring. Water runoff is typically highest in March and April, and lowest in September. The majority of land in the Umatilla Subbasin is privately owned (82%). Most public land is within the boundaries of the Umatilla National Forest (Figure 3).

The subbasin can be roughly divided into two physiographic regions located north and south of Pendleton. The Blue Mountains dominate the region south of Pendleton. Grasses and small shrubs dominate the drier, south facing slopes. Conifers dominate the north facing slopes and higher elevations. Miocene basalts are the dominant parent materials in this area. The combination of steep canyon walls and predominantly impervious bedrock leads to "flashy" runoff and poor ground water recharge. Extreme low flows are common during summer and dry conditions. This effect is less pronounced in the Upper Umatilla River and Meacham Creek watersheds, which supply 40-50% of the average flow to the Umatilla River.

North of Pendleton the river has cut a low valley into a broad upland plain. The geology is dominated by basalt bedrock with loess, alluvial and glaciofluvial deposits (Walker & MacLeod 1991). Vegetation is predominately agricultural crops and sagebrush-grass communities. Historically, deciduous trees were abundant in riparian areas, but are now greatly reduced as a result of clearing and stream channelization for agriculture and urban development. Impacts of water diversion on river flow is most pronounced in the lower 35 river miles where six major irrigation dams were constructed in the early 20th century. Irrigation storage reservoirs were constructed in the Cold Springs and McKay Creek watersheds in 1917 and 1927, respectfully. Release of stored water from McKay Reservoir in summer significantly reduces water temperatures in the mainstem Umatilla River below RM 52. Surface water is diverted for irrigation, storage, or groundwater recharge almost year-round with highest removals occurring in April and May (over 400 cfs). Historically, irrigation withdrawals dewatered sections of the lower river for periods mostly in the summer, fall, and winter, but also during low flow periods in the spring. Over the past decade, a flow enhancement program that provides Columbia River water to irrigators has been implemented to improve anadromous salmonid passage and habitat conditions in the lower river. The following text provides a general description of the watersheds delineated in Figure 2.

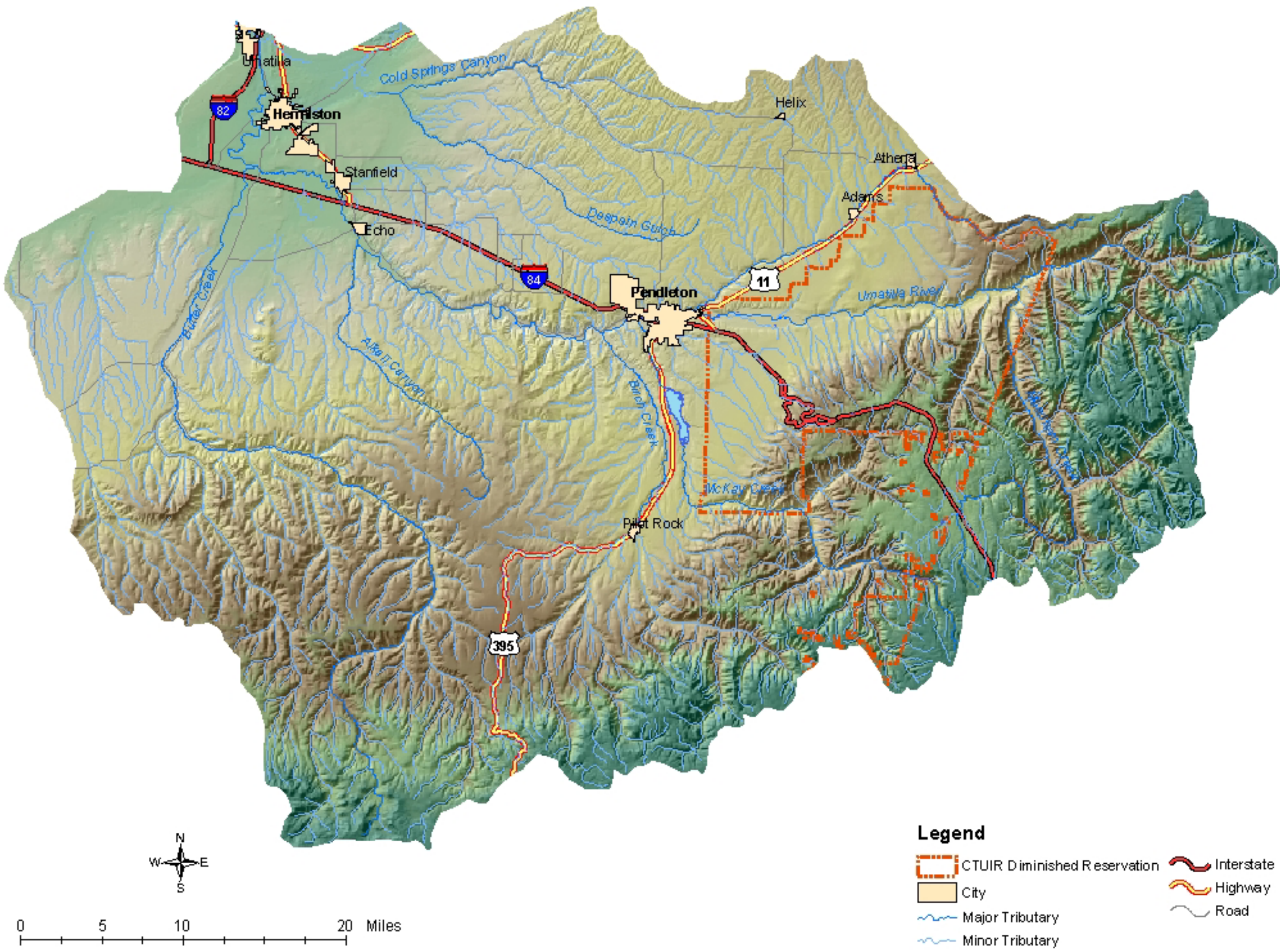

Figure 1. Topography of the Umatilla Subbasin

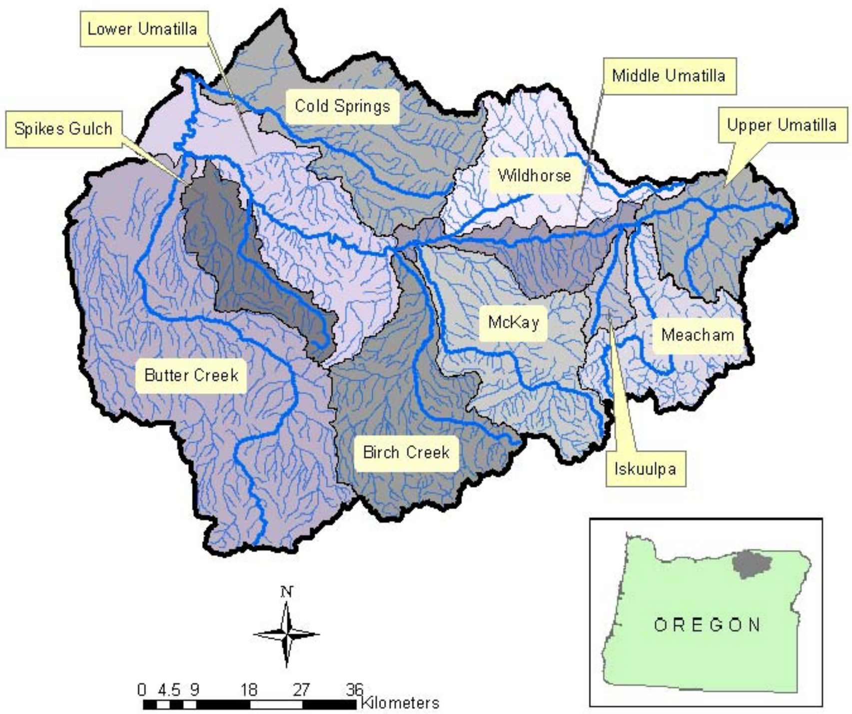

Figure 2. Major watersheds of the Umatilla Subbasin. Upper Umatilla contains both the North and South Forks.

Lower Umatilla: The landscape in the Lower Umatilla is dominated by dry land agriculture and a number of irrigation canals and diversion dams. The stream channel is low gradient and substrates are mixed silt, sand, gravel, cobble, and bedrock with some riffle-pool diversity. The channel is diked and artificially stabilized throughout much of its reach. The fish community is dominated by warm water introduced and native species including northern pike minnow (*Ptychocheilus oregonensis),* smallmouth bass (*Micropterus dolomieu*), and various suckers (*Catostomus* spp.). This reach hosts a large portion of the fall Chinook salmon and coho salmon spawning and rearing habitat and is a target area for fall Chinook salmon and coho salmon reintroduction in the subbasin. Habitat restoration actions in this area of the watershed include bank stabilization, riparian seeding and planting, and passage improvements.

Cold Springs: The Cold Springs landscape is dominated by agriculture and rangeland. The drainage is a low-lying arid system that receives minimal precipitation and discharge. Historically, Cold Springs Reservoir was filled from November thru March using mainstem Umatilla River water withdrawn at RM 27. The primary channel is mixed sand and silt, and is dry during much of the year. The banks are poorly stabilized, and the channel is moderately to extremely incise. The riparian zone is disturbed throughout most of the reach, offering little or no solar protection to in-stream flow. The fish community is dominated by warm water species.

Butter Creek: The Butter Creek landscape is predominantly agricultural in the lower section. The headwaters are moderately intact and include some sections of the Umatilla National Forest. The riffle-pool diversity is moderate. The channel throughout the lower reach is mixed silt, sand, gravel, and cobble, and is moderately incise. Headwaters support redband trout (*O. mykiss*) populations, along with a variety of endemic sculpins (*Cottus* spp.) and suckers. The fish community is dominated by warm water species in the lower section. There are numerous diversion dams and fish passage problems below the Umatilla National Forest boundary. This watershed could support steelhead production if passage problems are corrected. Habitat restoration actions in this watershed include bank stabilization, riparian fencing, riparian planting and seeding, and off stream watering.

Middle Umatilla: Land use in the Middle Umatilla is predominantly agricultural, ranching, and urban. The streams are channelized in many areas and substrates are mixed sand, gravel, and cobble. Small ephemeral tributaries drain into the Umatilla throughout. Summer flows are received from both disturbed and pristine areas, and the water is relatively warm by the time it enters the Umatilla mainstem. The fish community is mixed warm and cool water species, including some steelhead/redband trout and fall Chinook salmon production, pike minnow, sculpins, and smallmouth bass. The Umatilla mainstem in this area is passage, summer holding, and fall-winter rearing habitat for spring Chinook salmon. Tributaries in this area are the target for hatchery supplementation of steelhead. The Umatilla mainstem in this area is a secondary target for reintroduction of fall Chinook salmon and coho. Habitat restoration actions in this area of the watershed include riparian fencing, riparian seeding and planting, and passage improvements.

Table 3. Length, drainage area, and location of the confluence with the mainstem for the major watersheds of the Umatilla River (from (Saul et al. 2001).

Major tributary	Tributary length (miles)	Drainage area (sq. miles)	Distance from the mouth of the Umatilla River (river miles)
Lower Umatilla	48	295	0 - 48
Cold Springs	27	302	5
Butter Creek	57	654	14
Spikes Gulch	24	126	19
Middle Umatilla	31	109	48 - 79
Birch Creek	31	285	48
McKay Creek	32	260	52
Wildhorse Creek	34	195	55
Iskuulpa Creek	12	31	77
Meacham Creek	31	178	79
Upper Umatilla	9	134	90

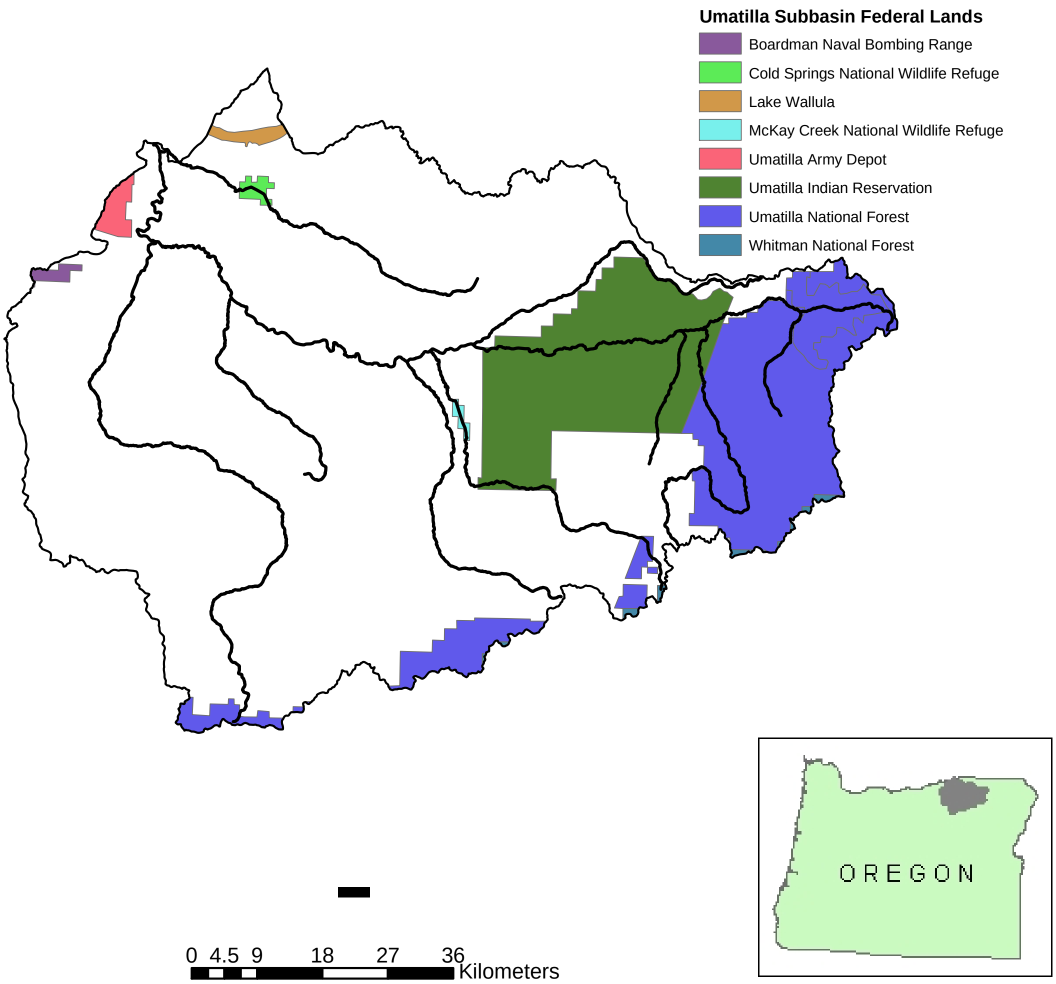

Figure 3. Government lands in the Umatilla Subbasin.

Spikes Gulch: Similar to the Cold Springs system, but without a reservoir.

Birch Creek: The Birch Creek headwaters are moderately to largely intact throughout, and include portions of the Umatilla National Forest. The lower sections are dominated by agriculture and rangeland. The main channel is mixed sand, gravel, cobble, and is slightly incise. There are a variety of passage barriers in the upper headwaters that currently limit anadromy. The riparian quality varies from excellent in the headwaters, to moderate or highly disturbed in the lowlands. The fish community is dominated by redband trout and steelhead production, coupled with endemic cool water fishes. The watershed is managed as a native steelhead sanctuary, and appears to be minimally impacted by hatchery supplementation. Historically, the watershed produced spring Chinook salmon (Swindell 1941). Habitat restoration actions in this watershed include channel reconstruction, bank stabilization, riparian fencing, riparian planting and seeding, passage improvements, and instream structures.

McKay Creek: The McKay Creek landscape is diverse topographically and biologically. The headwaters include portions of national forest, intermixed with corporate and privately owned timber land. The headwater channels are gravel, cobble, and bedrock, and have relatively functional riparian habitat. The lower sections are predominately agricultural and rangeland. Much of the discharge from the watershed is collected in McKay Reservoir, and released into the mainstem Umatilla from late-spring to mid-fall for irrigation use or fish passage, homing and habitat enhancement. McKay Dam is impassible to upstream fish migration. McKay supports redband trout and a large number of endemic cool and cold-water species, along with introduced smallmouth bass. Historically, the watershed produced steelhead and spring Chinook salmon (Swindell 1941). Habitat restoration actions in this watershed include riparian fencing and riparian planting and seeding.

Wildhorse Creek: The Wildhorse watershed is dominated by dry land agriculture. The channel is mixed silt, sand, and gravel, and is moderately to entirely incise. The riffle-pool diversity and sinuosity are artificially low. The water quality is poor, and it is a significant source of suspended sediment input into the Umatilla mainstem. Riparian condition is poor. The fish community is dominated by warm water species. Despite its many problems, Wildhorse supports a small amount of redband trout and steelhead production. Habitat restoration actions in this watershed include riparian fencing, riparian planting and seeding, and instream structures.

Iskuulpa Creek: The Iskuulpa Creek landscape is mixed new growth timber and rangeland. The channel is mixed sand, gravel, and cobble, and is slightly incise and moderately sinuous. The water quality is good, and riparian cover is good and improving. Iskuulpa Creek is blocked to fish passage near the mouth during low flows due to bedload accumulation behind a dike and bridge. The resident fish community includes redband trout and several endemic cool water species. Iskuulpa Creek is an important natural steelhead production area and a target of hatchery supplementation. Habitat restoration actions in this watershed include riparian fencing and land acquisition.

Meacham Creek: A railway built in 1880 runs the length of the Meacham Creek watershed along the valley floor and constrains the channel in many locations. Channel sinuosity is moderate. The headwaters are dominated by south facing slopes that are a patchwork of private and U.S. Forest Service land. Much of the higher grounds have been logged, but most of this activity has been conducted outside of the stream channels. Upland grazing has reduced bank and channel stability. The streambed is mixed silt, sand, gravel, and cobble, and supports moderate riffle-pool diversity. Meacham supports a large steelhead spawning aggregate and a variety of cool water species including sculpins, mountain whitefish, and redband trout. The headwaters support a small sub-population of ESA listed Bull Trout (*Salvelinus confluentus*). Mainstem Meacham provides the second most spring Chinook salmon spawning and rearing habitat in the subbasin. This watershed is a target for hatchery supplementation of steelhead and reintroduction of spring Chinook salmon. Habitat restoration actions in this watershed include bank stabilization, channel reconstruction, riparian fencing, passage improvements, and instream structures.

Upper Umatilla: The entire Upper Umatilla watershed lies within the Umatilla National Forest, and the North Fork is designated a wilderness area. This portion of the system has been rarely logged, and receives little or no anthropogenic stressors with the exception of a road running up the south fork. The stream channel and riparian characteristics are pristine, and riffle-pool diversity and sinuosity are high. The banks are stable and provide significant hyporheic exchange. The Upper Umatilla supports steelhead, and the majority of the spring Chinook salmon natural production. In addition, the system supports a large spawning aggregate of Bull Trout, and a number of endemic cold and cool water species. This watershed is a target for reintroduction of spring Chinook salmon. Habitat restoration actions in the South Fork include bank stabilization, channel reconstruction, and instream structures.

2.1 Management Actions

The Umatilla Subbasin is the target of a number of restoration, mitigation, and supplementation-focused management actions. Collectively these programs represent a complex network of interconnected, interdependent, and auto-correlated short- and long-term projects. The following sections briefly outline these programs to help provide context and background for the reader.

2.1.1 Hatchery Programs

Artificial production within the Umatilla Subbasin includes summer steelhead, spring and fall Chinook salmon, and coho salmon programs. Umatilla Hatchery, constructed and operated under the Fish and Wildlife Program, is the central production facility for the Umatilla Subbasin Fish Restoration Program. It is located on the Columbia River near the town of Irrigon, Oregon. It is operated by ODFW and currently produces summer steelhead, spring Chinook salmon, and subyearling fall Chinook salmon. Other facilities that produce smolts for the Umatilla River include Bonneville Hatchery, which produces yearling fall Chinook salmon, Little White Salmon Hatchery, which produces spring Chinook salmon, and Cascade Hatchery and Lower Herman Creek Ponds, which produce coho salmon. The summer steelhead, spring Chinook salmon, and subyearling fall Chinook salmon programs are funded by the Bonneville Power Administration (BPA) as part of the Northwest Power and Conservation Council’s Fish and Wildlife Program. The yearling fall Chinook salmon program is funded under the U. S. Army Corps of Engineers John Day Mitigation Program, and the coho are produced under the Mitchell Act.

In addition to the juvenile release programs, an adult fall Chinook salmon-outplanting program was initiated in 1996. Surplus Upriver Bright stock from Priest Rapids and Ringold Springs hatcheries are released into the mid-Umatilla River (RM 37 or RM 56) to increase numbers of spawning adults for natural production. The operational goal of the program is to release 1,000 adults annually. Actual releases have ranged from 200 to 970 (Table 4).

Table 4. Fall Chinook salmon adult outplants released into the Umatilla River (river mile 37 or 56) to supplement natural spawning.

Year	Number of adults released
1996	712
1997	940
1998	200
1999	970
2000	471
2001	942
2002	859
2003	737
2004	612

An integral part of the artificial production program for the subbasin also includes juvenile acclimation and adult holding and spawning satellite facilities (Figure 4). These facilities are all operated by CTUIR under the Umatilla Hatchery Satellite Facilities Operation and Maintenance Project. There are five acclimation facilities in the subbasin; Bonifer Pond (RM 81), Minthorn Springs (RM 64), Imeques C-mem-ini-kem (RM 80), Thornhollow (RM 74), and Pendleton (RM 56). The first acclimation facility (Bonifer) was constructed and began operations in 1983. With the completion of the Pendleton facility in 2000, most hatchery production groups released into the subbasin are now acclimated. There are also three adult holding and spawning facilities. Summer steelhead are held and spawned at Minthorn, fall Chinook salmon at Three Mile Dam, and spring Chinook salmon at South Fork Walla Walla.

The first releases of hatchery-reared summer steelhead occurred from 1967 through 1970 and were of Skamania and Oxbow stocks. The first release of Umatilla stock steelhead occurred in 1975 and all brood since then have been of endemic stock. The current program releases 150,000 smolts in the upper subbasin (Table 5). Broodstock (100 naturally-reared and 20 coded wire tagged hatchery-reared) are collected from September through April at Three Mile Falls Dam (RM 3.7) on the lower Umatilla River. Twenty hatchery-reared fish are used in brood to reduce removals of naturally-reared males from the disproportionately female run and buffer production losses when holding mortality is higher than normal. Naturally-reared fish are spawned preferentially, and any unused hatchery-reared brood are released upriver to spawn naturally. Collections are scheduled proportionate to the average run timing of naturally-reared steelhead during the previous five years with the intent of incorporating a representative cross-section of their life history diversity into the brood. Brood fish are immediately transported upstream to the Minthorn adult facility (RM 63.8) where they are held until spawning.

Smolts are released at one of three upriver release locations. The release in the lower two miles of Meacham Creek is intended to increase adult returns to that tributary for supplementation while reducing the risk of hatchery-reared juveniles residualizing in summer juvenile rearing areas higher in the watershed. Management intent of releasing smolts from the Minthorn and Pendleton acclimation sites is to both enhance in-subbasin fisheries (particularly in the upper river) while supplementing spawner abundance in the smaller tributaries above Pendleton that produce steelhead. All release sites are located above Birch Creek to reduce the risk of hatchery-reared adults returning to Birch Creek, which is managed as a natural steelhead sanctuary.

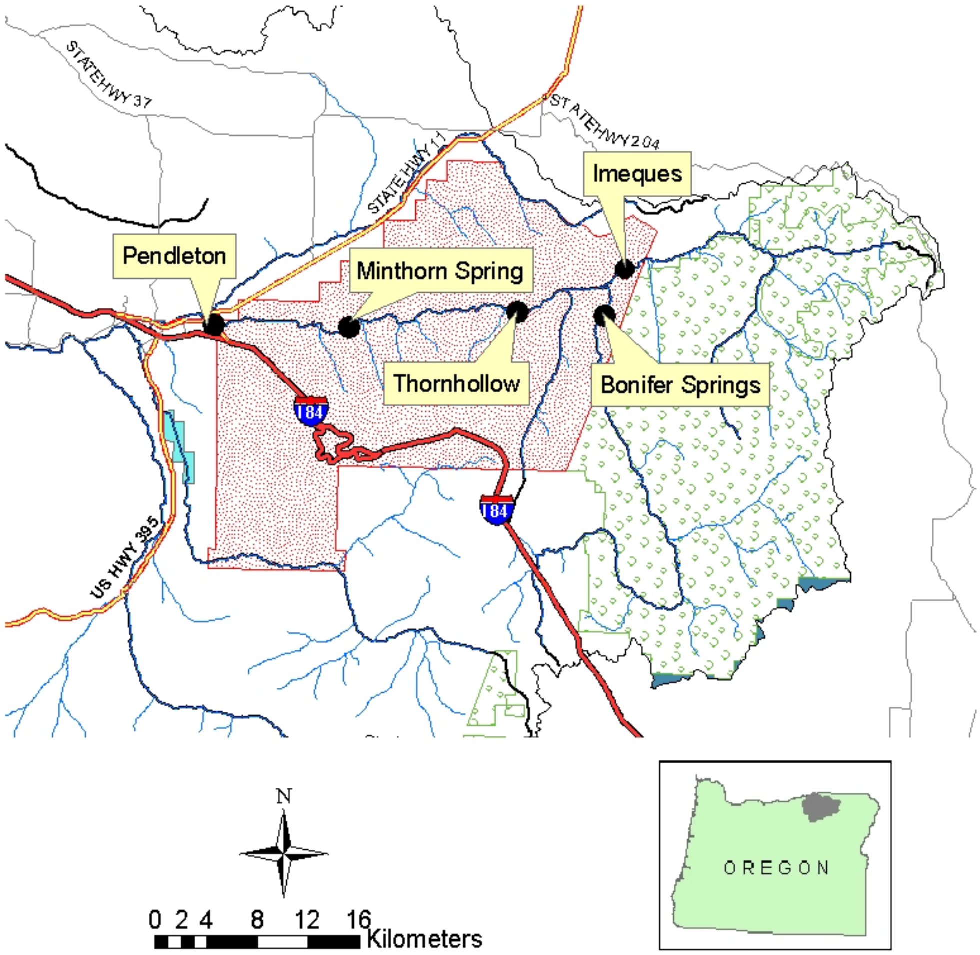

Figure 4. Location of acclimation facilities in the Umatilla Subbasin.

Carson stock spring Chinook salmon have been released in the Umatilla Subbasin since 1986. Historically, numbers released and release locations have varied, however, the current program is to acclimate and release 810,000 yearling smolts annually into the upper mainstem Umatilla River. Beginning in 1996, Carson stock spring Chinook salmon returning to the Umatilla River have been the primary broodstock source for the Umatilla Subbasin hatchery program. The operational goal for the program is to collect all 560 brood fish at Three Mile Dam. Broodstock are collected from mid-April to the end of June proportionate to the average timing of spring Chinook salmon run during the previous five years with the intent of incorporating a representative cross-section of life history diversity in the brood. All smolts are released from the Imeques acclimation facility at RM 80 of the Umatilla mainstem in March and April. Holding capacity of the facility is inadequate to release all production at the same time. Imeques is located at the lower end of productive spring Chinook salmon spawning and summer rearing areas in the Umatilla mainstem and just above the Meacham Creek confluence. This location was selected with the intent of optimizing spawner contributions to Meacham Creek while potentially developing spatial segregation of hatchery-reared fish spawning near the acclimation facility and naturally-reared adults spawning in the prime habitat higher up in the watershed.

Fall Chinook salmon releases have included both subyearling and yearling life stages. Past smolt production since 1982 has varied from 0.6 – 3.8 million subyearlings and 100,000 – 564,000 yearlings. The current program is to release 600,000 subyearlings and 480,000 yearlings. Spring Creek Tule stock was used for the first brood of subyearlings. Since then, all releases have been of Upriver Bright stock. Upriver Bright fish returning to the Umatilla River and collected and spawned at Three Mile Falls Dam have been the primary brood source for the yearling program since 1997. Current locations of acclimation sites for release of fall Chinook salmon are higher in the subbasin than the areas where most natural spawning occurs (below Pendleton). Potential locations for acclimation sites lower in the subbasin were previously considered but no suitable sites were identified due to topography or landownership constraints.

2.1.2 Habitat Enhancement

Salmonid habitat in the Umatilla Subbasin has been considerably degraded over the last century. Extensive vegetation removal and disturbance associated with urban development, cultivation, forestry, transportation corridors, flood control and navigation has occurred and continues to occur in some places in the subbasin. Based on data assembled for subbasin planning (www.nwpcc.org) approximately 70% of the Umatilla River has been levied or channeled and 70% of all Umatilla tributaries are in need of riparian improvement. The result is an aquatic landscape which, in many places, suffers from inadequate stream flow, excessive temperatures, structural impediments, inadequate riparian corridors, simplified and reduced instream habitat, and excessive erosion. These factors have jeopardized stronghold habitats, reduced the number of adult fish returning to spawn, and have contributed to decreased smolt-to-adult returns for anadromous species. Limited high quality salmonid habitat continues to persist in the subbasin. Habitat conditions generally follow an elevation gradient, with higher quality habitat in the upper portion of the subbasin, while lowland portions contain the most degraded habitat.

Habitat restoration activities in the Umatilla Subbasin have been conducted by a variety of local, state, and federal agencies. The CTUIR, ODFW, and U.S Forest Service (USFS) are the primary sponsors of BPA funded habitat restoration projects in the subbasin. In general, lead responsibilities for restoration activities is CTUIR on the reservation, USFS on the National Forest, ODFW in Birch Creek, and the Soil and Water Conservation District (SWCD) in Butter Creek. Habitat restoration actions by these entities have included channel reconstruction, bank stabilization, instream structures, riparian fencing and planting, land acquisition, and off-stream livestock watering. Table 5 summarizes these habitat restoration actions and the number of stream miles affected.

Table 5. Summary of habitat restoration projects conducted in the Umatilla Subbasin since 1980.

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

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

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

2.1.3 Passage Enhancement

Steelhead and salmon still encounter passage impediments while migrating through the mainstem Umatilla River and tributaries in the Umatilla Subbasin. Many passage improvement projects have been implemented in the subbasin since the mid-1980's. Passage restoration activities were first focused on the most severe problems in the lower mainstem Umatilla River. The river channel was deepened through shallow bedrock reaches below Three Mile Falls Dam in 1984, and adult and juvenile fish passage facilities were reconstructed from 1988 to 1994. Effectiveness of these passage improvements has been evaluated. Juvenile passage evaluation was conducted by ODFW, adult passage evaluation was conducted by CTUIR. Current passage impediments are now primarily located in tributary streams. Table 8 lists the location, severity, and potential restoration action for known passage impediments.

2.1.4 Flow Enhancement

Throughout much of the 20th century, irrigation diversions dewatered large portions of the lower Umatilla River during juvenile and adult salmonid migration seasons. Dewatering of the lower Umatilla River was a primary factor in the extinction of several species of indigenous salmonids. During the early stages of the Umatilla Subbasin Fisheries Restoration Program, adults returning to Three Mile Falls Dam were trapped and hauled upriver beyond the dewatered lower river reach. The need to improve fish passage in the lower river was amplified by the NPPC's 1987 authorization for constructing Umatilla Hatchery to increase adult steelhead and salmon returns to the Umatilla River. In 1988, congress authorized implementation of the Umatilla Basin Project (BOR 1988), a program to enhance flow for fish passage and rearing in the lower Umatilla River.

Flow enhancement in the lower Umatilla River is achieved by pumping Columbia River water into irrigation canals in exchange for leaving live flow in the Umatilla River or rights to water in an irrigation storage reservoir (McKay Reservoir). Locations of irrigation canals, and pump and delivery systems for the "water exchange" are shown in Figure 5. The first priority of the flow enhancement program (Phase I) was to provide adult fish passage to Three Mile Falls Dam where they could be collected for brood or transported upriver. Phase I pumps water into the West Extension Irrigation District canal and was completed in 1993. The second stage of the project (Phase II) provided water exchange with the Maxwell, Feed, and Furnish Canals and the ability to acquire rights to 35% of the water stored in McKay Reservoir. Storage capacity of McKay Reservoir is 65,534 acre-feet. Phase II was completed in stages from 1993-1999. A conceptual model of the flow exchange project in relation to typical timing of smolt and adult migrations and hatchery-reared smolt releases is provided in Figure 6. Collectively the hatchery, habitat, and hydrosystem programs interact with environmental and ecological variability to provide the backdrop against which UBNPMEP evaluates natural production and tributary harvest. The following sections describe results from 2003-2004 efforts to evaluate these interacting factors.

Table 6. Known passage impediments in the mainstem Umatilla River and tributaries in the Umatilla Subbasin.

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

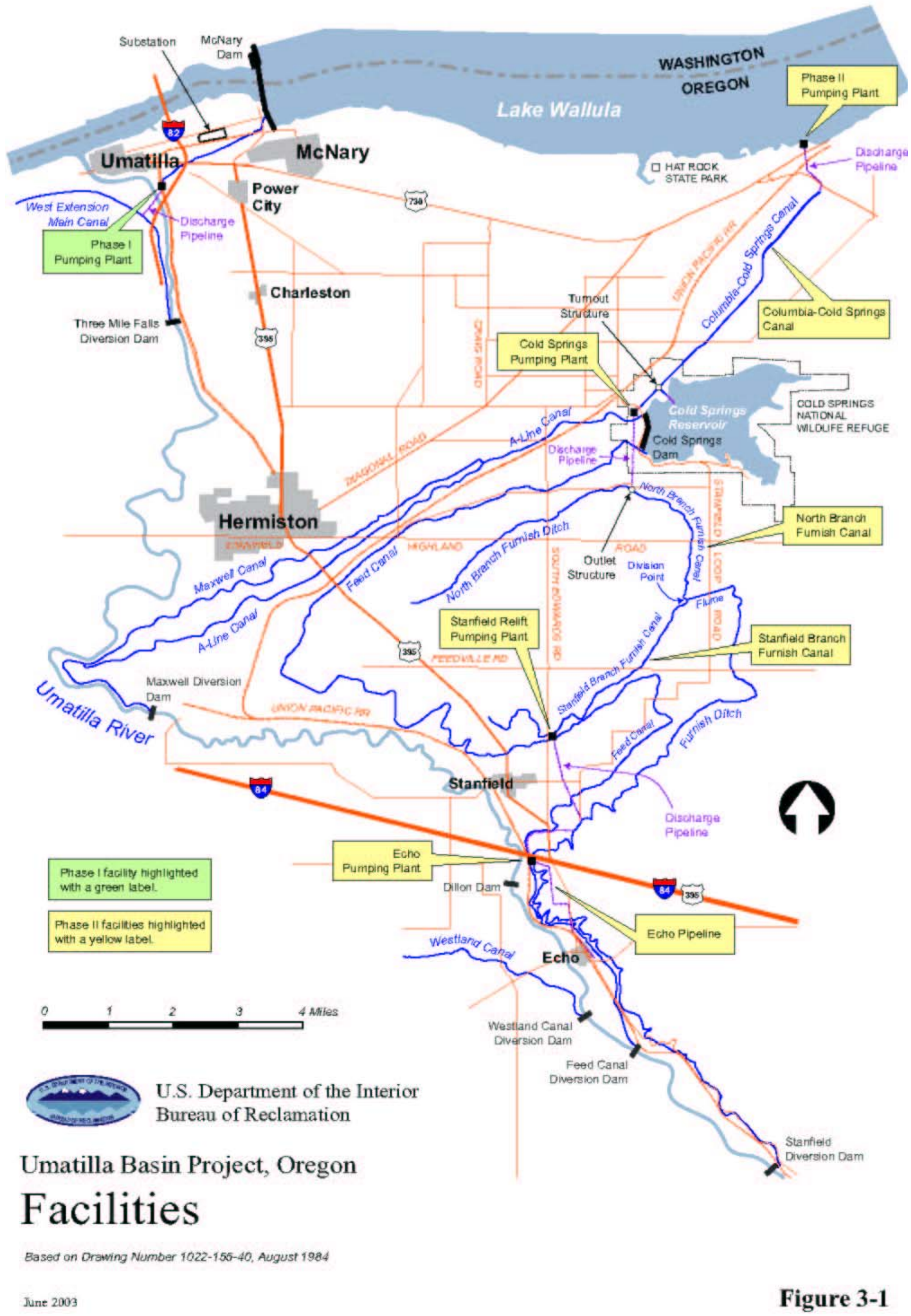

Figure 5. Location of irrigation canals and dams in the lower Umatilla mainstem, and Phase I and Phase II water exchange pump stations and delivery systems for pumping Columbia River water into the canals. Figure is by permission from BOR.

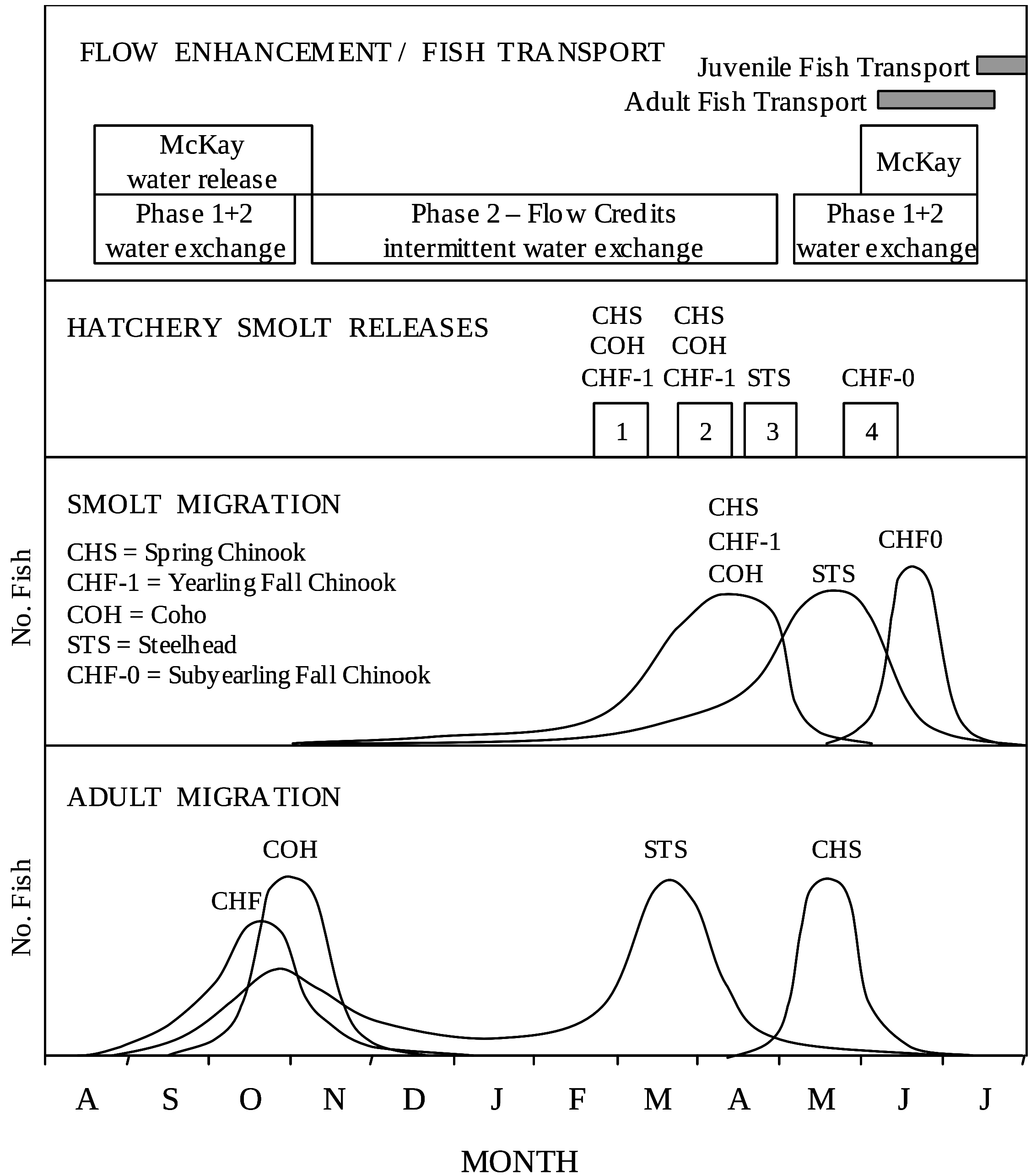

Figure 6. Generalized illustration of the timing of flow enhancement, fish transport, hatchery-reared smolt releases, and smolt and adult steelhead and salmon migrations in the Umatilla Subbasin.

3 Methods

3.1 Spawner Surveys and Adult Returns

Enumeration of returning adult salmonids at Three Mile Dam since 2000 has been by a combination of capturing, anesthetizing with carbon dioxide and handling fish, alternating with video taping without capture (alternating about every 7-10 days). Adult salmonids enumerated from video tape were apportioned (Chinook-gender, fin clip, jack vs. adult and summer steelhead gender fin clip, one vs. two ocean) 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. Spring Chinook salmon were classified as either adults (610 mm fork length or larger) or jacks (less than 610 mm fork length) and summer steelhead were classified as one ocean (less than 660mm fork length) or 2 ocean (660 mm fork length or larger). Gender was determined by external sexual characteristics.

On the spawning grounds we used traditional visual spawning ground survey methods. Crews walked three to four mile stream reaches in established index areas. Most of the sites required a full day to access and sample. Crewmembers walked alone the margins of the smaller tributaries or in pairs on opposite banks of larger streams. Surveyors wore polarized glasses and baseball caps during the surveys to minimize glare. To reduce stress on pre-spawning salmonids, surveyors moved carefully and quietly through holding and spawning areas. They did not probe debris jams or throw rocks into holding pools. High water and poor instream visibility or landowner denial prevented surveys at certain times and locations, and limited the spatial coverage of the surveys.

Redds were identified and judged to be complete based on redd size and depth, location, and amount and size of rock moved. All redds were reviewed by our most experienced surveyors for consistency. Orange flagging was tied to nearby vegetation to mark redds and prevent recounting. The flagging was labeled with the date, location, species and number of males and females observed on or near redds. Crews also recorded information in data books. For each redd, surveyors recorded the stream name, GPS coordinates, date of first observation, gender, number and origin (marked or unmarked) of fish observed on or near the redd, carcasses sampled in the area, and habitat type. GPS coordinates of carcasses found during the survey were recorded, and fish measured from the middle of the eye to the hypural plate (MEHP). Fork length was also recorded if marks indicated that a coded wire tag might be present. Obvious injuries were recorded in an attempt to determine the cause of death in pre-spawning mortalities. Carcasses were cut open to determine egg retention of the females and spawning success of the males. Pre-spawning mortality was defined as death of a fish before spawning. Females with egg retention estimated near 100% and males with full gonads were therefore classified as pre-spawning mortalities. Tails of sampled fish were removed at the caudal peduncle to prevent re-sampling of the carcass.

Snouts were collected from salmon and steelhead carcasses with clipped left or right pelvic and adipose fin clips to search for coded wire tags. The snout was removed by cutting through the head from behind the orbit and down to the mouth. Snouts were placed in plastic bags and given an individual snout number for identification. Snouts and accompanying biological data were sent to ODFW's Mark Process Center in Clackamas for coded wire tag extraction and reading.

USFWS and ODFW conducted 2004 Summer/Fall BT surveys. We coordinated field work and findings to avoid duplication of effort. Occasionally, BT and CHS salmon spawning overlapped even though BT are generally higher in the basin and spawn later than CHS. CTUIR surveyed the primary CHS spawning areas and reported any BT redds observed to the State and Federal biologists. They survey the primary BT spawning areas and reported CHS redds to CTUIR.

Summer steelhead escapement surveys were conducted on 21.0 miles of six index tributaries of the Umatilla River. Spring Chinook salmon escapement surveys were conducted on 46.6 miles of the Umatilla River and Meacham Creek. Information on the reaches including distances surveyed and beginning and ending GPS coordinates are in Table 7 and Figure 7.

Table 7. Spawner survey index reaches for the Umatilla River

			Beginning		End	
#	**Miles**	**Species**	**Lat**	**Long**	**Lat**	**Long**
1	3.3	STS	0391044	5061686	0390767	5056649
2	3.4	STS	0390767	5056649	0388864	5051946
3	3.1	STS	0399193	5042473	0403526	5043378
4	1.0	STS	0403526	5043378	0404675	5044062
5	2.5	STS	0396673	5047601	0398593	5049956
6	1.0	STS	0393801	5059883	0394765	5059163
7	3.2	STS	0407493	5064253	0406179	5060097
8	3.0	STS	0386371	5059857	0384078	5057520
1	4.0	CHS	0407481	5064258	0413466	5064610
2	3.4	CHS	0407481	5064258	0403200	5066190
3	3.0	CHS	0403200	5066190	0399675	5064282
4	3.1	CHS	0399675	5064282	0395463	5062931
5	3.3	CHS	0395463	5062931	0391033	5061684
6	3.2	CHS	0391033	5061684	0386731	5060093
7	3.6	CHS	0386731	5060093	0381027	5059904
8	6.1	CHS	0381027	5059904	0373753	5058575
9	5.0	CHS	0394130	5061949	0393991	5055745
10	4.8	CHS	0393991	5055745	0396673	5047601
11	4.0	CHS	0396673	5047601	0399194	5042467
12	3.1	CHS	0399194	5042467	0403526	5043378

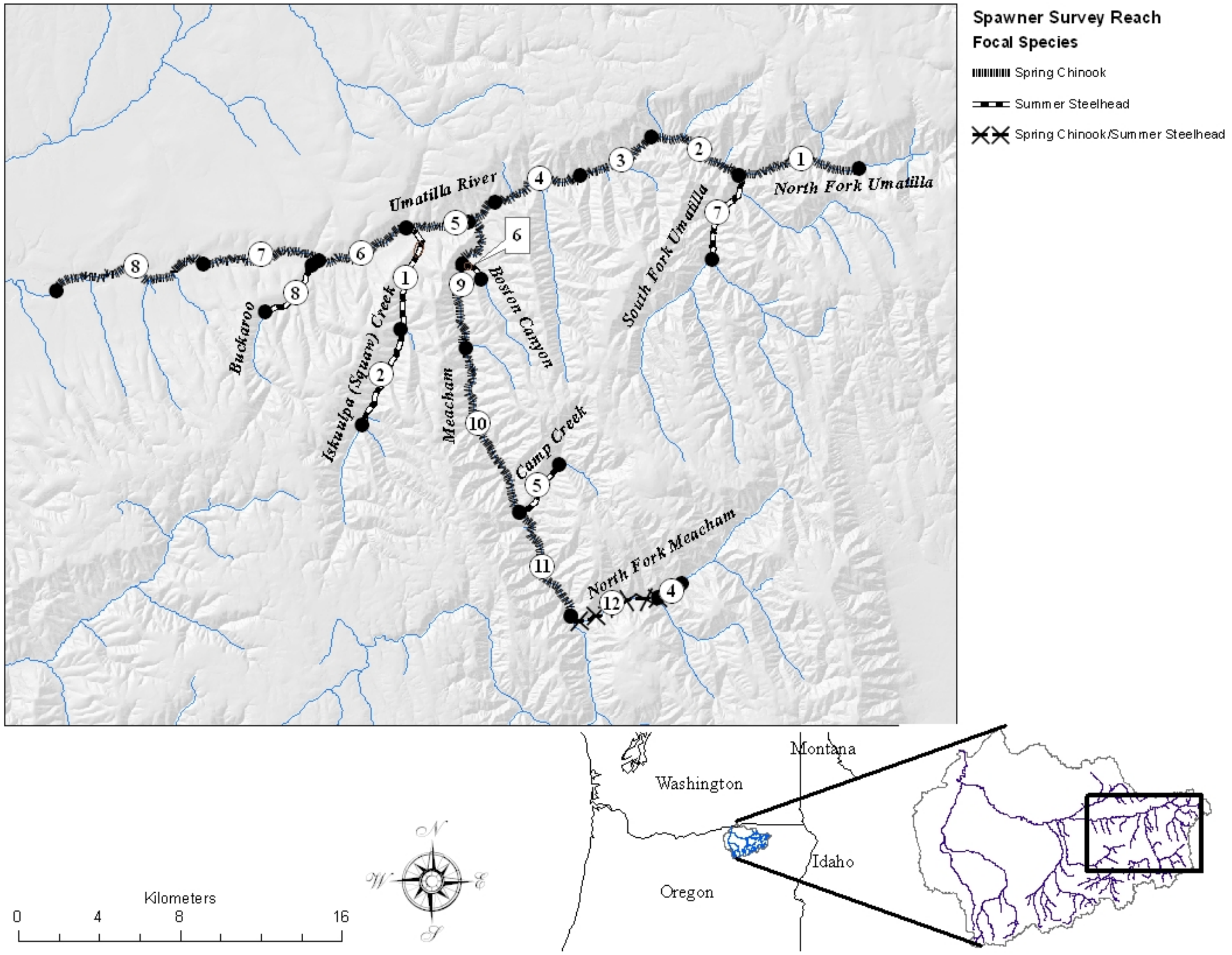

Figure 7. Spring Chinook and summer steelhead redd/carcass survey reaches. See Table 7 for details on the survey reaches.

3.2 Age and Growth

Scale samples were collected opportunistically from adult salmonids for age, growth, and cohort determination during egg takes and spawner/carcass surveys by both CTUIR and ODFW personnel. Adult scales collected for age, growth and racial studies were collected from the preferred area two rows above the lateral line on the left side of the fish in a diagonal line between the posterior edge of the dorsal fin and the anterior end of the anal fin. Additional scales were collected on the right side of adult fish in the same area because of the high percentage of regenerate scales observed. Since most adults sampled were from mortalities, approximately 5 scales were removed from each side of adult salmonids sampled, in the preferred area. Scales collected were placed in coin envelopes and descriptive biological data was written on the front of the coin envelope (species, date collected, GPS coordinates, mid-eye to hypural length in mm, marks, gender, collector, and remarks).

High quality adult scales which had the most complete life history data had a small round focus. Utilizing a dissecting microscope, the best 1-3 scales were removed from the coin envelope and mounted on gum cards. The gum cards were then pressed in cellulose acetate. Scales were observed and interpreted under a microfiche reader at magnifications of 42X and/or 72X. The European method of age designation was utilized to record age data. An age 1.3 spring Chinook salmon spent about 20 months in freshwater from egg deposition to seaward migration, three winters in the ocean and returned to spawn at total age 5. An age 2.2 summer steelhead spent about 23 months in freshwater, migrated to the ocean and spent 2 winters in the ocean, migrated into the Columbia River during the summer of fall, held in the mainstem Columbia or Umatilla River and spawned the following spring at total age 5.

Age information was used to assign proportions of the escapement to particular brood years. For example, a four year old fish returning in 2004 was assigned to the 2000 brood year. This partitioning allowed for the analysis of escapement, spawning, and carcasses metrics by brood year, and to allow for the estimation of productivity in terms of adult recruits per spawner.

3.3 Temperature Monitoring

Deployment of thermographs in the Umatilla River Basin was coordinated with other projects and agencies to maximize consistency and coverage without duplicating effort during 2003 and 2004. Figure 8 shows the location of the UBNPME project thermographs. Table 8 is the key for Figure 8. Some of the thermograph locations have been monitored consistently since 1993 while other sites have only been monitored for one or two years.

Vemco Mini-Loggers were used to record water temperatures at one hour intervals. Instruments were initialized in the office and anchored to large trees or boulders with steel cables in the field. Thermographs and cables were concealed to minimize tampering by the public. Thermographs were checked monthly after deployment to ensure proper function and placement. In November and December of 2003 and 2004 all thermographs were retrieved and processed in the laboratory.

Water temperature data were imported into Excel files and checked against the deployment, monthly checks, and recovery logs. Data was graphed and examined for errors and deployment problems. Protocols for deploying thermographs and summarizing data are outlined below.

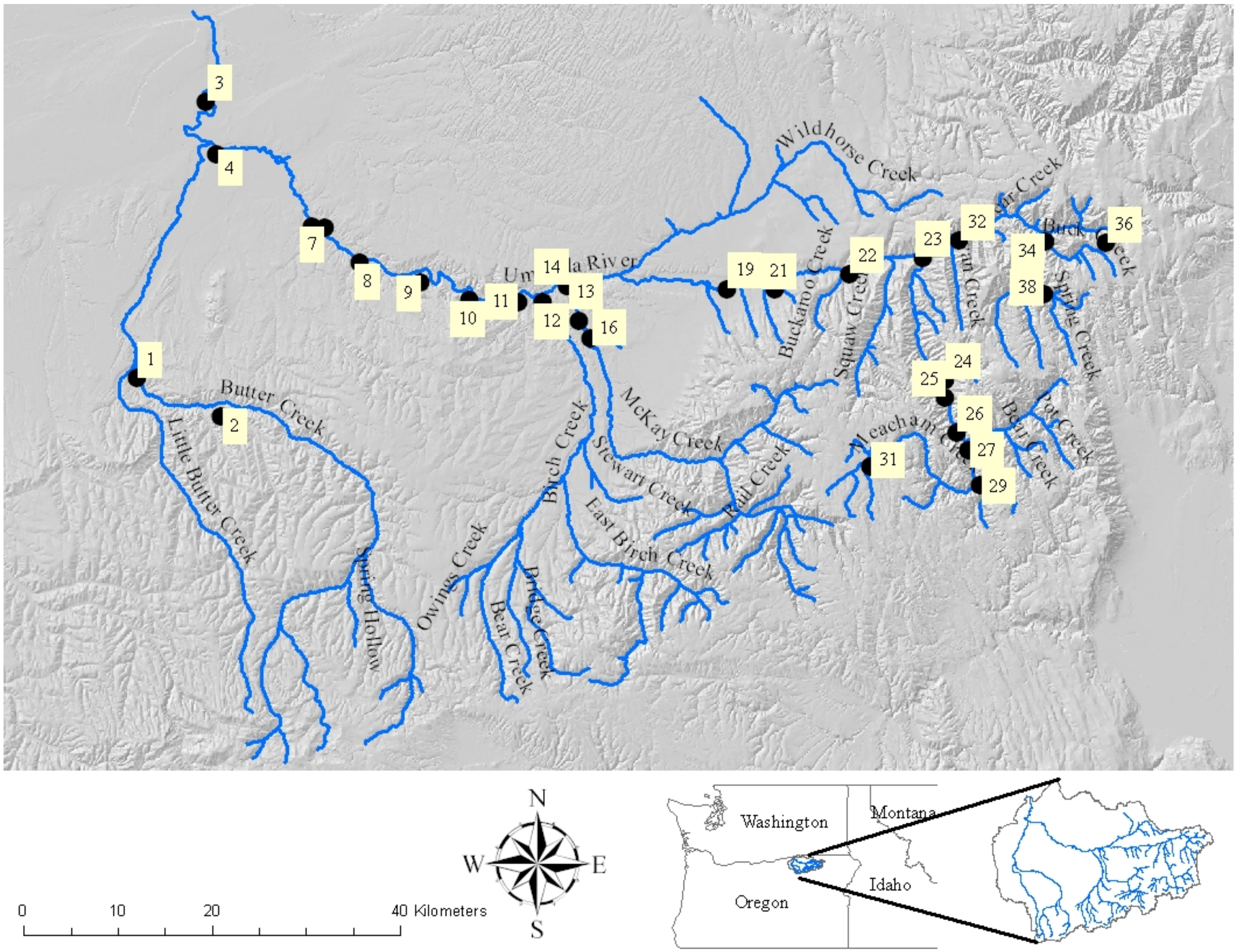

Figure 8. Location of thermographs deployed during the 2003 and 2004 summer monitoring seasons.

Table 8. Site description for thermograph deployment in the Umatilla Subbasin (see Figure 8).

Site Number	Stream	Serial Number 2003	2004	Location	River Mile
1	Butter Creek	7555	7555	Pine City	20
2	Butter Creek	7557	7557	USGS Gage	28.5
3	Umatilla River	8008	8008	Ponds Farm	8.7
4	Umatilla River	7550	8005	Maxwell Dam	15.3
5	Umatilla River	8010	8010	Below Stanfield Bridge	21.6
6	Umatilla River	8011	8011	At Westland Dam	27.2
7	Umatilla River	4901	123	Below Feed Canal Dam	28
8	Umatilla River	8012	8012	At Stanfield Dam	32.4
9	Umatilla River	8013	8013	At Yoakum	37
10	Umatilla River	8014	8014	Near Barnhart	42.5
11	Umatilla River	8015	8015	Near Coombs Canyon	47.5
12	Umatilla River	8016	8004	Near the Rieth Bridge	49
13	Umatilla River	8017	8017	Near McKennon Station	50.8
14	McKay Creek	5602	5602	Near the Mouth	0.1
15	McKay Creek	5600	5600	Near McKay School	1.9
16	McKay Creek	5601	5601	Heavens Lane Bridge	3.7
17	Patawa Creek	4897	n/a	At Goad Road	1.3
18	McKay Cr, N.	4906	n/a	At USGS Gage	0.2
19	Umatilla River	8018	8018	Above Minthorn Springs	63
20	Moonshine Creek	4899	n/a	At Flow Gage near highway	1
21	Umatilla River	8019	8019	0.2 miles above Cayuse Br.	67.7
22	Umatilla River	8020	8020	At Thorn Hollow	73.1
23	Umatilla River	7549	8007	Lower Imeques	79.4
24	Meacham Creek	8009	8009	Two miles below Camp Cr.	9
25	Camp Creek	8006	8006	Meacham Creek Basin	0.5
26	Meacham Creek	8004	7556	Near Duncan	13
27	N. F. Meacham	8005	7549	Near the lower camp	0.5
28	Meacham Creek	4898	n/a	First bridge above N.F.	17.5
29	E. Meacham C.	8007	7552	Meacham Creek Basin	0.2
30	Meacham Creek	7552	n/a	Below Butcher Creek	20.5
31	Meacham Creek	7554	7550	Near Interstate 84 Bridge	31
32	Umatilla River	8021	8021	Above Ryan Creek	82.5
33	Umatilla River	8022	8022	Bar-M Ranch Road	87
34	Umatilla River	7558	7558	Below forks	89.2
35	N. F. Umatilla	8025	8025	Below Coyote Creek	2.7
36	N. F. Umatilla	8026	8026	End of N. F. River Trail	4
37	Buck Creek	8024	8024	Below Lake Creek	3
38	Thomas Creek	8023	8023	Upstream of lower bridge	0.25

Thermograph Deployment Protocol

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 a 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 at five minute intervals.
9. Add ice water to bring the temperature to 5^{o}C or below 30 minutes into the calibration exercise.
10. After 60 minutes, remove the units and download the temperature data.
11. Compare temperatures from each unit to the certified instrument data for each time reading.
12. Report the maximum, minimum and mean variance of each instrument from the certified instrument data.
13. Calculate the response delay for each unit in relation to the certified instrument.
14. Record and summarize the calibration data and post on the website.

Protocol for Using Certified Thermometers in the Field

1. Protect the certified instrument from shock, compression, bending and high temperatures.
2. Place the certified instrument within 10 cm of the thermograph's 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 settings, header, time and date.
4. Check function indicator light on thermograph.
5. Label unit with site name and river mile with a Tyvek tag.

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 certified thermometer.
4. Place the unit in the main channel in moving water (and where it will be in moving water at lower flows).
5. Cable the unit to a large tree or boulder.
6. Hide the cable 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 and cable are hidden.
3. Ensure that water flows around the sensor end of the unit.
4. Record the date, time and water temperature of the certified thermograph on the Quality and Assurance Record Sheet. Take water temperatures within 10 cm of the unit.
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 and Downloading Data

1. Pull units after October 31st and prior to November 30 (to avoid loss during high-water events).
2. On the data sheet record the date, time and temperature when the unit was pulled from the water. Take water temperatures within 10 Cm of the unit.
3. Attach a new Tyvek tag to the unit with the site name, date, 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 monthly check record sheets with recorded temperatures and times.
7. Save and archive original data file and create a text file with the Vemco software (DOS Text file, also known as American Standard Code for Information Interchange, or ASCII file).

Post Season Calibration

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

Protocol for Summarizing Thermograph Data

Proprietary thermograph software generates its 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 over-written, it is critical that each file is renamed. The original binary data, the converted ASCII file and the Excel file are stored together in electronic folders specific to each monitoring site. The original file was then uploaded to an SQL Server-Based database, and later extracted for analysis using a Microsoft Access ™ front end.

Quality Control Check

The temperatures recorded on the thermograph were compared with those recorded by the certified thermometer. The times and dates when units were deployed were checked as well. The field data sheets were used to ensure that the instrument number was correct. Abnormal data was noted, and marked in the database. Abnormal data was indicated by temperatures suggesting that the unit was out of the water, buried in the substrate, or simply not recording information.

3.4 Harvest Monitoring

Field Surveys

Tribal estimates of adult spring Chinook salmon in the Umatilla River Basin were derived by summarizing and expanding data from creel surveys conducted in the field. A non-uniform stratified, random roving creel survey design was used to allocate survey effort for the assessment of the Tribal spring Chinook fishery. The creel survey was employed for June and July patterned after methods described by (Malvestuto 1996). Staffing requirements consisted of a supervising biologist and technician.

Harvest monitoring efforts were allocated to designated reaches of the Umatilla River from the west boundary of the Umatilla Indian Reservation (RM 56.1) to Fred Gray's Bridge (RM 80.1) and on the lower ¼ mile of Meacham Creek. These sections were chosen based on the habitat's availability to anglers, and on salmon and fisherman distribution information collected during creel monitoring efforts from 1993 to 2002. In 2003 the harvest monitoring reach was divided into eight survey reaches that began at the black railroad bridge at RM 71.9 and ended at Fred Grey's Bridge at RM 80.1 (Table 9). Reaches were repeatedly surveyed during each scheduled day sequentially from either the bottom up or from the top down depending on a randomized schedule.

Table 9. Spring Chinook roving creel survey reaches for 2003.

Survey Reach	Sub Reach	RM	Procedure
Black Bridge	Black Bridge	71.9	check pool at the bridge and go over RR tracks, walk 300 yards upstream to bend with large pool at RM 72.1 along the bedrock corner
City Levee	City Levee	73.7	stop at gate, walk 400 yards to levee, check long pool
Thorn Hollow	Buckaroo Confluence	74.1	from Thorn Hollow Bridge walk downstream to pool at the mouth of Buckaroo
	Below Thorn Hollow Bridge	74.3	pool at acclimation facility, 20 yard below outlet
	Above Thorn Hollow Bridge	74.5	bedrock pool 250 yards above bridge
Weathers' Levee	Weathers' Levee	75.3	survey 1 mile of river above, below and along the river levee
Squaw Creek	Squaw Cr. Confluence	77.8	one pool at mouth of Saddle Hollow (200 yards long)
Gibbon	Lower Graybeal Pool	78.2	cross RR tracks, turn left, drive 200 yards to gate, from gate walk to river, two pools next to hillside
	Upper Graybeal Pool	78.6	100 yds above Graybeal's, follow trail from RR switch to bend next to north hillside
	Gibbon Right of Way	78.8	pools and runs along tracks for 0.3 miles
Meacham Confluence	Ed Clarks Lower Pool	79.4	300 yards below Ed Clark's upper pool
	Ed Clarks Upper Pool	79.6	old mouth of Meacham Creek
	Mouth of Meacham	79.8	walk up from upper Ed Clarks pool
	Beehive	79.9	walk up from Meacham C., 2 pools north of beehives
Imeques	Imeques Facility	80.1	walk from upper bridge to outlet, pools near hillside

In 2004 reach locations were influenced by ecosystem diagnosis and treatment (EDT) reach designations, and a revised understanding of spring Chinook holding and fishing areas. Reaches were located downstream from the most productive spawning grounds. As in 2003, the refuge area was not surveyed. Table 10 lists the survey reaches and their downstream coordinates. Figure 9 depicts the location of the reach breaks.

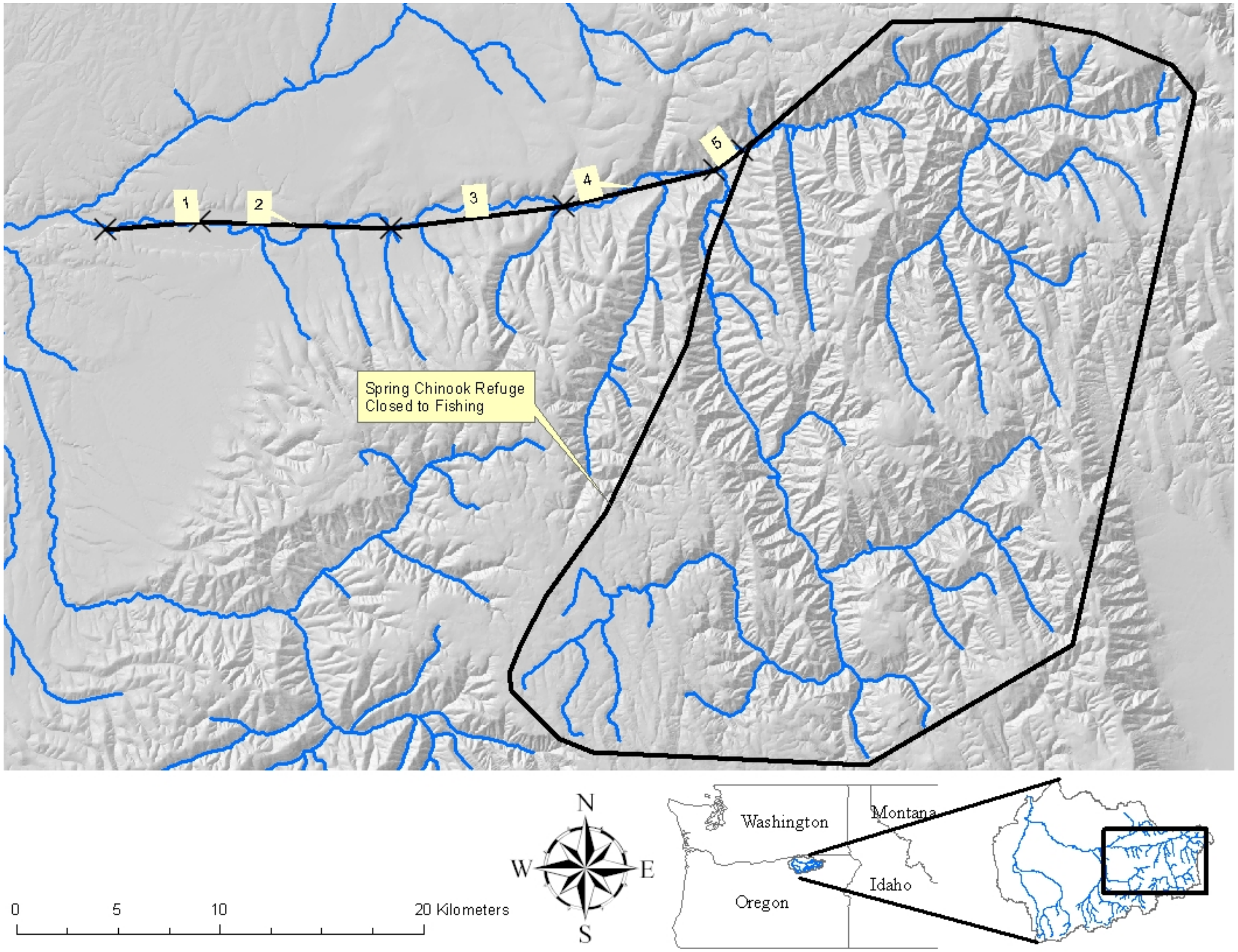

Figure 9. Location of creel survey reaches used to monitor the Tribal spring Chinook and summer steelhead harvest.

Table 10. River Mile (RM) and downstream coordinates for the reaches associated with the 2004 Tribal spring Chinook tributary fishery monitoring.

#	RM	Lat	Long	Description
1	56.1-59.5	364220	5058984	West Reservation Boundary to Mission Bridge
2	59.5-67.2	368852	5059347	Mission Bridge to Moonshine Creek Confluence
3	67.2-73.4	378233	5059016	Moonshine Confluence to Buckaroo Creek Confluence
4	73.4-78.8	386738	5060095	Buckaroo Creek to Meacham Creek Confluence
5	0-0.3	394134	5061920	Mouth to Bingham Springs/Meacham Road Bridge #1
6	78.8-80.1	395492	5062892	Meacham Creek to Bingham Springs/Fred Gray Bridge

Data was recorded on a handheld data logger using Data-Plus Professional© by Electronic Data Solutions (http://www.elecdata.com) connected to a Trimble AG-Plus GPS system. Hard copies of data sheets provided a back-up method to record data incase the data logger malfunctioned. Data was retained on the data logger in non-volatile memory and downloaded to a desk top computer each day backup.

2003 Schedules and Surveys

In 2003 the monitoring schedule was developed without replacement for a timeslot within a weekly survey period. Randomized sample times were deleted and another time was randomly selected if a timeslot was disproportionably selected among all weeks. This prevented the selection of almost every Sunday afternoon timeslot and no Saturday morning timeslots. This unbalanced sampling regime occurred when the schedule was produced using a simple computer generated random number table. Selected timeslots were also deleted and replaced through random selection if the schedule required the same surveyor to work sequential shifts. Weekend and holidays were scheduled at a higher overall survey rate than weekdays (Table 11). Weekday afternoons were selected at a higher rate than weekday mornings. In 2003 between June 2 and July 27 the scheduled surveys included 15 of 32 weekend periods, 8 of 38 weekday evening periods, 5 of 38 weekday morning periods and 2 of 4 holiday periods. Each day was divided into two survey periods; 05:00 through 13:00 hours during the morning and 13:00 to 21:00 hours during the evening.

Surveyors recorded the reach name, survey direction, date, start time, stop time and the total number of Chinook fishermen observed. Start time was recorded when the reach was first approached; stop time was recorded when the surveyor left the reach. The time spent in each reach was documented to compute survey effort and was variable depending on the length of the reach, presence of anglers, and the number of interviews conducted. Fishermen were interviewed as individuals (no groups) and were asked about their catch for the year-to-date and their catch and effort for the current day. A separate data entry was made for anglers interviewed multiple times during the same day. We recorded only the harvest and effort that occurred since the last interview (for fisherman that were interviewed more than once during a day). Crews recorded the number of Chinook salmon, bull trout, trout and mountain whitefish harvested that day. Year-to-date catch also included coho, fall Chinook, steelhead, rainbow trout, bull trout, mountain whitefish, and lamprey.

Table 11. Spring Chinook salmon harvest monitoring schedule for 2003. Initials are for particular staff members. Down and up designate downstream or upstream survey routes.

Date	Day	AM 5:00-13:00	PM 13:00-21:00	Sunrise	Sunset
2-Jun-03	Monday			511	2040
3-Jun-03	Tuesday			510	2041
4-Jun-03	Wednesday			510	2042
5-Jun-03	Thursday		EH down	509	2043
6-Jun-03	Friday			509	2043
7-Jun-03	Saturday		DT up	509	2044
8-Jun-03	Sunday			508	2045
9-Jun-03	Monday			508	2045
10-Jun-03	Tuesday	EH up		508	2046
11-Jun-03	Wednesday			508	2046
12-Jun-03	Thursday			507	2047
13-Jun-03	Friday		EH down	507	2048
14-Jun-03	Saturday	DT down		507	2048
15-Jun-03	Sunday	EH down		507	2048
16-Jun-03	Monday			507	2049
17-Jun-03	Tuesday		EH up	507	2049
18-Jun-03	Wednesday			507	2050
19-Jun-03	Thursday		EH up	507	2050
20-Jun-03	Friday			508	2050
21-Jun-03	Saturday	DT down		508	2050
22-Jun-03	Sunday		EH down	508	2051
23-Jun-03	Monday			508	2051
24-Jun-03	Tuesday		EH up	509	2051
25-Jun-03	Wednesday			509	2051
26-Jun-03	Thursday	EH up		509	2051
27-Jun-03	Friday			510	2051
28-Jun-03	Saturday	DT down		510	2051
29-Jun-03	Sunday		EH up	511	2051
30-Jun-03	Monday			511	2051
1-Jul-03	Tuesday			512	2050
2-Jul-03	Wednesday		EH down	512	2050
3-Jul-03	Thursday			513	2050
4-Jul-03	Friday		EH down	513	2050
5-Jul-03	Saturday	DT up		514	2049
6-Jul-03	Sunday	EH down		515	2049
7-Jul-03	Monday		EH up	516	2049
8-Jul-03	Tuesday			516	2048
9-Jul-03	Wednesday			517	2048
10-Jul-03	Thursday	EH up		518	2047
11-Jul-03	Friday			519	2046
12-Jul-03	Saturday	DT down		520	2046
13-Jul-03	Sunday		EH up	520	2045

2004 Schedules and Surveys

In 2004 a stratified randomization algorithm was used to avoid problems associated with sequential shifts and un-balanced sampling regimes. At least one weekend and one weekday shift was selected for each seven day sampling period. A random number generator was used to determine the number and distribution of additional shifts to be performed in a given week.

When a reach was first approached, start-time was recorded by the surveyor. End-time was later recorded when the surveyor departed the reach. The amount of surveyor effort was dependent on length of reach, presence of anglers, number of interviews, and accessibility. As a result, survey time spent at each reach was variable (Figure 2). The total time spent at all reaches was later used to compute survey effort for expansions.

Three timeslots consisting of five hours each were established for weekday surveys and 12 hour timeslots were used for weekends. Timeslots to be surveyed were selected using a random number generator in Microsoft Excel.

Surveying began at reach one and progressed in an upstream manner, throughout the circuit of all six reaches. Upon completing a circuit, the surveyor proceeded in a downstream manner regressing from reach six to reach one. This pattern would be completed as many times as possible within a given time slot.

One creel surveyor would conduct the field surveys on a given day and collect the following data at each reach: surveyor, reach number, date and timeslot. If fishermen were present, individual interviews were conducted and the following data was recorded; name, effort (nearest half-hour), time, Global Positioning System (GPS) coordinates. When a fish was caught, the following data was taken; species, marks, length, weight, and whether kept or released. Scales samples were taken from the preferred area of the fish for age and growth studies. The snout was taken if the fish had adipose and ventral fin clips. These marks indicated the possible presence of a coded wire tag.

Additional year to date (YTD) information was taken opportunistically from a fraction of anglers encountered to collect species-specific information from multi-basins. If an angler was interviewed for YTD information, the most recent information was used for post-season analysis. Post-season YTD information is discussed below.

Harvest totals were estimated and updated on a weekly basis. Results were then reported to CTUIR fisheries management officials to provide support data for making adaptive management decisions. The updated estimates were used as a monitoring tool to increase the probability that escapement goals were being met and harvest rates were not exceeding pre-set quotas.

Table 12. Spring Chinook salmon harvest monitoring schedule for 2004. Asterisk indicates creel survey performed in the field on that day.

2004 Date	Day	AM 6-11	MID 11-4	PM 4-9	WE/HOL 7-7	Sunrise	Sunset
1-May	Saturday				*	558	2016
2-May	Sunday				*	557	2018
3-May	Monday			*		555	2019
4-May	Tuesday			*		554	2020
5-May	Wednesday		*			553	2021
6-May	Thursday	*				551	2023
7-May	Friday		*			550	2024
8-May	Saturday				*	548	2025
9-May	Sunday				*	547	2026
10-May	Monday		*			546	2028
11-May	Tuesday	*				545	2029
12-May	Wednesday					543	2030
13-May	Thursday					542	2031
14-May	Friday					541	2032
15-May	Saturday				*	540	2034
16-May	Sunday				*	539	2035
17-May	Monday					537	2036
18-May	Tuesday					536	2037
19-May	Wednesday					535	2038
20-May	Thursday					534	2039
21-May	Friday					533	2040
22-May	Saturday				*	532	2041
23-May	Sunday					532	2043
24-May	Monday					531	2044
25-May	Tuesday			*		530	2045
26-May	Wednesday	*				529	2046
27-May	Thursday		*			528	2047
28-May	Friday			*		527	2048
29-May	Saturday				*	527	2049
30-May	Sunday				*	526	2049
31-May	Monday				*	526	2050
1-June	Tuesday					525	2051
2-June	Wednesday		*			524	2052
3-June	Thursday			*		524	2053
4-June	Friday		*			523	2054
5-June	Saturday					523	2054
6-June	Sunday					523	2055
7-June	Monday					522	2056
8-June	Tuesday					522	2057
9-June	Wednesday			*		522	2057
10-June	Thursday	*				521	2058
11-June	Friday				*	521	2059
12-June	Saturday				*	521	2059
13-June	Sunday				*	521	2100
14-June	Monday					521	2100

2004 Date	Day	AM 6-11	MID 11-4	PM 4-9	WE/HOL 7-7	Sunrise	Sunset
15-June	Tuesday					521	2101
16-June	Wednesday		*			521	2101
17-June	Thursday	*				521	2101
18-June	**Friday**			*		**521**	**2102**
19-June	**Saturday**				*	**521**	**2102**
20-June	**Sunday**					**521**	**2102**
21-June	Monday					521	2103
22-June	Tuesday					522	2103
23-June	Wednesday					522	2103
24-June	Thursday					522	2103
25-June	**Friday**					**523**	**2103**
26-June	**Saturday**					**523**	**2103**
27-June	**Sunday**					**523**	**2103**
28-June	Monday					524	2103
29-June	Tuesday					524	2103
30-June	Wednesday					525	2103
1-July	Thursday					525	2103
2-July	**Friday**					**526**	**2103**
3-July	**Saturday**				*	**527**	**2102**
4-July	**Sunday**				*	**527**	**2102**
5-July	Monday					528	2102
6-July	Tuesday					529	2101
7-July	Wednesday					529	2101
8-July	Thursday					530	2101
9-July	**Friday**					**531**	**2101**
10-July	**Saturday**				*	**532**	**2100**
11-July	**Sunday**					**533**	**2059**
12-July	Monday					533	2058
13-July	Tuesday					534	2058
14-July	Wednesday					535	2057
15-July	Thursday					536	2056
16-July	**Friday**					**537**	**2056**
17-July	**Saturday**					**538**	**2055**
18-July	**Sunday**				*	**539**	**2054**

Analysis

Harvest estimates for Umatilla Basin spring Chinook salmon were calculated by expanding angler count, effort and harvest data. The amount of surveyor effort for a day (se) was tallied by summing $\left(\sum\right)$ the time spent at all six individual reaches for a given day (Equation 1).

Equation 1. $(se) = \sum_{reach1}^{hr} + \ldots \sum_{reach6}^{hr}$

The daily surveyor effort (se) was divided into the total hours of daylight (dl) to generate a conversion factor (cf)(Equation 2). The conversion factor was later used in expansion formulas.

Equation 2. $(cf) = dl/se$

Mean estimates of angler effort per reach (mae) were calculated by dividing the total angler effort in hours (tae) by the number of anglers interviewed (ai) in a particular reach (Equation 3). This generated six (mae) values, one per reach.

Equation 3. $(mae) = tae/ai$

The total angler effort (tae) per day was calculated by adding the sum $(\sum)$ of the six time values that anglers spent at each reach. The same result could be achieved by multiplying the number of anglers interviewed (ai) by mean angler effort (mae) per reach (Equation 4). Summation of the six average angler effort values was generated to give a partial expansion estimate of angler hours for the time surveyed.

Equation 4. $(tae) = \sum_{reach1}^{hr} + \ldots \sum_{reach6}^{hr}$ **or** $(ai) \times (mae)$

Total angler hours (ce) were computed by multiplying the total time surveyed for a day (se) by the sum of total angler effort per reach (tae), divided by the individual reach time surveyed (re) and multiplied by the conversion factor (cf) (Equation 5). This was done for each of the six reaches per day surveyed, and added to achieve an expanded estimate.

Equation 5. $(ce) = \left[\frac{(se) \times (tae)}{(reach1)}\right] \times (cf) \ldots + \left[\frac{(se) \times (tae)}{(reach6)}\right] \times (cf)$

Data projections for days not surveyed were generated by assigning the average values from days surveyed for metrics such as; survey time, number of anglers, and fishing effort for the particular day of the week. Complete harvest expansions for days not surveyed were thus based on information from the survey days adjusted for the hours of daylight. Harvest estimates for salmonid species other than spring Chinook were based entirely on YTD information gathered through post season phone or person-to-person interviews due to the small sample size.

Post Season Interviews

Post season harvest interviews were conducted with enrolled CTUIR members via telephone and in person. Tribal harvest of fall Chinook, coho and steelhead was estimated only through post-season telephone surveys and interviews. No expansions were conducted from this data. Harvest estimates were considered conservative due to be being based entirely on reported catch. Telephone interviews were conducted by contacting tribal fishermen using a contact list of known Tribal fisherman. This list had been developed over time from past harvest interviews. Phone interviewers recorded name, date, interview type, harvest method and effort, and number of salmonid species kept in each basin.

Data acquired following the post season for spring Chinook salmon season was used to supplement and cross reference harvest estimates generated from the field survey data. Estimates of salmonid species other than spring Chinook were based entirely on post season interview data. Post season interviews were also a valuable source for estimating annual harvest of salmonid species in other subbasins.

4 Results and Discussion

4.1 Spawner Surveys and Adult Returns

4.1.1 Summer Steelhead

4.1.1.1 Steelhead Returns to Threemile Dam

Total enumeration of summer steelhead adults at 3MD began in 1988. The natural component of the return has varied between 724 and 3658 and averaged 1695, and the hatchery return has varied between 165 and 1862 and averaged 774 fish (Figure 10). Returns of natural summer steelhead to 3MD in 2003 and 2004 were 2119 and 2111 adults respectively. Hatchery returns to 3MD in 2003 and 2004 were 959 and 1278. Over the past sixteen years both the natural and hatchery components of the summer steelhead run have increased, despite considerable variability in returns.

The fraction of natural vs. hatchery summer steelhead has varied considerably in the past fourteen years (Figure 11). The fraction of natural fish has declined slightly, and the fraction of hatchery fish has increased slightly, during the study period. These patterns do not appear to be significant, and are confounded by variability in the distribution.

Based on scale analysis almost 90% of returning adult summer steelhead returning to 3MD spent two years in freshwater before outmigration (Figure 12 and Figure 13). Nearly equal numbers of total age 4 and 5 adult steelhead returned in all years combined

(Figure 14 and Figure 15). There was significant variability in the distribution of age classes across years.

Return per spawner data for 12 brood years between 1988 and 1999 were complete except for age 6 returns from the 1999 brood which are usually not significant. Return per spawner has varied between 0.51 and 2.61, and averaged 1.01: approximately replacement (Figure 16). Only 4 of the 12 brood years returned above replacement level; two broods were near replacement level and 6 broods were well below replacement level. In general productivity as measured in adult returns per spawner has increased during the sampling period.

Between 1988 and 2001 total natural escapement at 3MD has decreased slightly, while the returns for each given brood year have increased more so (Figure 17). The stock-recruitment curve is beginning to take the shape of a traditional Ricker recruitment curve (Figure 18). Additional years of data are needed to increase the resolution of the curve and confidence in its estimators. Out-of-basin survival appears to be important in the recruitment of stock, as is evident by the lack of a relationship between smolt releases and brood year production (Figure 19). Sufficient data is not available to conduct a more sophisticated analysis of the impacts of in-basin and out-of-basin factors, but this level of analysis requires significant time and computations. This evaluation should be conducted using both statistics and biological models as time and resources allow, to facilitate a proper evaluation of habitat, hatchery, harvest, and hydrosystem conditions.

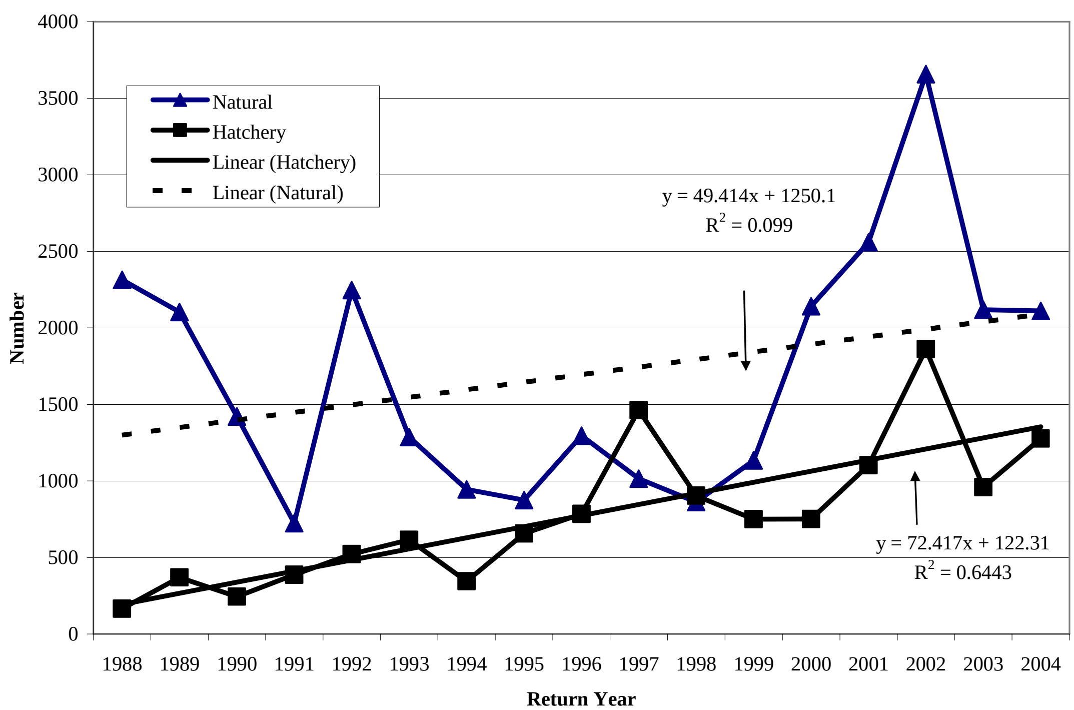

Figure 10. Natural and hatchery return of summer steelhead to 3MD, Umatilla River, 1988-2004.

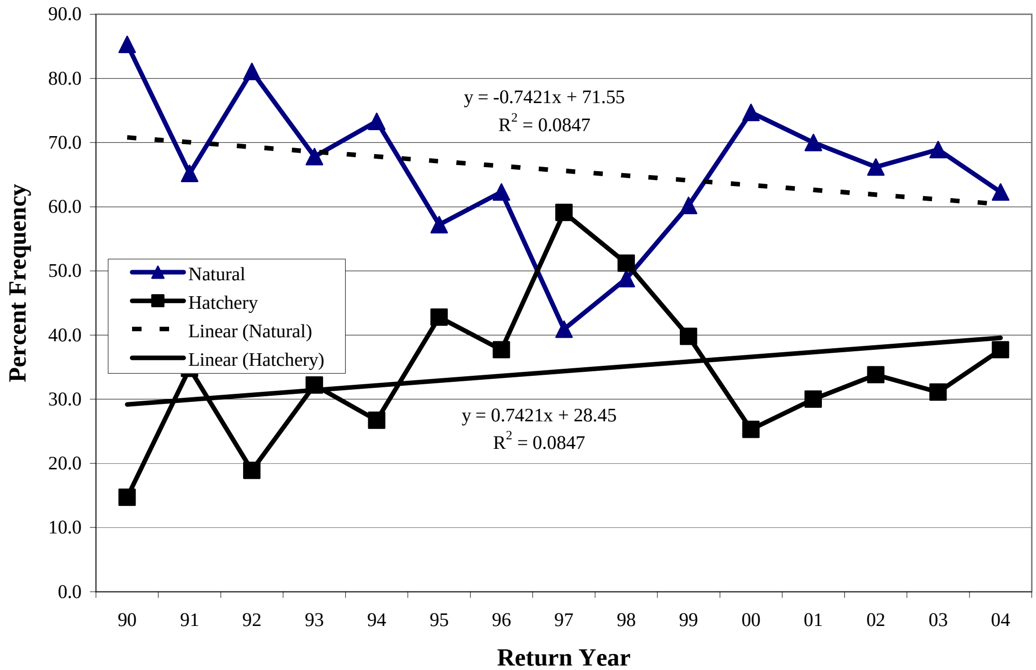

Figure 11. Percent frequency of natural and hatchery summer steelhead at 3MD, Umatilla River, by return year.

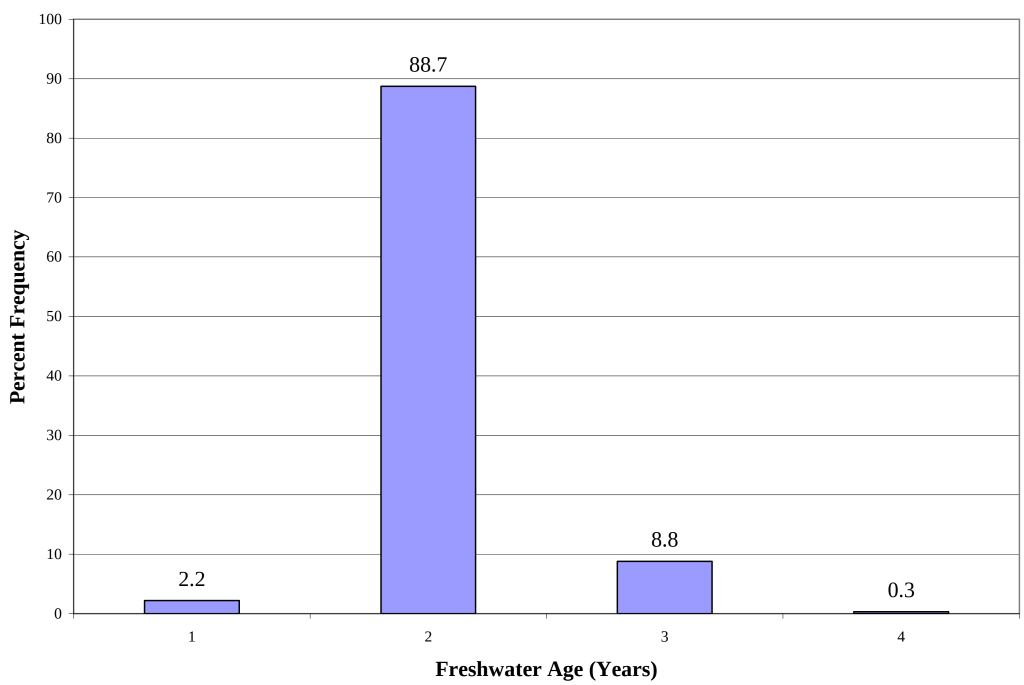

Figure 12. Freshwater age of naturally returning summer steelhead to 3MD, Umatilla River, for the 1983, 1989, 1990, 1992 and 1994-2004 return years (n=866).

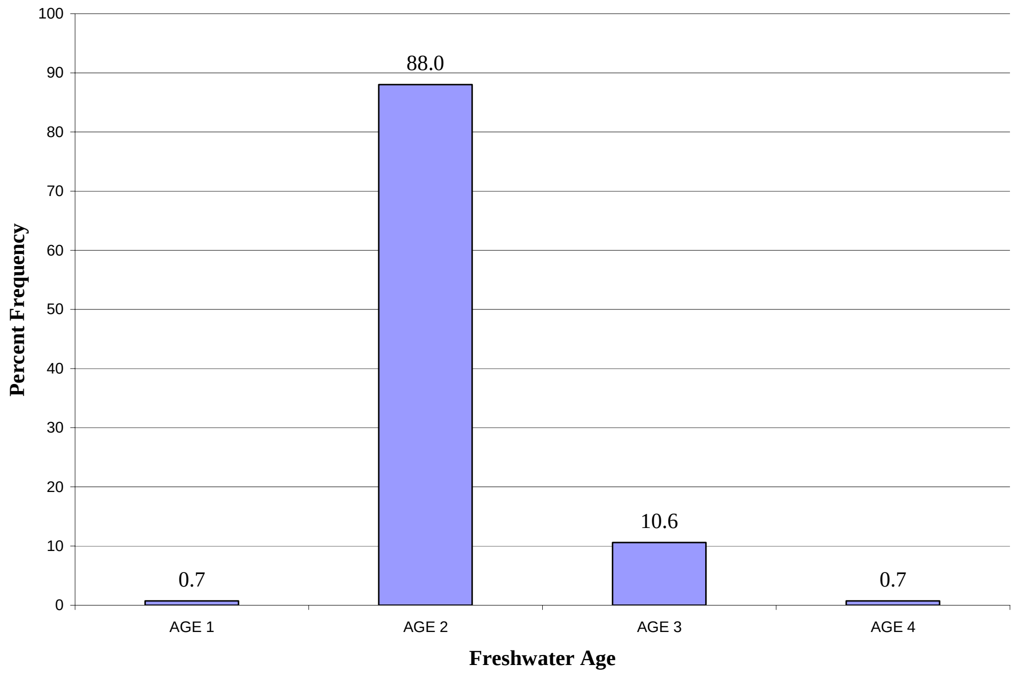

Figure 13. Freshwater age of natural summer steelhead adults returning to the Umatilla River, 1991-1996 brood years.

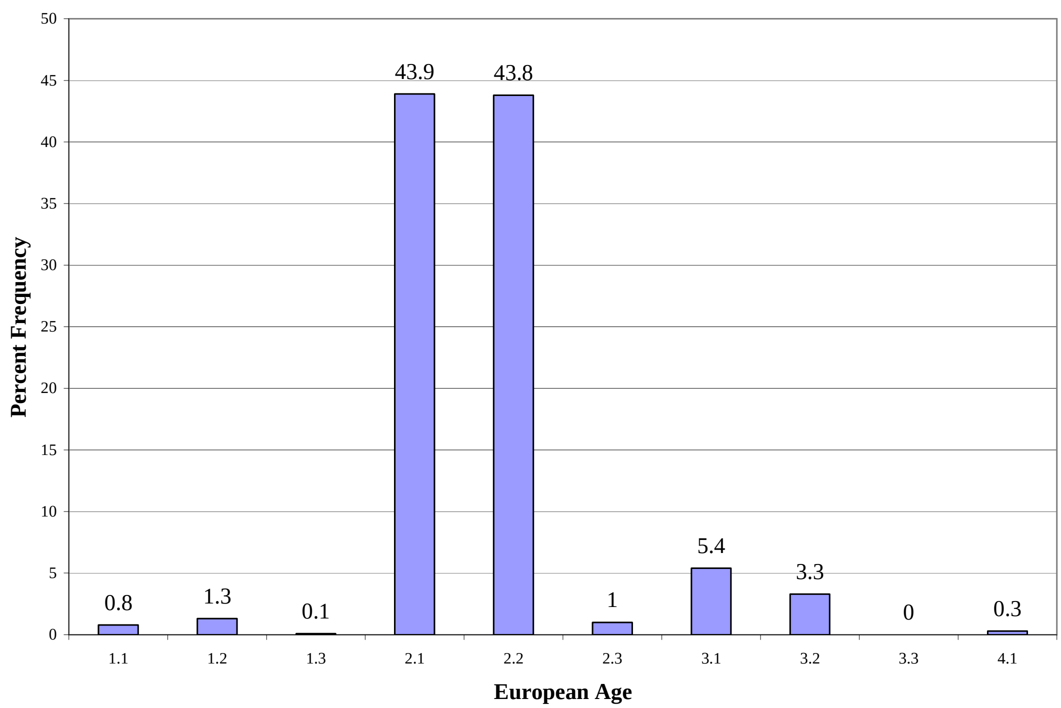

Figure 14. European age of natural summer steelhead adults in the Umatilla River, 1983, 1989, 1990, 1992, and 1994-2004 return years (n=866).

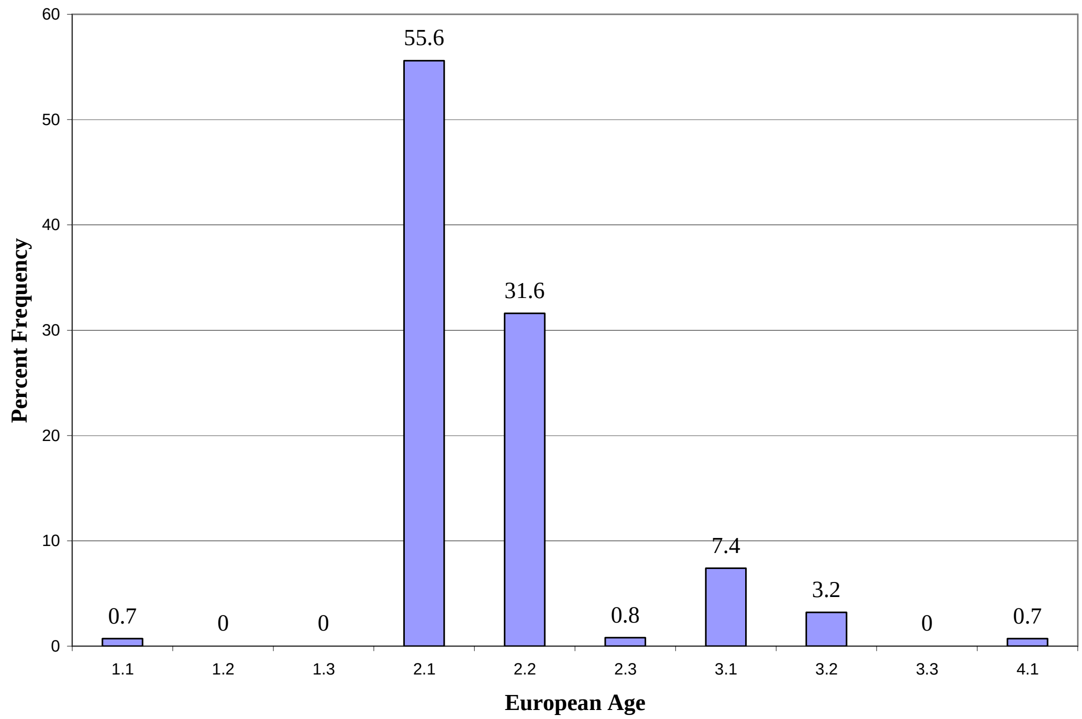

Figure 15. European age of natural summer steelhead adults in the Umatilla River, 1991-1996 brood years.

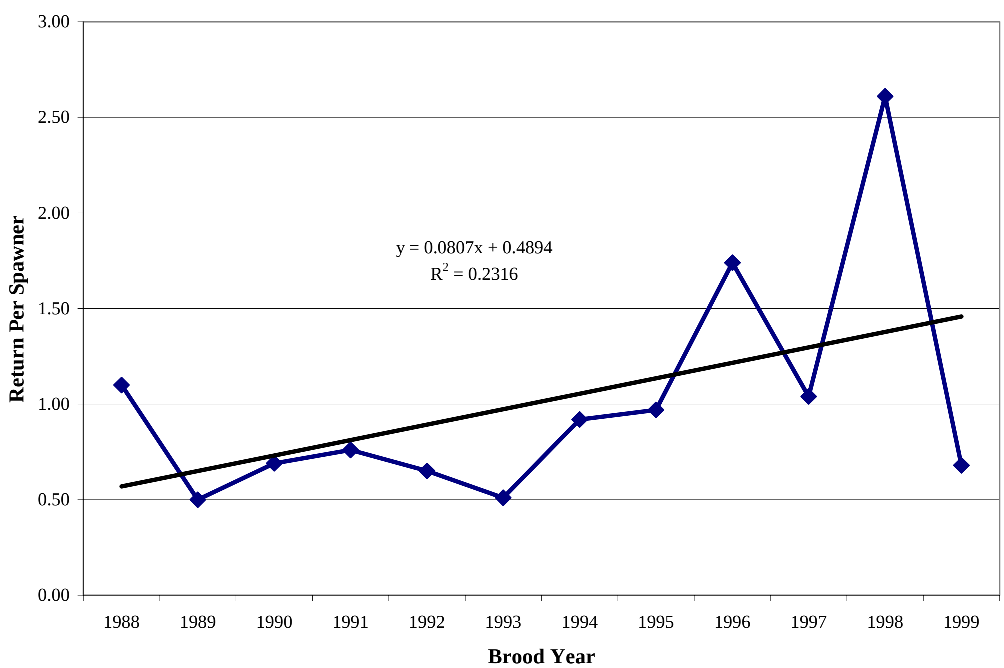

Figure 16. Summer steelhead return per spawner in the Umatilla River, 1988-1999 brood years.

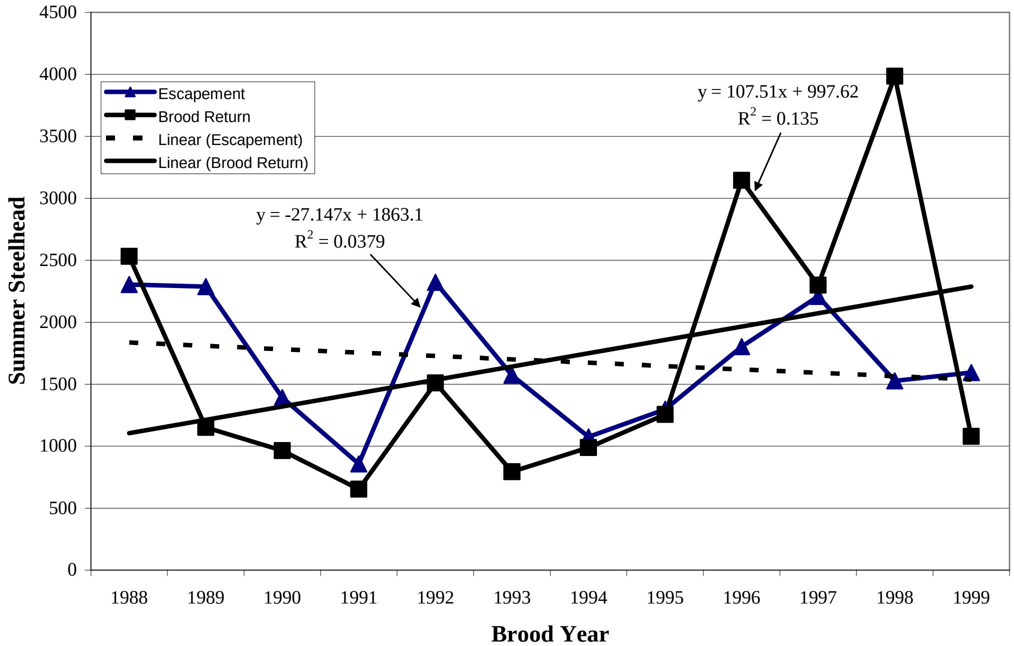

Figure 17. Total summer steelhead escapement and natural returns to 3MD Umatilla River, 1988-1999.

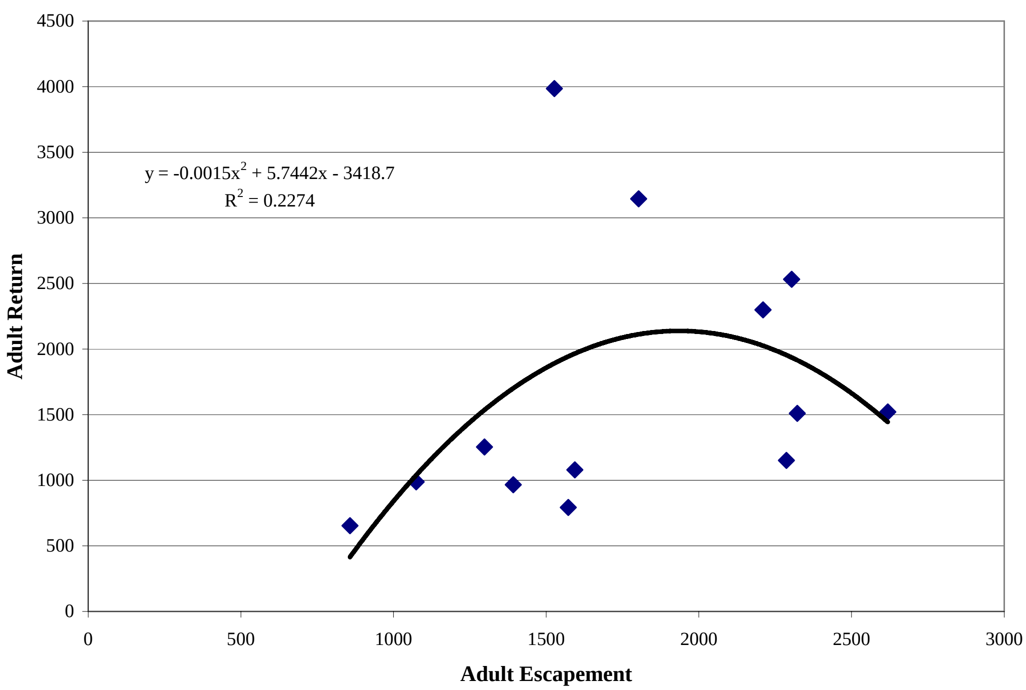

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Figure 18. Stock-recruitment curve for Umatilla summer steelhead, 1988-1999 brood years.

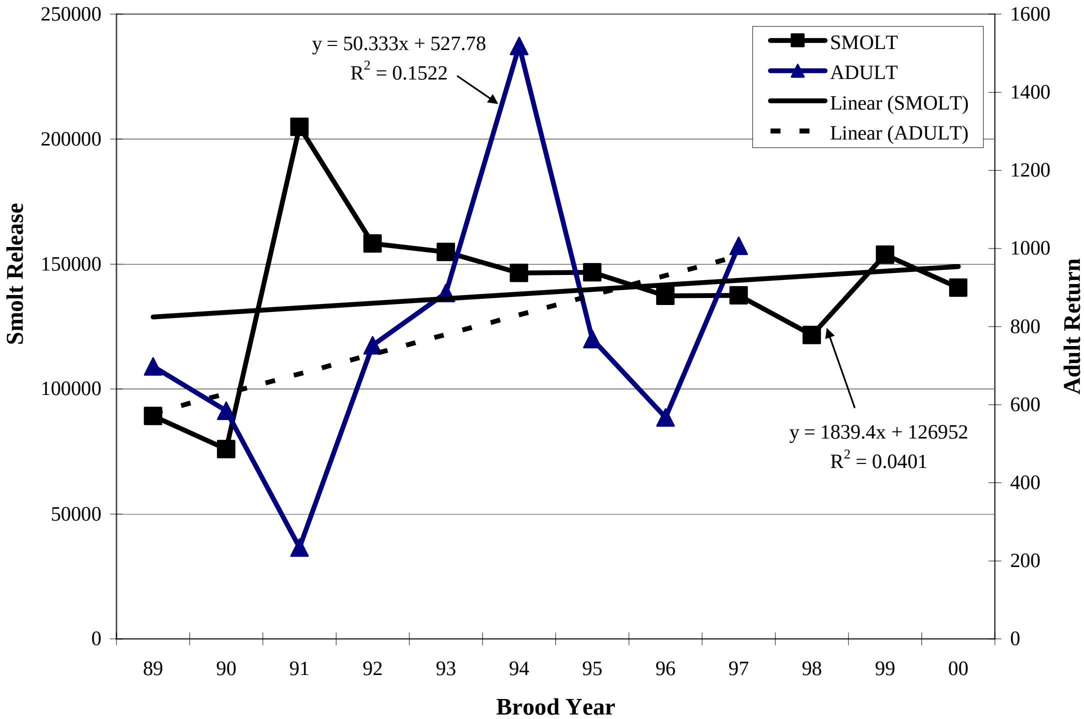


Figure 19. Summer steelhead adult escapement, and hatchery smolt releases, 1989-1997.

Table 13. Summer steelhead returns to 3MD, Umatilla River, by sex, origin, and brood year.

					Natural						Hatchery				Total
Brood Year	Sex	1.1	1.2	2.1	2.2	2.3	3.1	3.2	4.1	1.1	1.2	1.3	Total Natural	Total Hatchery	Return
1987	Female				253								253		
	Male				145								145		398
1988	Female			1062	497	18		18	0		78		1595	78	
	Male			787	141	4		4	0		42		936	42	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	314	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	231	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	66	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	347	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	345	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	800	2598
1995	Female	0	0	406	192	24	114	73	0	225	231	8	809	464	
	Male	0	0	244	93	10	70	29	0	243	54	1	446	298	2017
1996	Female	19	0	1048	848	0	95	66	0	239	30	0	2076	269	
	Male	11	0	643	339	0	48	28	0	219	5	0	1069	224	3638
1997	Female	0	0	730	622	56	134	0	0	339	300	0	1542	627	
	Male	0	0	367	271	16	103	0	0	349	103	0	757	453	3379
1998	Female	0	0	1374	1033	0	120	17	0	355	226	0	2544	355	
	Male	0	0	1053	305	0	76	7	0	341	172	0	1441	342	4682
1999	Female	0	28	273	275		121			692	350	0	697	1042	
	Male	0	8	175	114		85			772	191	0	382	963	3084
2000	Female	17	35	848						200	117		900		
	Male	11	14	595						215	30		620		
2001	Female	0								481					
	Male	0								649					

Table 14. Summer steelhead adult return, disposition, and escapement to the Umatilla River, 1987-2004. "*" indicates a rough estimate of harvest.

RUN YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Summer Steelhead (STS) Enumerated at TMD	**2480**	**2474**	**1667**	**1111**	**2769**	**1901**	**1290**	**1531**	**2081**	**2477**	**1765**	**1885**	**2892**	**3662**	**5519**	**3078**	**3389**
Natural STS Enumerated at Three Mile Dam (TMD)	**2315**	**2104**	**1422**	**724**	**2247**	**1286**	**945**	**874**	**1296**	**1014**	**862**	**1135**	**2141**	**2559**	**3658**	**2119**	**2111**
Hatchery STS Enumerated at TMD	**165**	**370**	**245**	**387**	**522**	**615**	**345**	**657**	**785**	**1463**	**903**	**750**	**751**	**1103**	**1861**	**959**	**1278**
Natural Female STS Enumerated at TMD						929	688	644	922	742	593	774	1358	1764	2240	1528	1296
Hatchery Female STS Enumerated at TMD						363	250	343	447	720	530	478	390	657	922	553	598
Natural Male STS Enumerated at TMD						357	257	230	374	272	269	361	783	795	1418	591	815
Hatchery Male STS Enumerated at TMD						252	95	314	338	743	373	272	361	446	939	406	680
Natural STS Sacrificed or Mortalities at TMD	20	12	25	2	3	0	0	0	7F-1M	5F	1F-1M	1F	0	2F	1F	1F	2F
Hatchery STS Sacrificed or Mortalities at TMD	5	17	143	50	112	49F-21M	45F-6M	19F-14M	57F-16M	51F-44M	43F-27M	51F-24M	29F-13M	69F28M	26F23M	54F28M	10F-2M
Natural STS Taken for Brood Stock	151	160	106	99	237	64F-64M	47F-46M	43F-43M	52F-50M	50F-50M	43F-43M	55F-55M	55F-60M	53F53M	50F50M	49F51M	52F-50M
Hatchery STS Taken for Brood Stock	0	0	0	103	95	49F-43M	23F-19M	34F-34M	14F-17M	10M	11F-19M	15M	15M	10M	10M	9M	10F-9M
Natural Females Released above TMD	1436	1232			1193	865	641	601	863	687	549	718	1303	1709	2189	1478	1242
Natural Males Released above TMD	708	702			814	293	211	187	323	222	225	306	723	742	1368	540	765
Hatchery Females Released above TMD	114	216			161	265	182	290	376	669	476	427	361	588	896	499	578
Hatchery Males Released above TMD	46	137			154	188	70	266	305	689	327	233	333	408	906	369	669
Natural STS Harvested above TMD-CTUIR						5	5	5	0	0	5	5	0	0	50*	50*	50
Hatchery STS Harvested above TMD-CTUIR						25	20	20	39	33	33	39	99	84	50*	50*	50

RUN YEAR	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Hatchery STS Harvested above TMD-ODF&W						22	5	21	25	24	12	47	4	3	57	5	15
Natural Female STS Potentially Available to Spawn	**1436***	**1232***			**1193***	**862**	**638**	**598**	**863**	**687**	**546**	**715**	**1303**	**1709**	**2164**	**1453**	**1217**
Hatchery Female STS Potentially Available to Spawn	**114***	**216***			**161***	**241**	**169**	**269**	**343**	**639**	**453**	**383**	**309**	**544**	**842**	**471**	**545**
Total Female STS Potentially Available to Spawn	**1550***	**1448***			**1354***	**1103**	**807**	**867**	**1206**	**1326**	**999**	**1098**	**1612**	**2253**	**3006**	**1924**	**1762**
Natural Male STS Potentially Available to Spawn	**708***	**702***			**814***	**291**	**209**	**185**	**323**	**222**	**223**	**304**	**723**	**742**	**1343**	**515**	**740**
Hatchery Male STS Potentially Available to Spawn	**46***	**137***			**154***	**165**	**58**	**246**	**274**	**661**	**305**	**191**	**282**	**365**	**853**	**342**	**637**
Total Male STS Potentially Available to Spawn	**754***	**839***			**968***	**456**	**267**	**431**	**597**	**883**	**528**	**495**	**1005**	**1107**	**2196**	**857**	**1377**
Natural STS Potentially Available to Spawn	**2144**	**1934**	**1290**	**623**	**2007**	**1153**	**847**	**783**	**1186**	**909**	**769**	**1019**	**2026**	**2451**	**3507**	**1967**	**1957**
Hatchery STS Potentially Available to Spawn	**160**	**353**	**102**	**234**	**315**	**406**	**227**	**515**	**617**	**1300**	**758**	**574**	**591**	**909**	**1695**	**810**	**1181**
Total STS Available to Spawn	**2304**	**2287**	**1392**	**857**	**2322**	**1559**	**1074**	**1298**	**1803**	**2209**	**1527**	**1593**	**2617**	**3360**	**5202**	**2777**	**3138**
STS Redds Observed in Index Reaches	138	77	High Water	High Water	135	High Water	64	74	119	138	126	218	238	382	347	322	208
Total STS Redds Observed	275	128	High Water	High Water	300	High Water	224	126	150	149	217	293	523	n/a	n/a	n/a	n/a
Index Reaches Miles Surveyed	18.5	20	High Water	High Water	21.4	High Water	21.4	21.4	21.4	21.4	21.4	21.4	21.4	21.4	19.4	21.4	19.9
Total Redds Per Mile in Index Reaches	**7.5**	**3.9**	**High Water**	**High Water**	**6.3**	**High Water**	**3.0**	**3.5**	**5.6**	**6.4**	**5.9**	**10.2**	**11.1**	**17.9**	**17.9**	**15.0**	**10.5**

4.1.1.2 Steelhead Spawning ground surveys

Spawning ground surveys concentrated on six index tributaries. Past surveys have shown a high correlation (R^2=0.90) between redds per mile in all areas surveyed and redds per mile in the six index tributaries (Figure 20). This is likely because the density of redds throughout the subbasin tracks closely (R^2=0.84) with the number of female steelhead available to spawn (Figure 21 and Figure 22). Interestingly, this relationship is stronger for index reaches than when considering all reaches examined in the past decade (R^2=0.78) (Figure 23). This may suggest bias in the selection of index reaches as these same tributaries are locally considered to be some of the higher quality spawning habitat for summer steelhead.

In 2003 surveys were conducted on 21.4 miles of index reaches, and 322 redds were enumerated. In 2004 surveys were conducted on 19.9 miles of index reaches and 208 summer steelhead redds were observed. Average annual redds observed per mile surveyed have varied between 2.5 and 18.0 from 1994-2004 (Figure 24). Figure 25 shows the density and distribution of summer steelhead redds enumerated in 2004. GPS coordinates were not collected in 2003.

Under certain conditions the origins of steelhead spawners can be determined visually. The power of this data is unknown, but the information may have some utility (Table 15). In 2003, 70.0% of the summer steelhead available to spawn (fish released above 3MD minus all harvest components) were naturally produced, and during spawning surveys 67.9% of the spawning steelhead were categorized as natural or hatchery origin. In 2004, 62.4% of the fish available to spawn were naturally produced, and on the spawning grounds 64.9% of the fish observed were naturals. Several additional years of observations will be needed to determine statistically the power of these visual observations.

Considerable resources are invested in the enumeration of summer steelhead redds. There is strong evidence that redd densities in index reaches are indicative of the available spawner population for a given year. In addition these surveys provide information on the utilization of habitat, and could provide information on the expansion or contraction of spawning if an appropriate survey design is developed. The Columbia System-wide Monitoring and Evaluation Partnership (CSMEP) and Pacific Northwest Aquatic Monitoring Partnership (PNAMP) are developing protocols for spatially balanced surveys that would address these requirements. To estimate the quantity of habitat that would need to be surveyed in a given tributary for spatially balanced sampling we calculated the rolling averages of summer steelhead redd densities from index tributaries based on 0.1 mile reaches. This is not a true power analysis, but does present a picture of the consequences of missing particular habitat units. In virtually all cases the average first climbs, and then declines steadily as the reaches move higher into the headwaters (Figure 26 through Figure 31). A sophisticated simulation will be needed to determine whether a randomized sub-sampling procedure could effectively capture this variability.

Table 15. Natural and hatchery escapement of summer steelhead based on visual observations during spawner surveys.

Brood Year	Iskuulpa Creek		NF Meacham Creek		Camp Creek		Boston Canyon Creek		Buckaroo Creek		South Fork Umatilla		Total Observed		Three Mile Dam STS		STS Available To Spawn	
	Nat	Hatch	Nat	Hatch	Nat	Hatch	Nat	Hatch	Nat	Hatch	Nat	Hatch	Nat	Hatch	Nat	Hatch	Nat	Hatch
2001 n=	4	3	4	0	2	0	0	1	5	2	2	0	17	6	2563	1099	2455	905
%=	57.1	42.9	100.0	0.0	100.0	0.0	0.0	100.0	71.4	28.6	100.0	0.0	73.9	26.1	70.0	30.0	73.1	26.9
2002 n=	14	6	2	0	4	3	0	6	3	4	0	0	23	19	3651	1862	3500	1696
%=	70.0	30.0	100.0	0.0	57.1	42.9	0.0	100.0	43.9	57.1	0.0	0.0	54.8	45.2	66.2	33.8	67.4	32.6
2003 n=	17	10	5	0	5	0	0	5	4	0	5	2	36	17	2118	956	2017	865
%=	63.0	37.0	100.0	0.0	100.0	0.0	0.0	100.0	100.0	0.0	71.4	28.6	67.9	32.1	68.9	31.1	70.0	30.0
2004 n=	19	7	3	0	0	0	0	6	2	0	0	0	24	13	2111	1277	2007	1246
%=	73.1	26.9	100.0	0.0	0.0	0.0	0.0	100.0	100.0	0.0	0.0	0.0	64.9	35.1	62.3	37.7	61.7	38.3

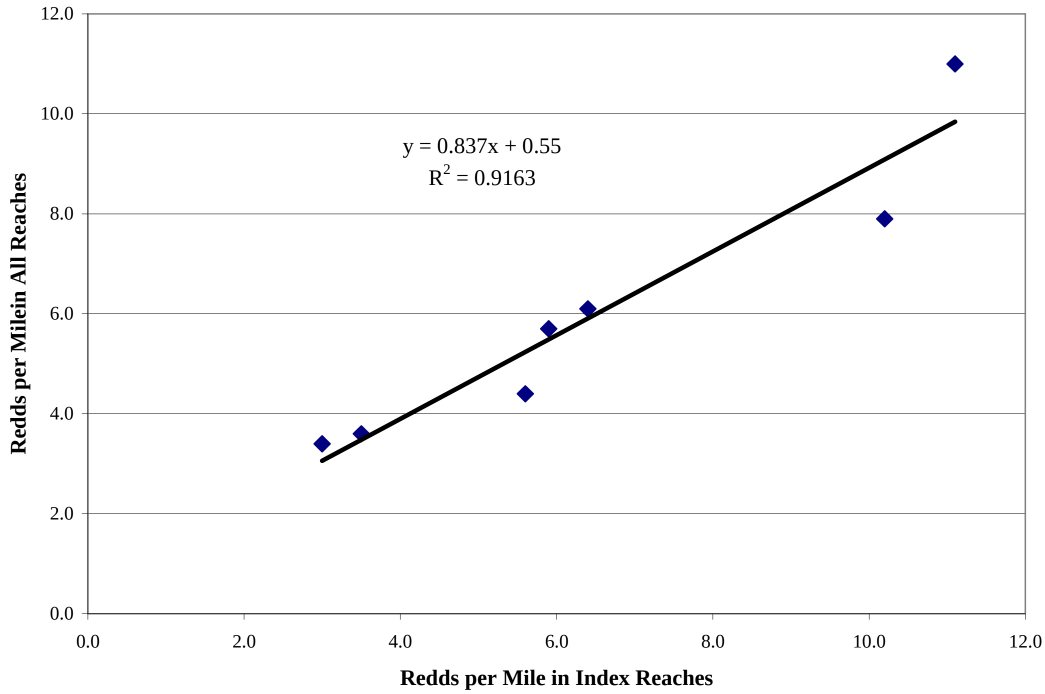


Figure 20. Summer steelhead redds per mile in index reaches and total redds per mile in all areas surveyed in the Umatilla River during 1993-2000.

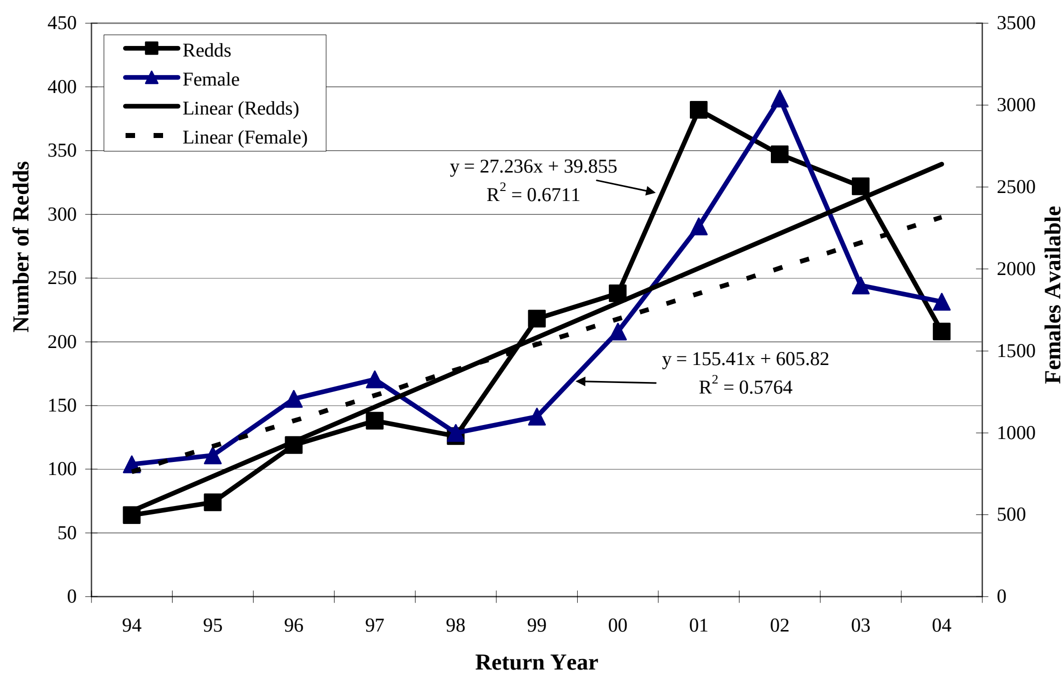


Figure 21. Summer steelhead redds enumerated in index reaches of the Umatilla River and females available to spawn.

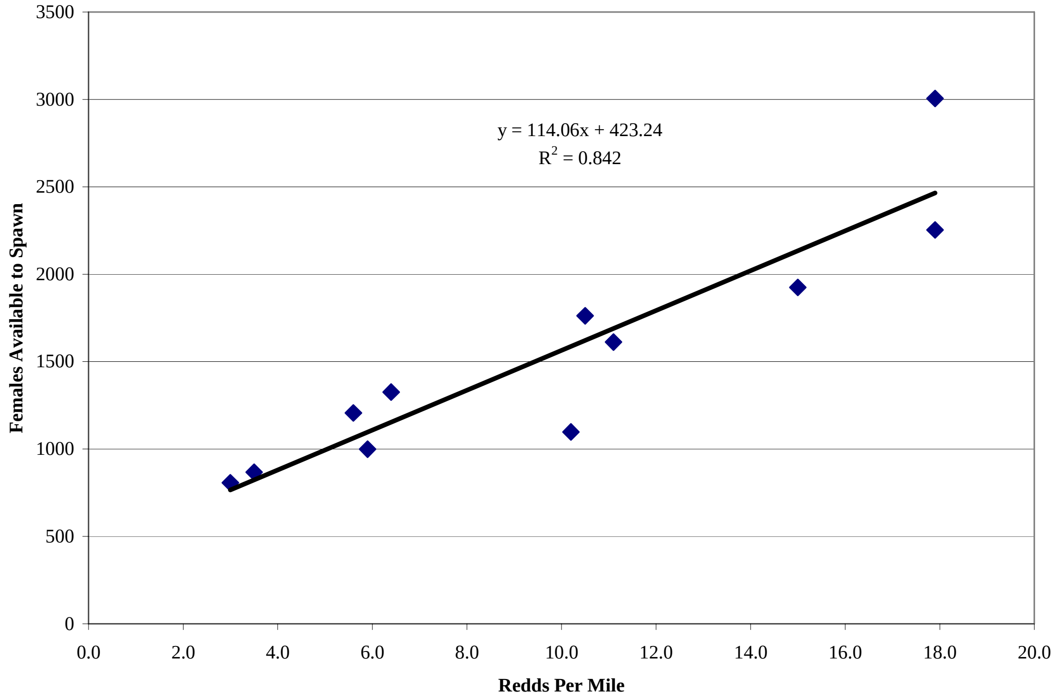


Figure 22. Female summer steelhead potentially available to spawn vs. redds per mile observed in index reaches during escapement surveys, Umatilla River, 1994-2004.

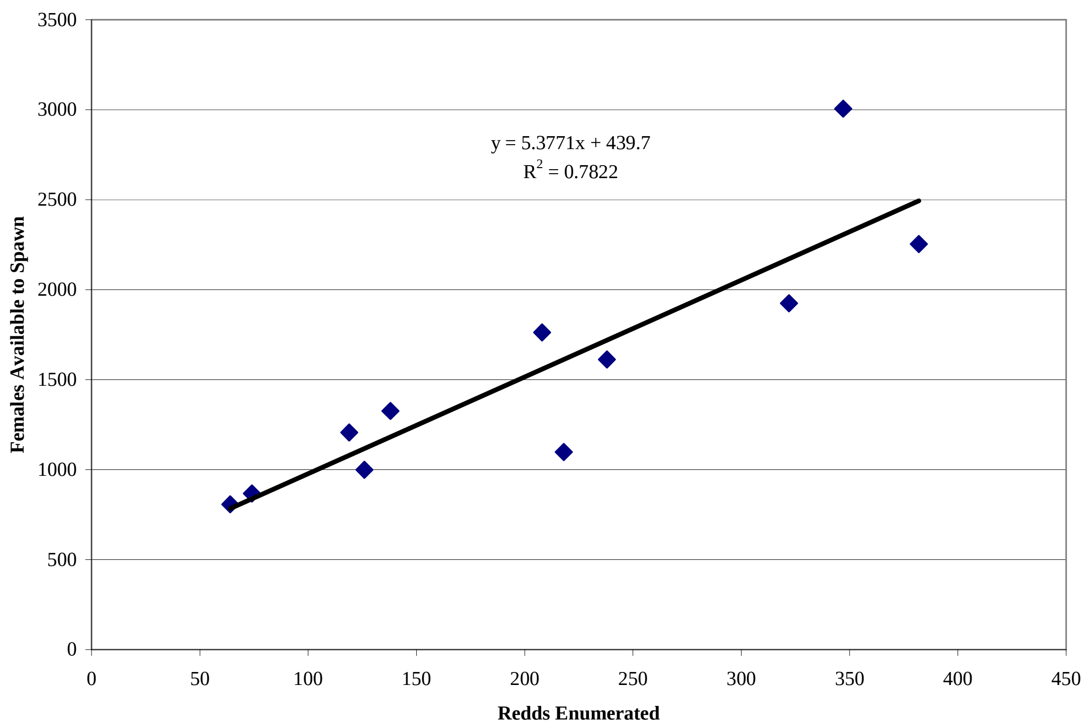


Figure 23. Female summer steelhead potentially available to spawn vs. redds enumerated in all reaches, Umatilla River, 1994-2004.

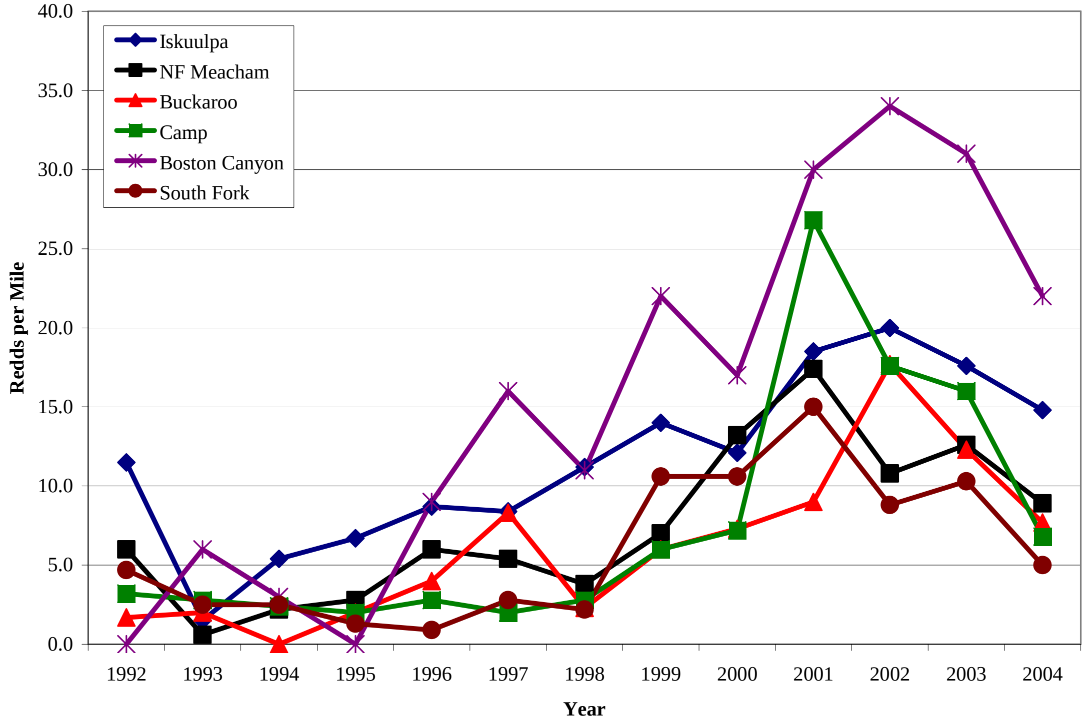


Figure 24. Summer steelhead redds per mile in index reaches of the Umatilla, 1992-2004.

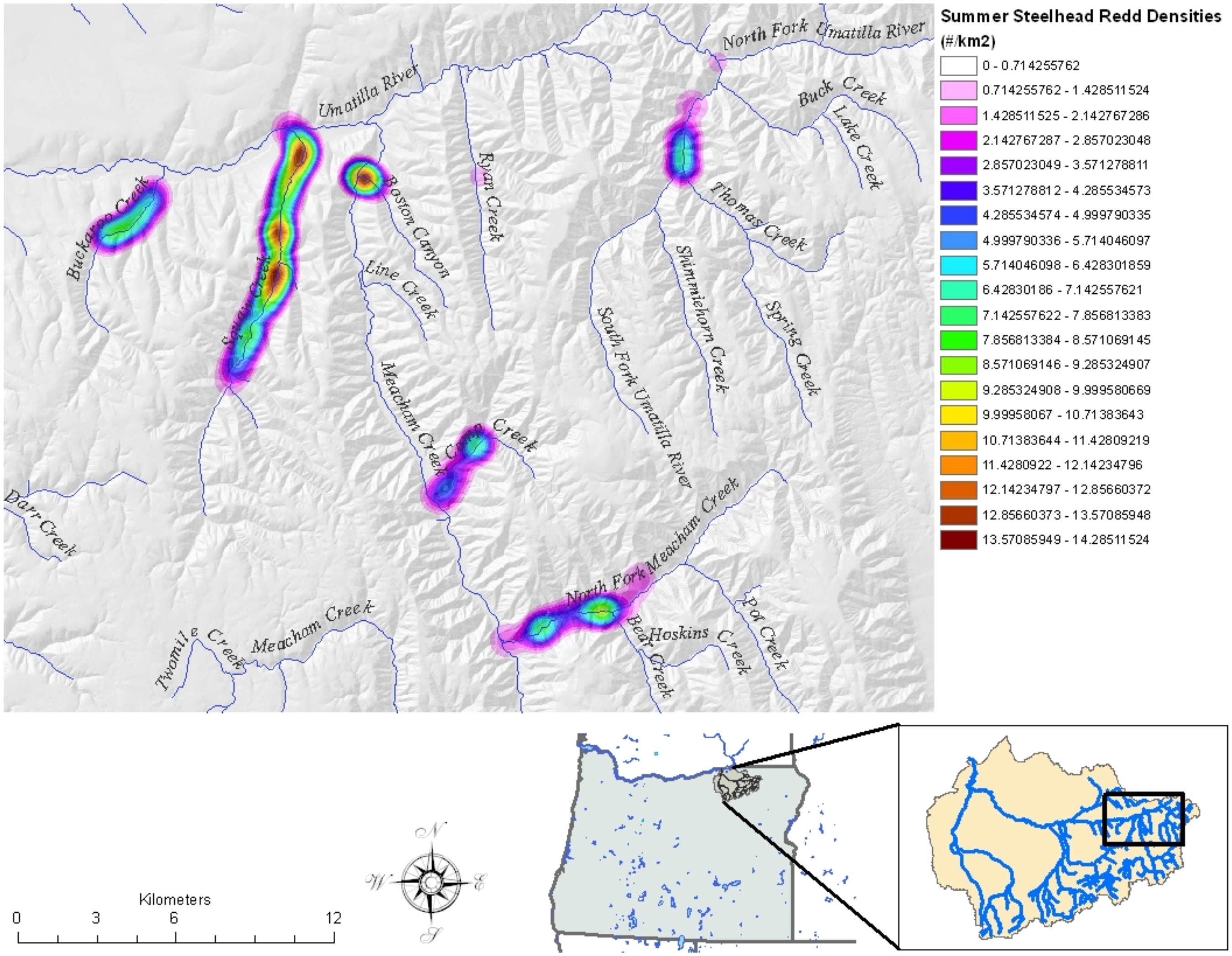


Figure 25. Density and distribution of summer steelhead redds enumerated during 2004 surveys.

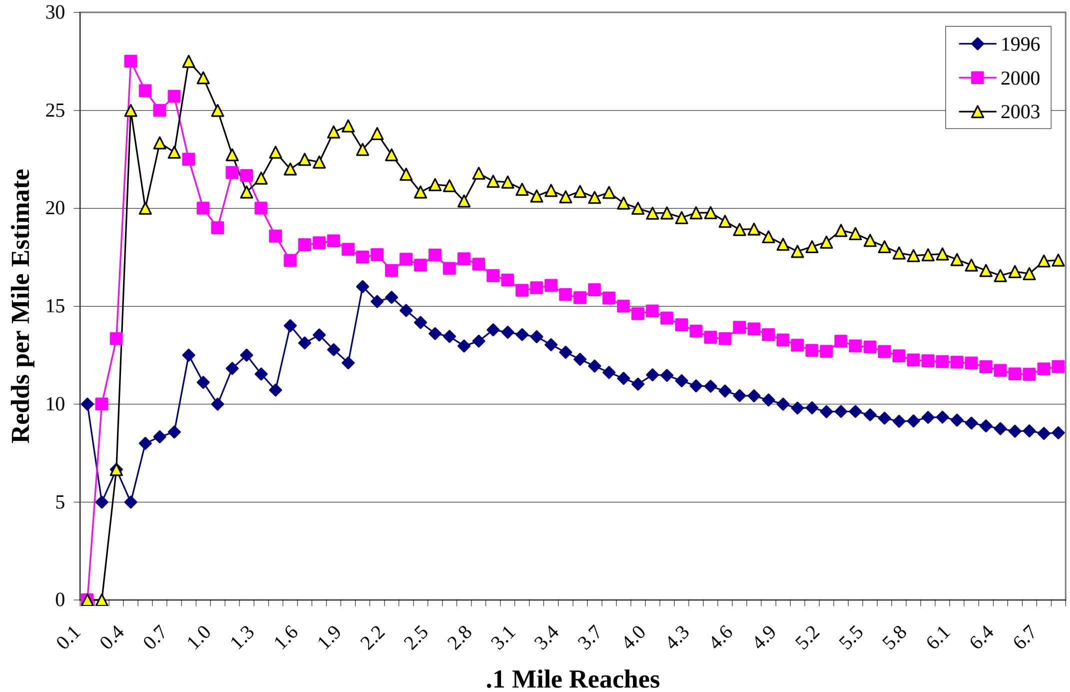


Figure 26. Rolling averages for STS redds/mile on Iskuulpa Creek for three survey years.

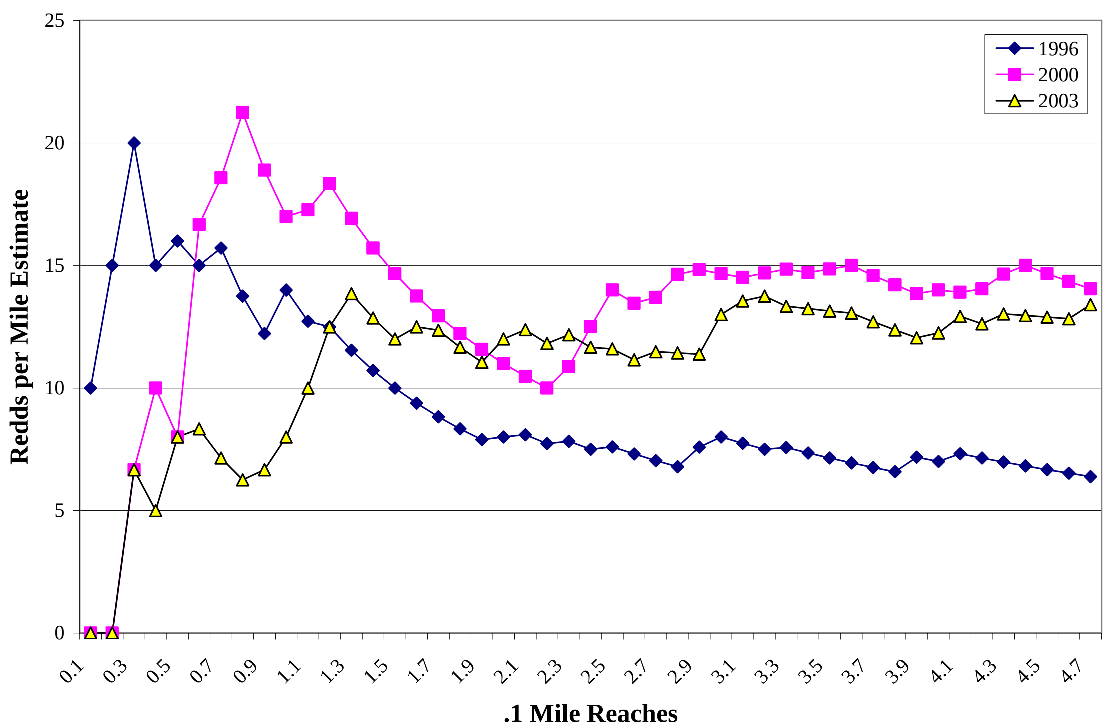


Figure 27. Rolling averages for STS redds/mile on Meacham Creek for three survey years.

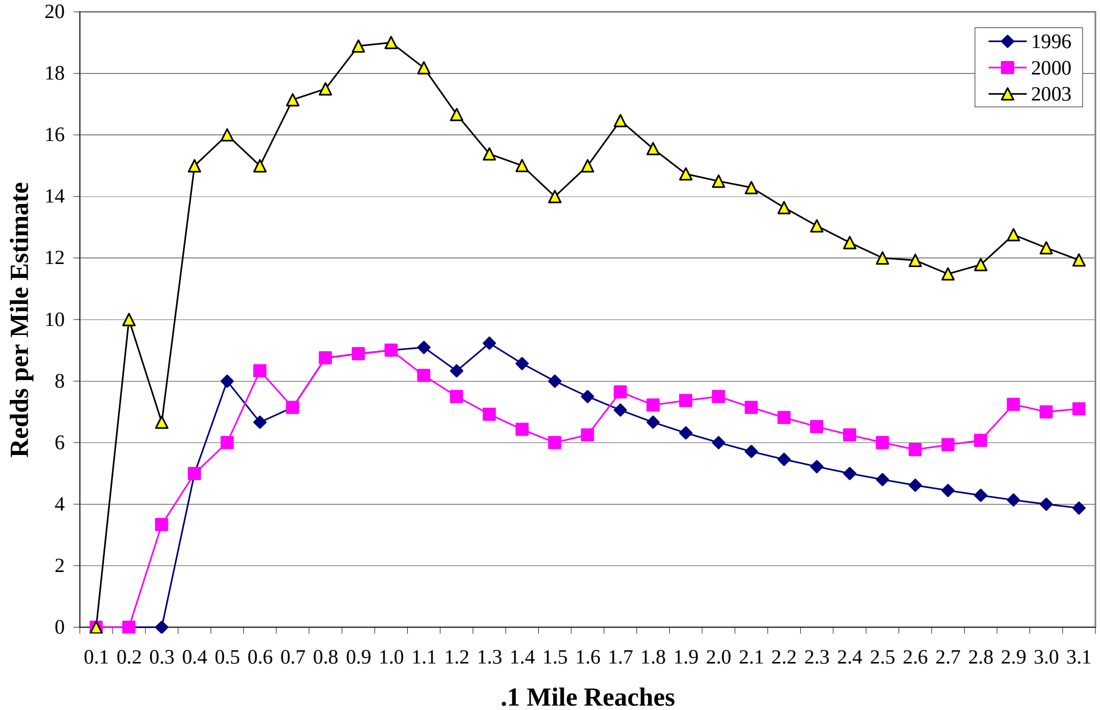


Figure 28. Rolling averages for STS redds/mile on Buckaroo Creek for three survey years.

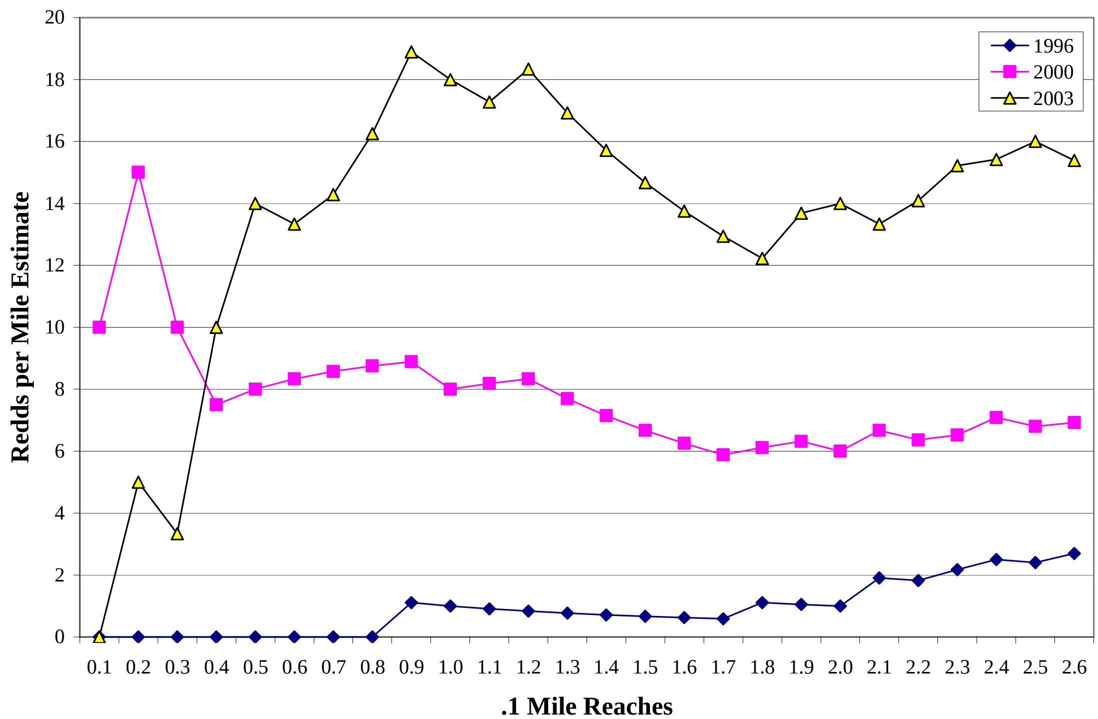


Figure 29. Rolling averages for STS redds/mile on Camp Creek for three survey years.

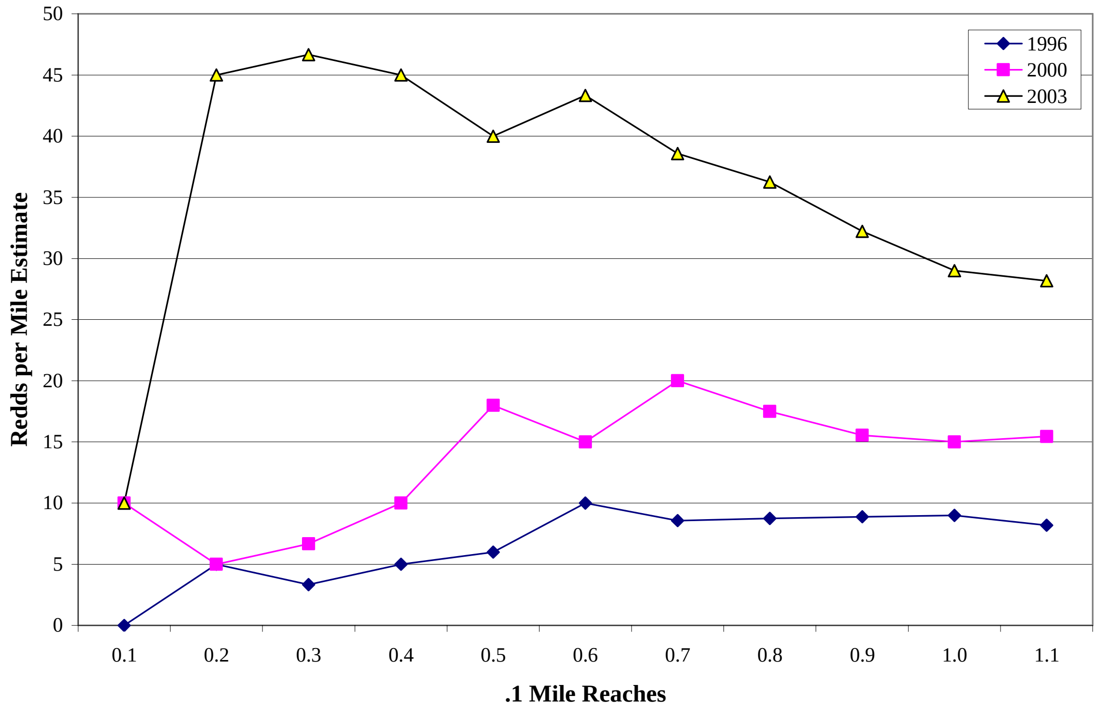


Figure 30. Rolling averages for STS redds/mile on Boston Canyon for three survey years.

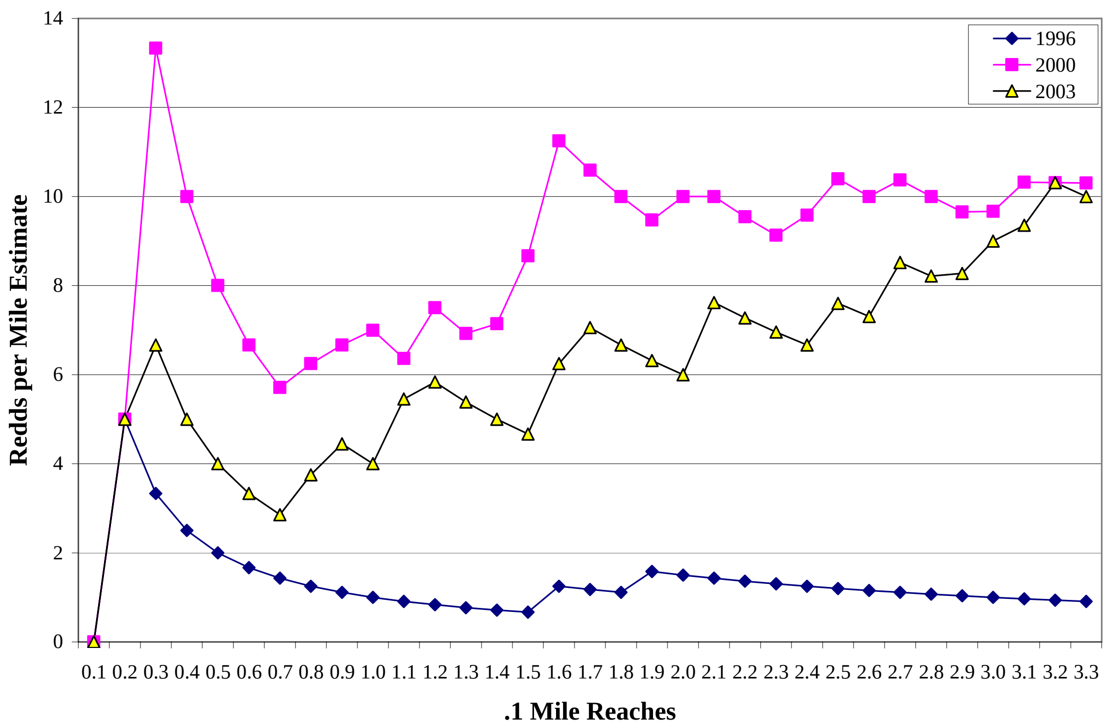


Figure 31. Rolling averages for STS redds/mile on the South Fork Umatilla for three survey years.

4.1.2 Spring Chinook Salmon

4.1.2.1 Return to Threemile Dam

The natural component of the adult spring Chinook salmon return to 3MD has varied between 22 in 1999 and 347 in 2000 and averaged 187 (Table 16 and Figure 32). The return of hatchery origin adults has varied between 68 in 1989 (the first year of an adult return) and 4886 in 2002 and averaged 1932. The natural return was estimated by analysis of spring Chinook salmon adult scales collected on the spawning grounds and in the sport fishery. The natural component of the sample was estimated to have 11-18 circuli and the hatchery component had 19-33 circuli (Table 16). The disposition of returns has been dominated by hatchery –origin adults (Figure 33). The natural return in 2004 was estimated by analysis of the four year old return separate from the five year old return. In 2004 a total of 541 unmarked adults returned to 3MD. Based on age analysis of 51 unmarked adults, 84.3% were age four, and 15.7% were age five. Of the 456 unmarked age four returns, scale pattern analysis indicated that 65.1% or 297 were naturally produced. Of the 85 age five unmarked fish returning, 37.5% were naturally produced. Both the natural and hatchery origin returns have been increasing throughout the monitoring period (Figure 35 and Figure 34). Adult and jack spring Chinook returns have increased considerably during the past fifteen years (Figure 32). Hatchery-reared returns have consistently been higher than naturally-reared returns, despite correlation in the increase of both stock fractions.

Table 16. Estimated number of naturally produced spring Chinook salmon returned to 3MD based on freshwater circuli counts of scales.

Return year	1996	1997	1998	1999	2000	2001	2002	2003	2004
Unmarked adults at TMD	165	179	67	30	420	3533	3895	2564	541
Estimated percent naturally produced	46.2	90.9	100.0	71.4	82.6	7.0	4.5	9.9	65.1-37.5
Estimated naturally produced adults	76	163	67	21	347	247	177	253	329
Unmarked jacks at TMD	1	0	0	2	83	133	141	6	23
Estimated percent naturally produced						20.0	50.0	100.0	
Estimated naturally produced jacks						28	70	10	
Range of circuli counts-natural	12-15	10-17	10-16	*	*	14-19	15-18	11-18	11-16
Range of circuli counts-hatchery	20-30	24-26	22-23	*	*	21-36	21-34	19-33	17-26
Unmaked adult scales-NCHS	18	40	21	5	71-1	8-2	14-1	37-0	28-0
Unmarked adult scales-HCHS	21	4	0	2	15	107-8	294-9	337-1	15-0
Marked adult scales-HCHS		10	3			18	57-2	81-1	13-0
Sample size n=	39	54	24	7	87	143	377	457	56

NOTES: * Samples classified as natural or hatchery origin only

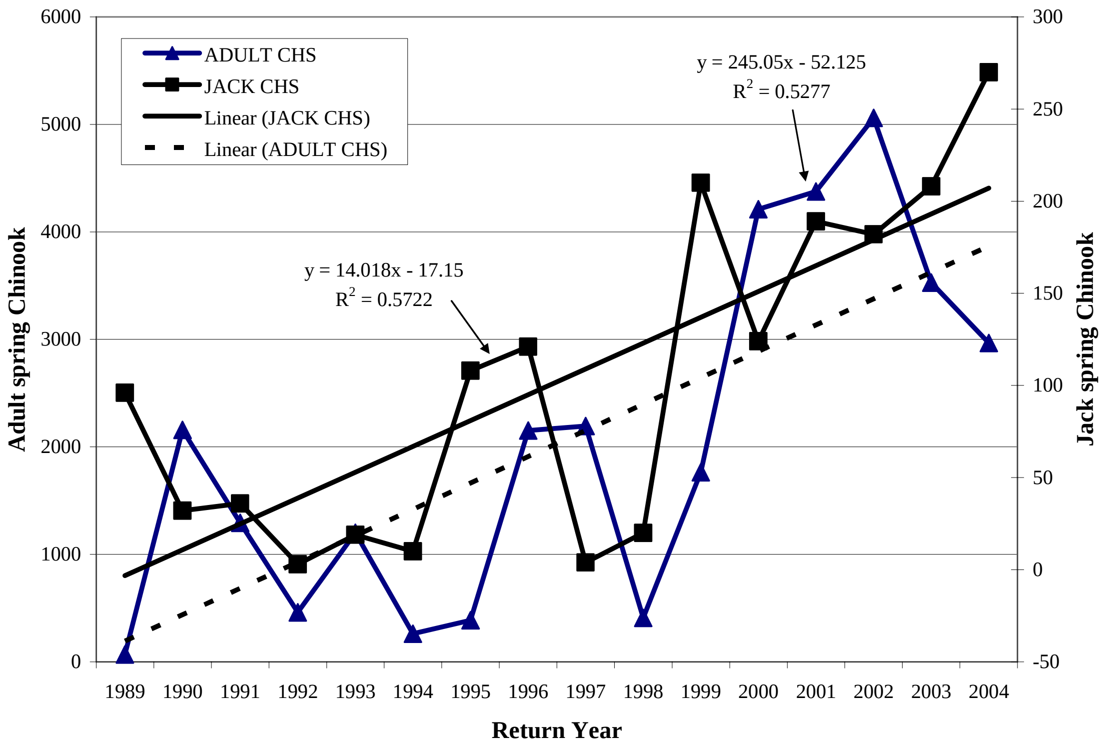


Figure 32. Adult and jack spring Chinook salmon returning to Three Mile Dam, Umatilla River.

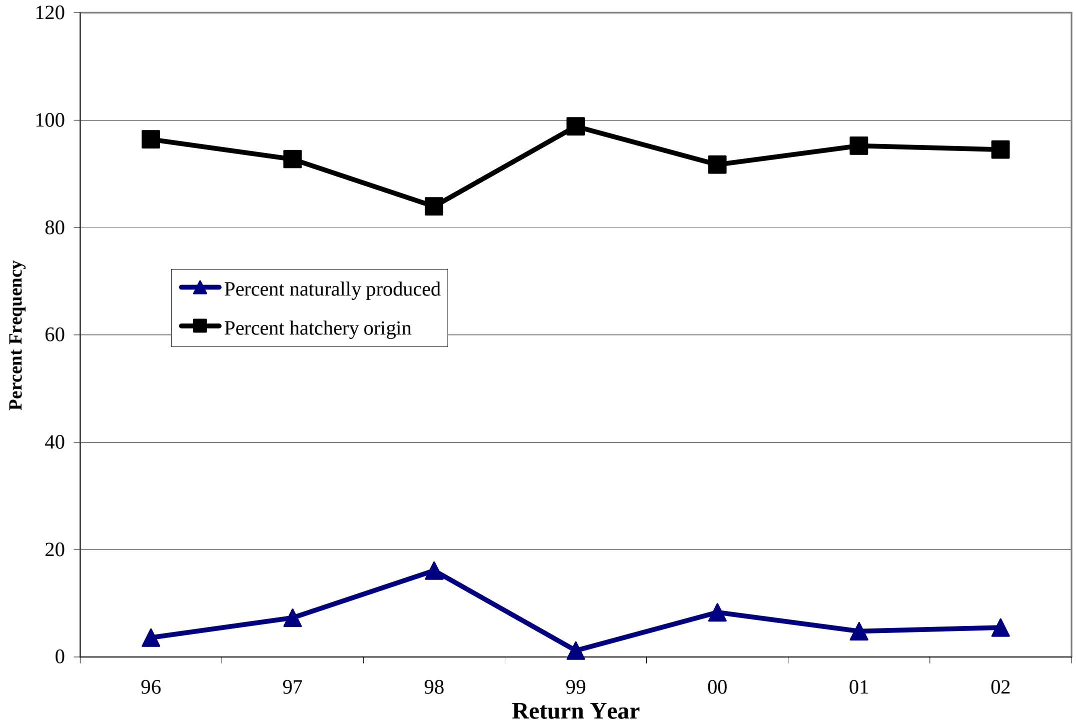


Figure 33. Origin of spring Chinook returning to the Umatilla River.

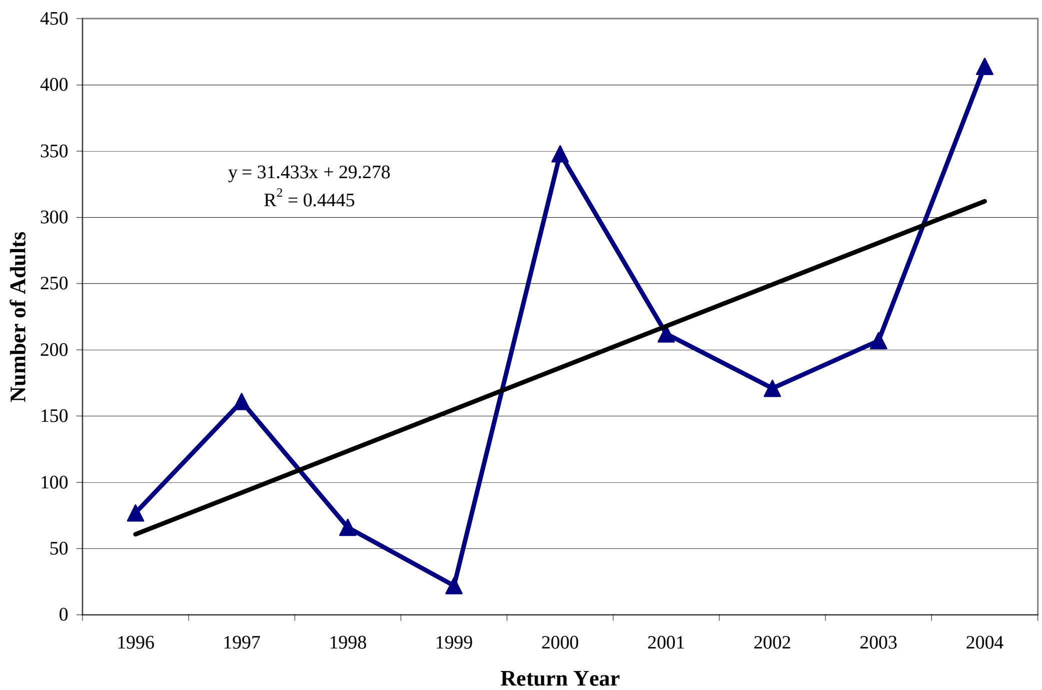


Figure 34. Naturally produced spring Chinook salmon adults returning to the Umatilla River.

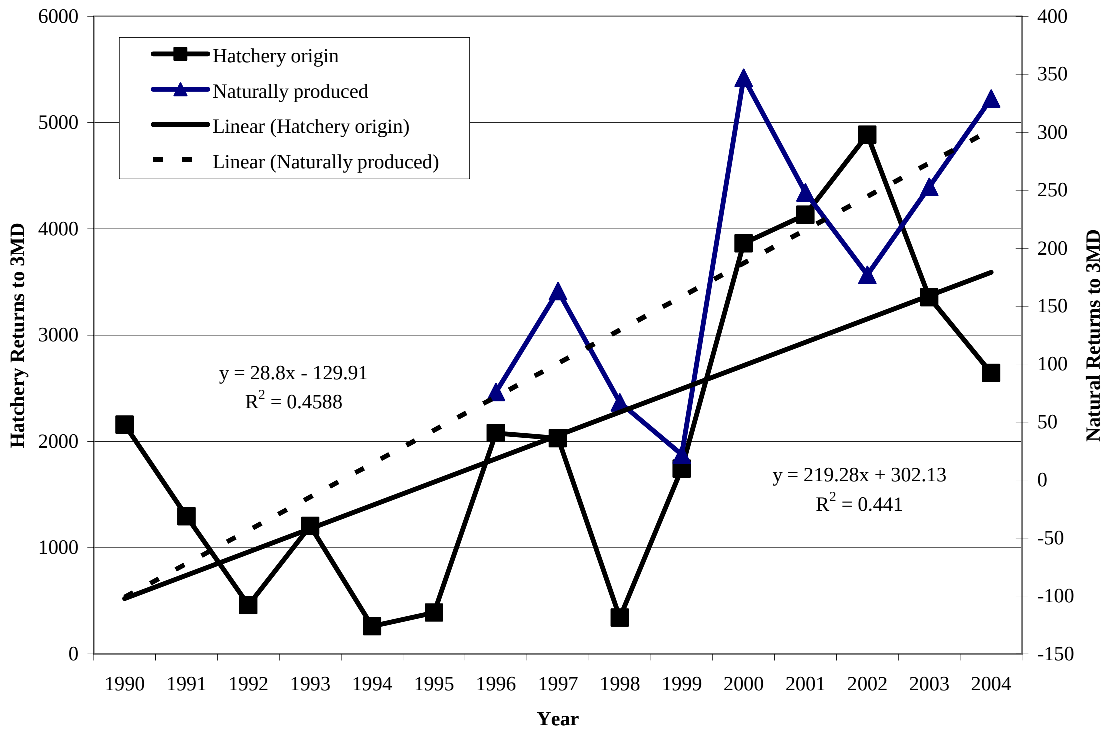


Figure 35. Number of natural and hatchery produced adult spring Chinook returning to 3MD.

Table 17. Spring Chinook disposition, returns, and escapement in the Umatilla Subbasin for Jacks (<750mm "J") and adults ("A").

YEAR	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Hatchery adults enumerated at TMD	68	2158	1294	461	1205	261	389	2077	2031	342	1743	3864	4134	4886	3356	2644
Estimated natural adults enumerated at TMD [1]								76	163	67	22	347	248	177	253	329
Total adults enumerated at TMD	68	2158	1294	461	1205	261	389	2152	2194	409	1765	4211	4382	5063	3609	2973
Hatchery jacks enumerated at TMD								119	2	20	207	118	156	169	127	245
Estimated natural jacks enumerated at TMD [1]								1	0	0	2	6	27	14	6	23
Total jacks enumerated at TMD	96	32	36	3	16	10	82	120	2	20	209	124	183	183	133	268
Sacrificed or mortalities at TMD	36	25	234	200	165	31	10A-45J	18A-39J	56A-2J	9A-2J	29A-50J	21A-8J	16A-25J	16A-12J	33A-23J	5A-38J
Taken for brood stock	0	200	0	0	0	0	0	0	600A	194A-8J	600A-31J	606A-13J	646A-31J	561A-27J	560A-28J	561A-29J
Taken for outplants												31A-5J		168A-8J	281A-1J	219A-20J
Adults released above TMD	64	1949	1085	263	1050	235	379	2134	1538	206	1136	3553	3720	4318	2735	2188
Jacks released above TMD	64	16	11	1	6	5	62	80	3	9	126	97	129	137	156	183
Harvested above TMD- CTUIR	0	0*	82	0	176	0	0	167	187	0	110 [2]	695 [3]	247 *	245*	234	460
Harvested below TMD-ODF&W												443	463	639	578	314
Harvested above TMD- ODF&W	0	20	23	0	18	0	0	206	31	0	11	143	80	110	110	20
Adults potentially available to spawn	64	1929	980	263	856	235	379	1761	1320	206	1015	2715	3393	3963	2391	1708
Adults sampled on spawning grounds	6	272	228	78	471	112	194	715	667	89	539	1388	986	1269	582	373
Jacks sampled on spawning grounds			2	1	3	1	22	24	1	2	40	32	13	30	23	29
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	25.2	21.9
Prespawning mortalities sampled (adults)			88	22	124	19	60	256	230	28	157	227	460	372	268	75
Prespawning mortalities sampled (jacks)			1	1	1	1	10	5	0	0	13	7	3	13	7	15
Spawned adults sampled			130	48	336	93	126	440	401	61	361	1102	501	772	307	271
Spawned jacks sampled			1		2	0	11	19	1	1	27	20	10	15	16	11
Redds observed	14	289	144	59	224	74	90	347	288	60	292	721	626	828	354	534
Spawned females sampled			81	37	205	56	73	267	244	41	228	689	335	513	166	177

NOTES: 1 The estimated escapement of natural spring Chinook adults was determined by scale analysis of a sample of unmarked returns to 3MD.
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

4.1.2.2 Spawning ground surveys

The number of spring Chinook redds have been increasing steadily throughout the monitoring period (Figure 36). The population may be adapting to conditions in the Umatilla, management actions may be increasing production, or this may be due to out-of-subbasin conditions. The distribution of spawners did not shift dramatically in 2003 vs. 2004 (Figure 37), but has shifted somewhat throughout the monitoring period (Figure 38 and Figure 38). These shifts are most likely related to some combination of spawner densities and environmental conditions, and may impact productivity, cohort strength, and future spawner densities and distributions. Figure 37 shows the density and distribution of spring Chinook redds in the Umatilla Subbasin.

Throughout the monitoring period the percent of unmarked carcasses (probable natural origin fish) has been highest in the headwaters (Figure 40). This suggests that the management objective of nurturing natural production high in the system is being attainted. Total escapement to 3MD and total redds enumerated have tracked closely throughout the monitoring period (Figure 41 and Figure 42), suggesting that spawners are making it to the spawning grounds, spawners are effectively depositing redds in correlation with their densities, and redd surveys are accurately detecting spawner status and trends.

The number of spring Chinook salmon redds enumerated in the Umatilla River has varied between 14 in 1989 (the first adult return) and 828 in 2002 and averaged 308 redds. In 2003 a total of 354 redds were enumerated and 605 carcasses were sampled. In 2004 534 redds were enumerated and 402 carcasses were sampled. From 1991 to 2000 the correlation between redds enumerated and carcasses sampled was very robust R^2=0.99 (Figure 43). With the addition of data through 2004 the correlation declined to R^2=0.789 (Figure 44). Based on observations on the spawning grounds, many of these carcasses may have been consumed by black bears,*Ursus americanus*.

It should be noted that the effort allocated to spawning ground surveys was decreased during the study periord. It may be that many more black bears frequent the Umatilla River during July through September since the large Chinook salmon returns after 1999, or it may be that surveyors are not sampling carcasses as fast as black bears are consuming them. Two other possibilities are that the black bear population has increased, or bears are learning that fish are once again available for consumption in the Umatilla subbasin. Long term grizzly bear observations at a salmon weir in Northern British Columbia have shown that when a large protein base becomes available (spawned out Chinook salmon) the same bears will return to feed at the proper time each year (Phil Timpany, personal communication). The sows would bring their new young and the density of bears would increase dramatically over time.

Pre-spawn and post-spawn mortalities have paralleled eachother somewhat during the monitoring period (Figure 45), while the numbers of both groups have increased on average. This suggests that while increases in total production have been attained, the quality of spawning habitat has not increased significantly during the study period. The fraction of pre-spawn mortalities has not decreased during the study period (Figure 47). Mean survival to spawning by reach based on carcass sampling varied between 95.6% in the North Fork to 10.7% about 20 miles below the Forks (Figure 46). In an average year about 33% of the carcasses sampled were prespawning mortalities. The average Chinook salmon (potentially available to spawn) per redd per year has varied between 3.2 and 6.8 (Figure 48) and averaged 4.7 fish. Fish per redd was greatest when prespawning mortality was high and lowest when prespawning mortality was low. Pre-spawning mortality remains a serious problem in the Umatilla, and is discussed more below in Section 4.2.

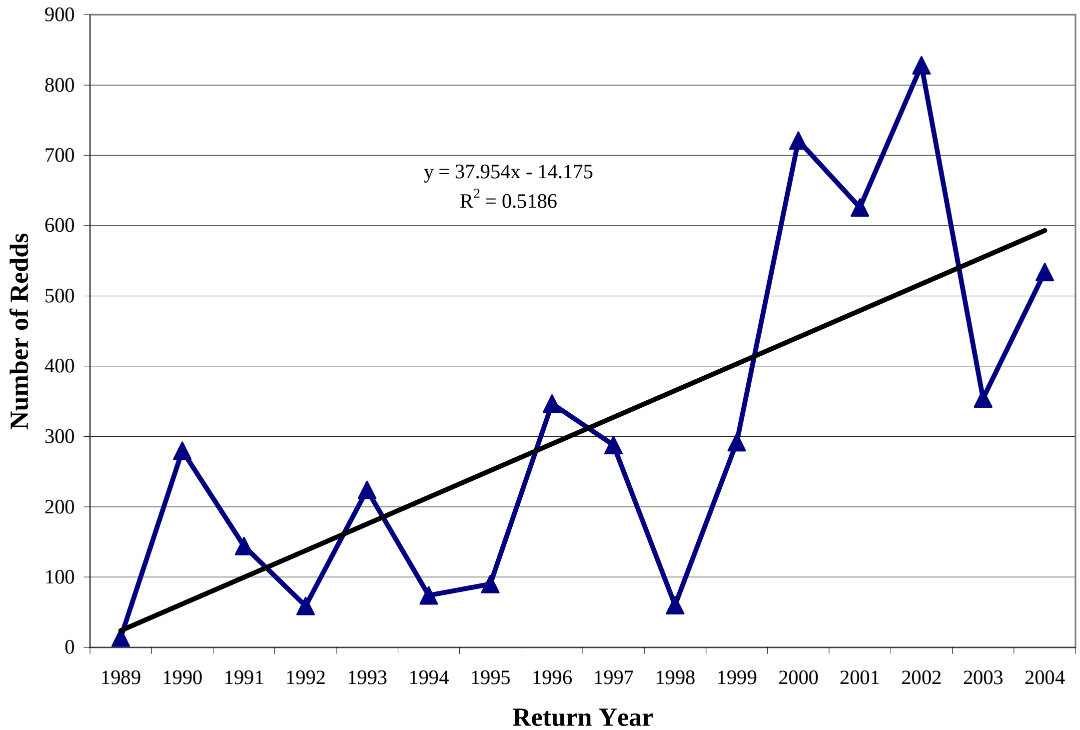


Figure 36. Spring Chinook salmon redds enumerated in the Umatilla River, 1989-2004.

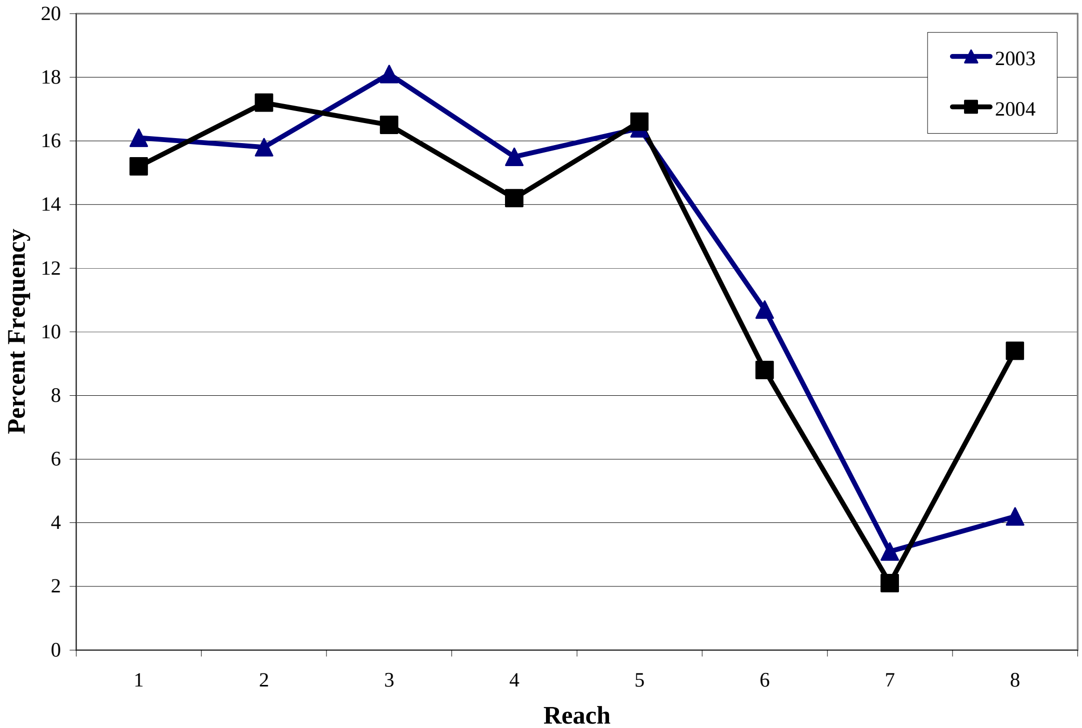


Figure 37. Distribution of spring Chinook salmon redds in the Umatilla River, 2003 and 2004. See Figure 7 and Table 7 for the reach locations.

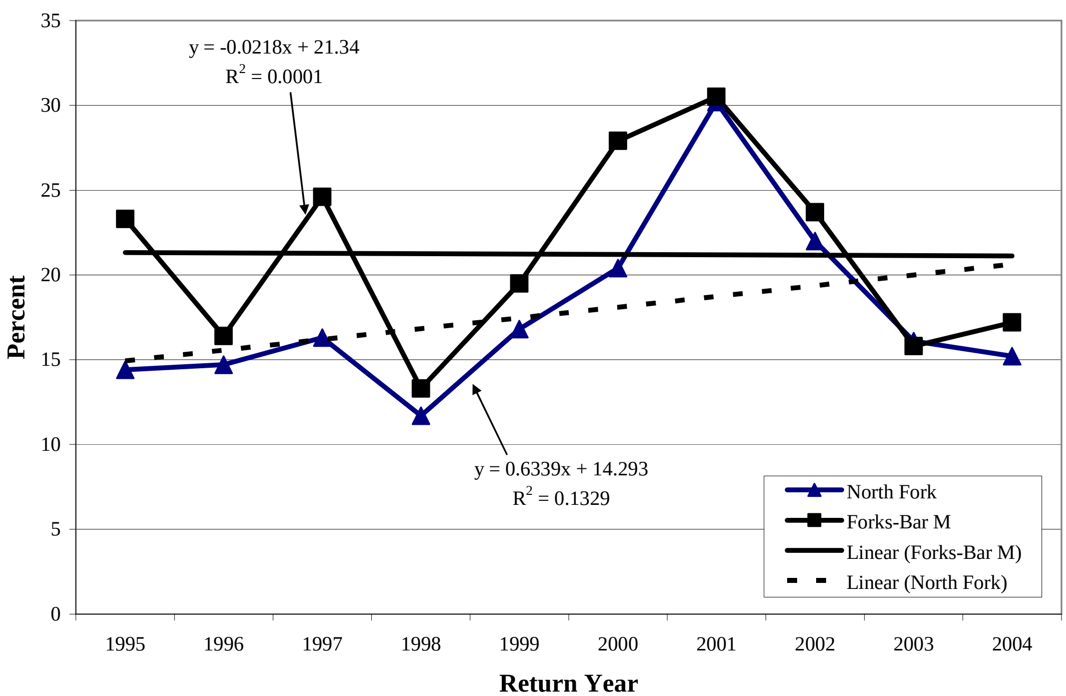


Figure 38. Percent of spring Chinook salmon redds enumerated in index areas by return year.

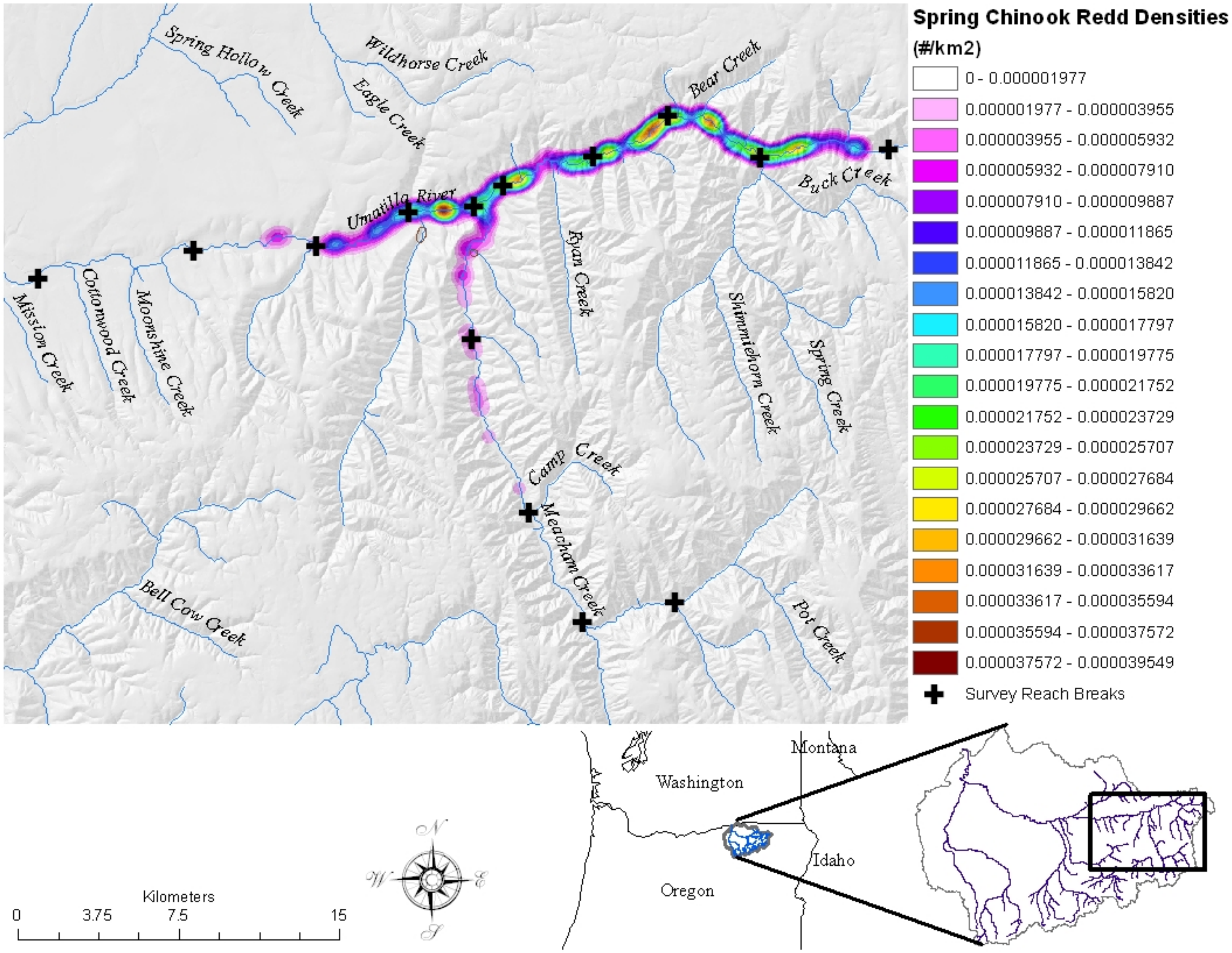


Figure 39. Distribution and density of spring Chinook redds enumerated during 2004 surveys.

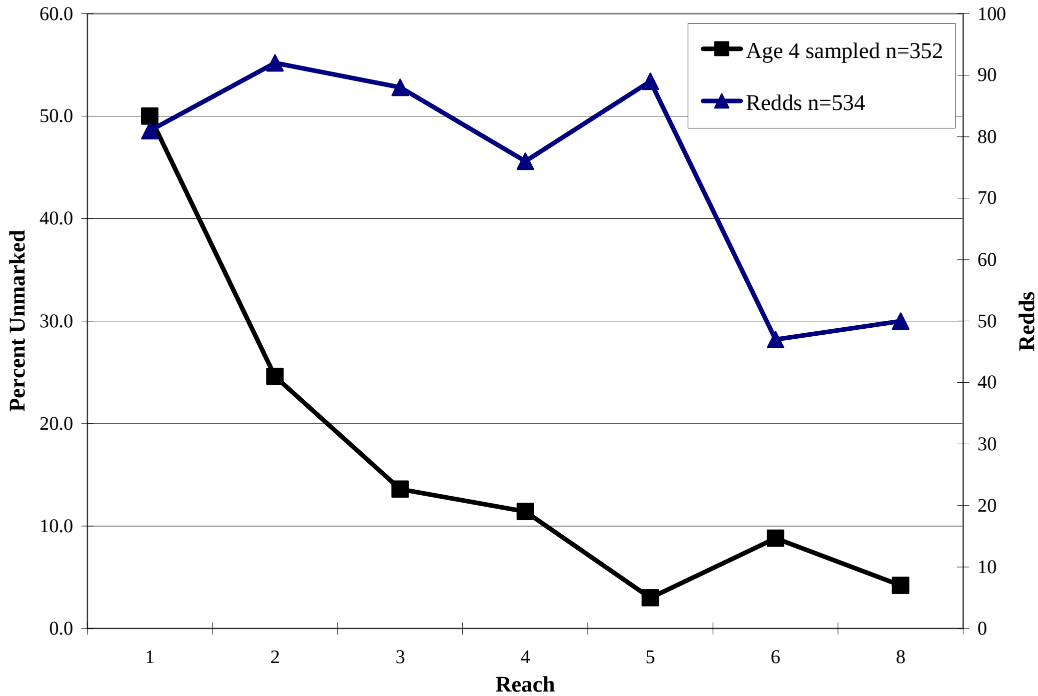


Figure 40. Percentage of age 4 spring Chinook salmon that were unmarked by reach (based on carcasses), and redds enumerated in these same reaches, 1991-2004. See Figure 7 and Table 7 for the reach descriptions.

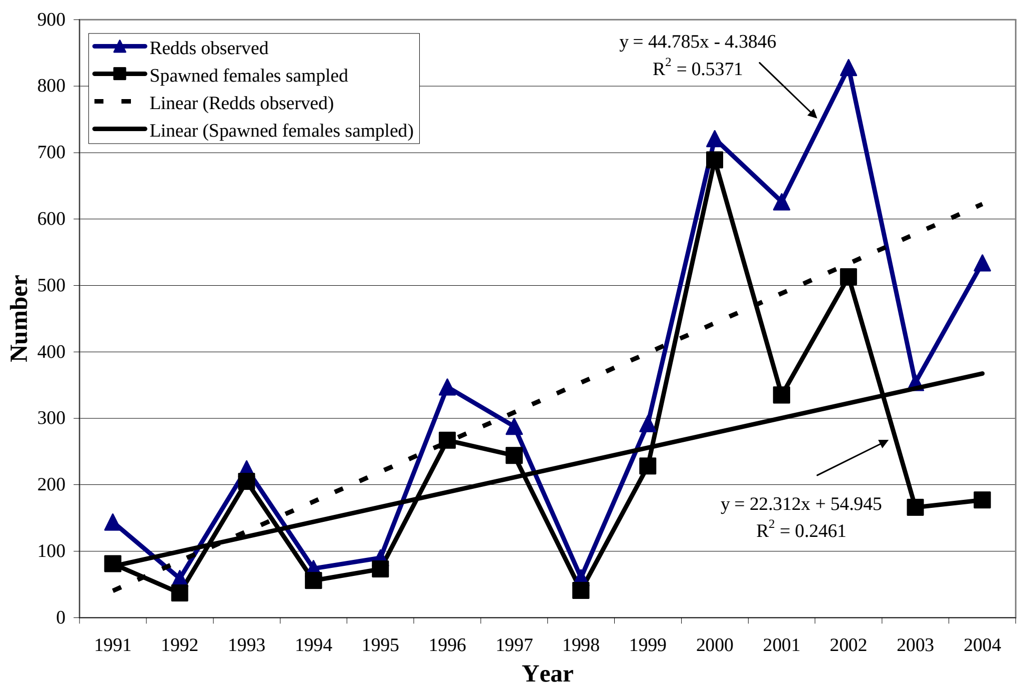


Figure 41. Redds enumerated and spawned female carcasses sampled in the spring Chinook index reaches.

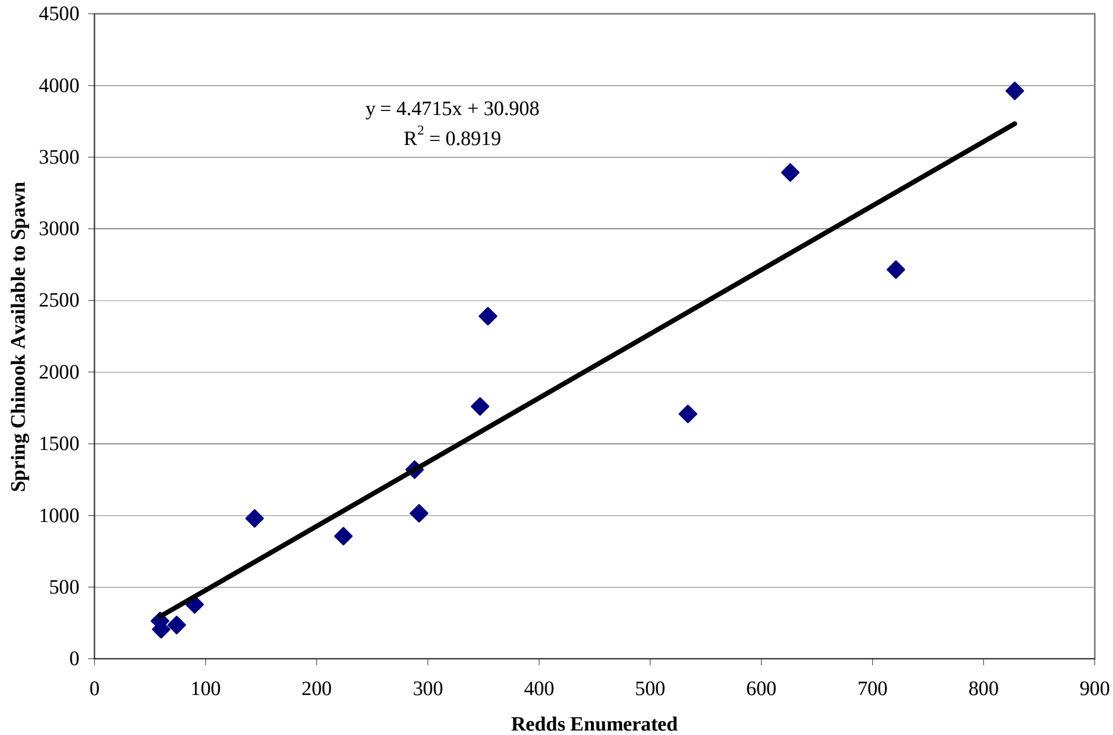


Figure 42. Spring Chinook salmon available to spawn vs. redds enumerated in the Umatilla Subbasin, 1991-2004.

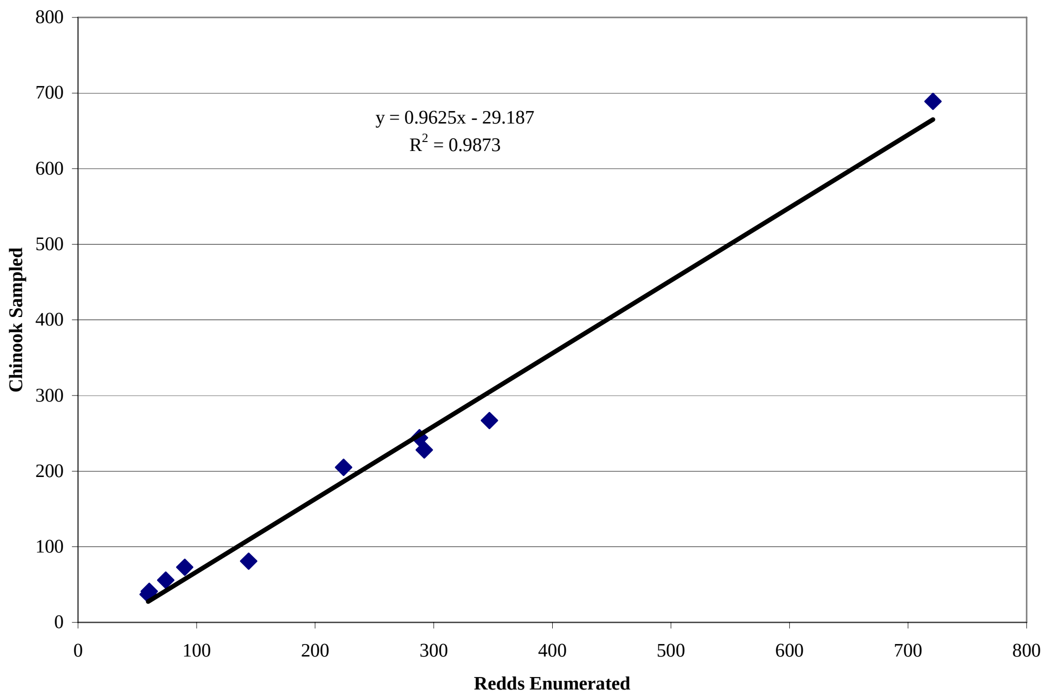


Figure 43. Spring Chinook salmon redds enumerated vs. carcasses sampled in the Umatilla Subbasin, 1991-2000.

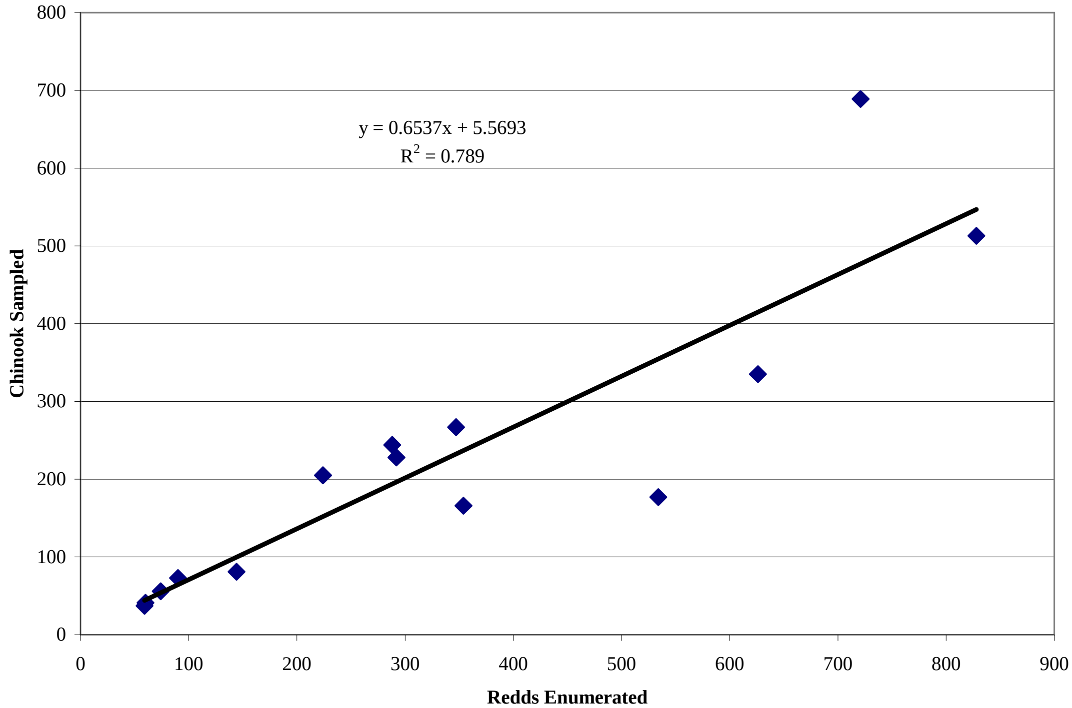


Figure 44. Spring Chinook salmon redds enumerated vs. carcasses sampled in the Umatilla Subbasin, 1991-2004.

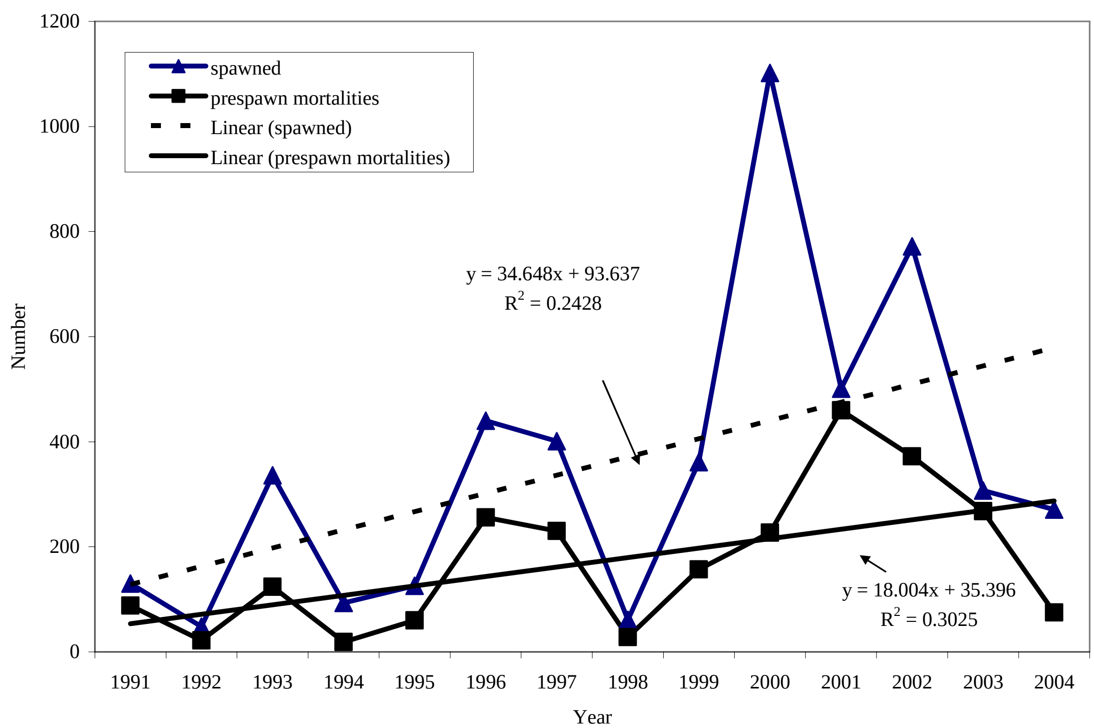


Figure 45. Pre-spawn and post-spawn mortalities for spring Chinook carcasses sampled in the Umatilla Subbasin, 1991-2004.

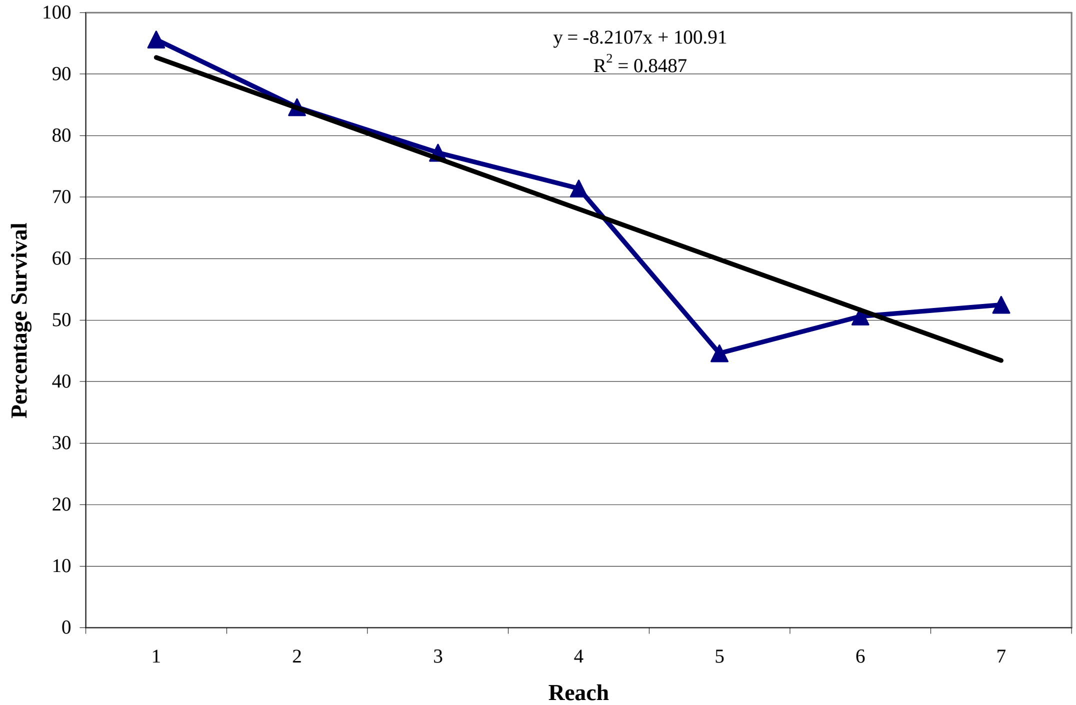


Figure 46. Mean survival by reach for spring Chinook salmon based on carcasses in the Umatilla River, 1991-2004 (n=7513).

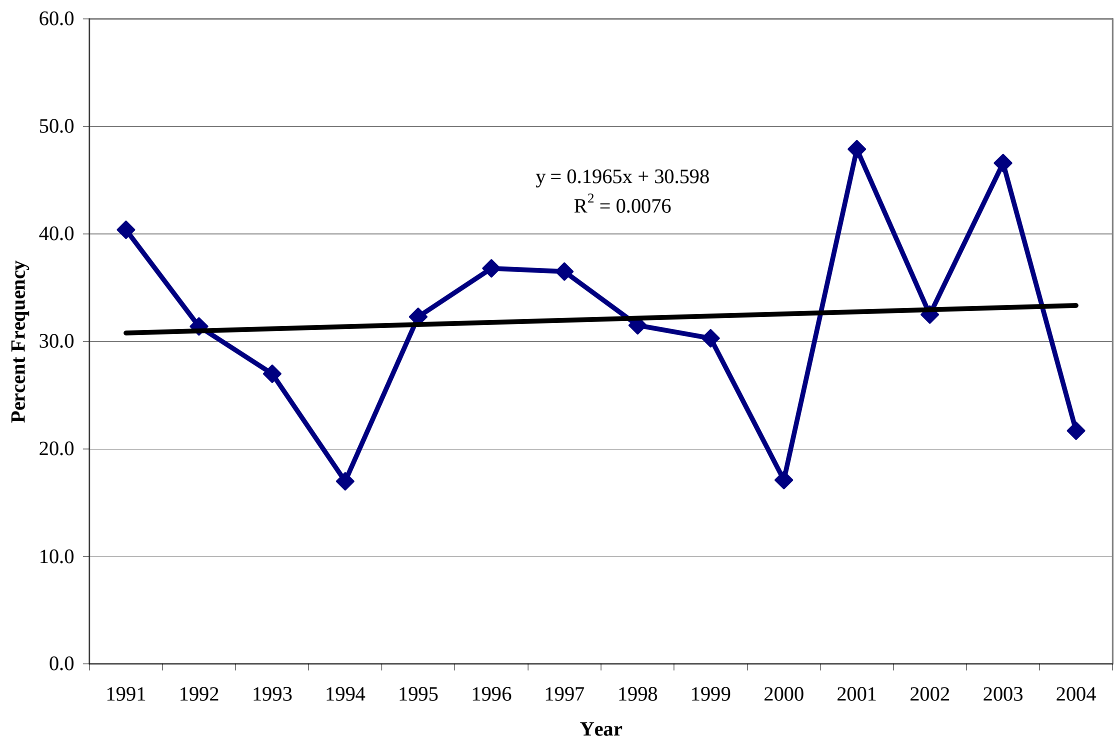


Figure 47. Spring Chinook salmon prespawn mortality by year in the Umatilla River, 1991-2004, n=2386.

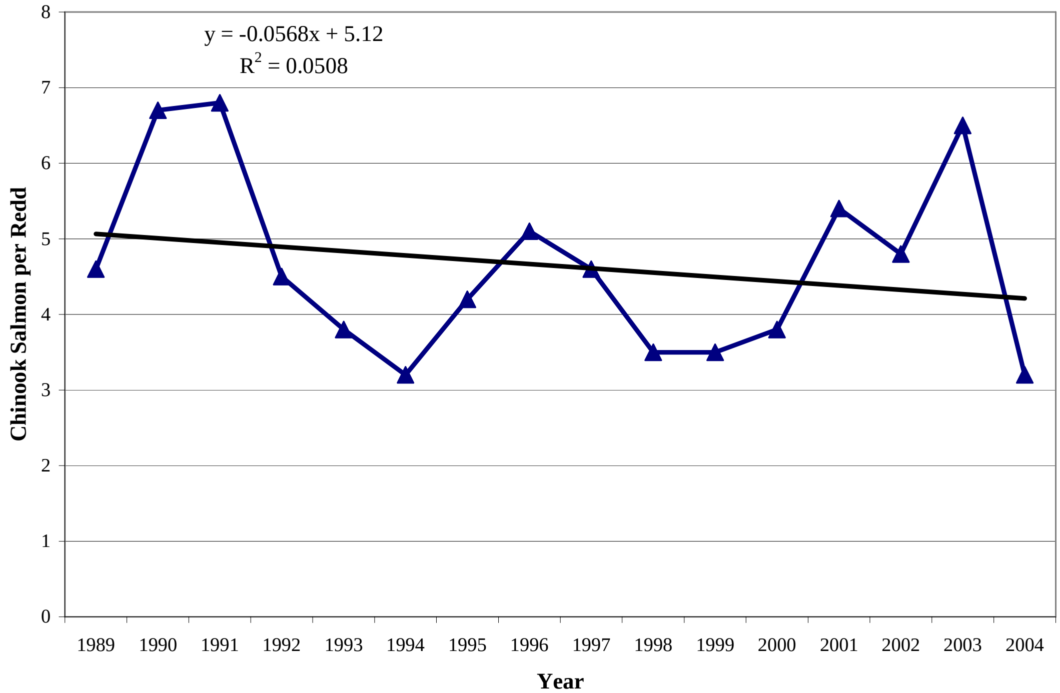


Figure 48. Spawners per redd by return year in the Umatilla Subbasin, 1989-2004.

4.2 Temperature Monitoring

4.2.1 Data Quality Control

Quality control protocols were expanded for the 2003 and 2004 deployments and included a preseason calibration in a water bath with ice being added to the bath after 30 minutes to create a temperature gradient. Little variation between units (0-0.2 °C) was observed after an initial adjustment during the first five minutes (Table 18 and Table 19). However, additional deviation (0 to 0.4 °C) began showing up in some units after 10 minutes and persisted through 30 minutes. A large amount of ice was added to the bath 30 minutes into the calibration test. There was a very large deviation (3 to 9.8 °C) between measured water temperature and thermograph recorded temperatures five minutes after ice was added. This represents a significant response lag under an artificial temperature change. Temperatures from 5 to 25 minutes for the calibration test evaluation showed reasonable consistency within and between individual temperature monitors. Temperature loggers deployed in the field record water temperatures every hour and are subject to water temperature changes of only 5-8 °C in a 24 hour period. At the end of the 60 minute calibration test, the deviation between the calibrated thermometer and the units had reduced to 0.2 to 0.7 °C, suggesting a reasonable level of accuracy and responsiveness in the units.

Table 18. 2003 pre-deployment calibration test results for thermographs deployed in the Umatilla River Basin. Data is reported as residuals between thermister units and a calibrated thermometer during a one hour cold-water treatment.

Time	14:00	14:05	14:10	14:15	14:20	14:25	14:30	14:35	14:40	14:45	14:50	14:55	15:00
Temp (^{o}C)	29.0	28.5	28.0	28.0	27.5	27.5	27.0	1.0	1.0	0.0	0.0	-0.5	0.0
Serial Number													
4896	0.3	0.1	0	0.2	0	0.2	-0.1	-5.4	-1.9	-1.4	-0.5	-0.7	-0.2
4897	0.3	0	-0.2	0.2	-0.3	0	-0.3	-6.1	-3.9	-2.6	-1.1	-1.2	-0.5
4898	0.3	0	-0.2	0.2	-0.1	0.2	-0.1	-4.6	-1.5	-1.3	-0.5	-0.9	-0.2
4899	0.3	-0.2	-0.2	0	-0.3	0	-0.3	-4.6	-1.6	-1.4	-0.7	-0.9	-0.4
4900	0.3	0	-0.2	0.2	-0.1	0.2	-0.1	-4.5	-1.8	-1.4	-0.7	-0.9	-0.4
4901	0.1	0	-0.2	0.2	-0.1	0	-0.3	-3.9	-1.3	-1.3	-0.7	-0.9	-0.4
4902	0.3	0	-0.2	0.2	-0.1	0.2	-0.1	-5.4	-2.8	-2	-0.8	-0.9	-0.4
4903	0.3	0.1	0	0.2	0	0.2	-0.1	-3	-0.9	-1	-0.4	-0.7	-0.2
4906	0.3	0	0	0.2	-0.1	0.2	-0.1	-5.1	-1.6	-1.3	-0.5	-0.7	-0.2
7548	0.3	0	-0.2	0.2	-0.1	0	-0.3	-6.8	-3.7	-2.5	-1.1	-1	-0.5
7549	0.3	0	-0.2	0.2	-0.1	0	-0.3	-5.7	-2.2	-1.7	-0.7	-0.9	-0.4
7550	0.3	0.1	0	0.2	0	0.2	-0.1	-4.3	-1.3	-1.3	-0.5	-0.7	-0.2
7551	0.3	0.1	0	0.2	0	0.4	0.1	-3.1	-0.7	-1	-0.4	-0.7	-0.2
7552	0.1	0	-0.2	0.2	-0.1	0.2	-0.3	-3.7	-1.3	-1.3	-0.7	-1	-0.5
7554	0.3	0.1	0	0.2	-0.1	0.2	-0.1	-6.3	-3.6	-2.3	-1	-0.9	-0.4
7555	0.3	0	0	0.2	0	0.2	-0.1	-4.3	-1.3	-1.3	-0.5	-0.9	-0.4
7557	0.3	0	-0.2	0.2	-0.3	0	-0.3	-6.8	-3.6	-2.6	-1.3	-1.2	-0.5
7558	0.3	0	0	0.2	-0.1	0.2	-0.1	-3.7	-1.3	-1.3	-0.5	-0.7	-0.2
5600	0.3	0.1	0	0.2	0	0.2	-0.1	-5.2	-1.9	-1.6	-0.7	-0.9	-0.4
5601	0.3	0	-0.4	0	-0.3	0	-0.3	-7.7	-4.5	-3.5	-1.6	-1.3	-0.7
5602	0.3	0	-0.2	0.2	-0.3	0	-0.3	-6.5	-3.9	-2.8	-1.3	-1.2	-0.5
8004	0.3	0.1	0	0.2	0	0.2	-0.1	-5.2	-1.9	-1.6	-0.7	-0.9	-0.4
8005	0.3	0	-0.2	0.2	-0.1	0	-0.3	-5.4	-2.7	-1.9	-0.8	-1	-0.5

Time	14:00	14:05	14:10	14:15	14:20	14:25	14:30	14:35	14:40	14:45	14:50	14:55	15:00
Temp (^{o}C)	**29.0**	**28.5**	**28.0**	**28.0**	**27.5**	**27.5**	**27.0**	**1.0**	**1.0**	**0.0**	**0.0**	**-0.5**	**0.0**
Serial Number													
8006	0.3	0	-0.2	0.2	-0.3	0	-0.3	-6.5	-3.9	-2.8	-1.3	-1.2	-0.5
8007	0.3	0	-0.4	0	-0.3	0	-0.3	-6.5	-4.2	-2.9	-1.3	-1.2	-0.7
8008	0.3	0	-0.2	0.2	-0.1	0	-0.3	-5.4	-2.7	-1.9	-0.8	-1	-0.5
8010	0.3	0	-0.4	0	-0.3	0	-0.3	-6.7	-3.6	-2.5	-1.1	-1.2	-0.5
8011	0.1	0	-0.2	0	-0.3	0	-0.3	-7	-2.7	-1.9	-0.7	-0.9	-0.4
8012	0.3	0	-0.2	0.2	-0.1	0	-0.3	-6.1	-3	-2	-0.8	-0.9	-0.4
8013	0.3	0	0	0.2	0	0.2	-0.1	-5.4	-2.4	-1.9	-0.8	-0.9	-0.4
8014	0.3	0	-0.2	0.2	-0.1	0.2	-0.1	-4.5	-1.5	-1.3	-0.5	-0.9	-0.4
8015	0.3	0	-0.2	0.2	-0.1	0	-0.1	-5.2	-3	-2	-0.8	-0.9	-0.4
8016	0.3	0	-0.2	0.2	-0.1	0	-0.3	-5.5	-2.2	-1.7	-0.7	-0.9	-0.4
8017	0.3	0	-0.2	0.2	-0.1	0.2	-0.1	-5.5	-3	-2	-1	-1	-0.5
8018	0.3	0.1	0	0.2	-0.1	0.2	-0.1	-6	-3	-2.5	-1.3	-1.2	-0.7
8019	0.3	0.1	-0.2	0.2	-0.1	0.2	-0.1	-6.1	-2.4	-1.7	-0.7	-0.9	-0.2
8020	0.3	0	-0.2	0.2	-0.1	0.2	-0.1	-5.1	-2.2	-1.7	-0.8	-1	-0.4
8021	0.3	0	-0.2	0	-0.3	0	-0.3	-7.9	-4.6	-3.5	-1.6	-1.3	-0.7
8022	0.3	0	-0.2	0.2	-0.3	0	-0.3	-7.9	-4.6	-3.2	-1.4	-1.2	-0.7
8023	0.3	0.1	0	0.2	-0.1	0.2	-0.1	-6.3	-3.7	-2.8	-1.3	-1.2	-0.7
8024	0.3	0	-0.2	0	-0.1	0	-0.3	-8	-4.2	-2.8	-1.1	-1.2	-0.5
8025	0.3	0	-0.4	0	-0.3	0	-0.3	-9.8	-5.5	-4.1	-1.9	-1.3	-0.7
8026	0.1	-0.2	-0.4	0	-0.3	-0.1	-0.3	-9.2	-5.2	-3.8	-1.6	-1.3	-0.7

Table 19. 2004 pre-deployment calibration test results for thermographs deployed in the Umatilla River Basin. Data is reported as residuals between thermister units and a calibrated thermometer during a one hour cold-water treatment

Time	16:00	16:05	16:10	16:15	16:20	16:25	16:30	16:35	16:40	16:45	16:50	16:55	17:00
Temp (°C)	28.0	28.0	27.5	27.5	27.0	27.0	27.0	25.0	25.0	24.5	23.5	24.0	24.5
Serial Number													
123	0.7	0.7	1.2	1	1.4	1.4	0.8	0.2	0.1	0.6	1.6	1.1	0.6
5600	0.7	0.7	1	1	1.4	1.2	0.5	0.2	0.1	0.6	1.6	1.1	0.6
5601	0.7	0.7	1	1	1.4	1.4	0.8	0.2	0.1	0.6	1.6	1.1	0.6
5602	0.7	0.7	1	0.9	1.4	1.2	0.5	0.2	0.1	0.6	1.6	1.1	0.4
7549	0.7	0.7	1	0.9	1.4	1.2	0.3	0.1	0.1	0.6	1.6	1.1	0.6
7550	0.7	0.5	0.9	0.9	1.4	1.2	1	0.2	-0.1	0.4	1.4	0.9	0.6
7552	0.7	0.7	1.2	1	1.4	1.4	0.5	0.2	0.1	0.6	1.6	1.1	0.6
7555	0.7	0.7	1	1	1.4	1.2	0.5	0.2	0.1	0.6	1.6	1.1	0.4
7556	0.7	0.7	1.2	1	1.2	1	0.5	0.1	0.1	0.6	1.6	1.1	0.6
7557	0.7	0.7	1	0.9	1.4	1.2	0.8	0.2	0.1	0.6	1.6	1.1	0.6
7558	0.7	0.7	1	0.9	1.4	1.2	1	0.2	0.1	0.6	1.6	1.1	0.6
8004	0.7	0.7	1	1	1.4	1.2	0.5	0.2	0.1	0.6	1.6	1.1	0.6
8005	0.9	0.7	1.2	1	1.5	1.4	0.8	0.4	0.1	0.6	1.6	1.2	0.6
8006	0.7	0.7	1	1	1.4	1.4	0.6	0.2	0.1	0.6	1.6	1.1	0.6
8007	0.9	0.7	1.2	1	1.5	1.4	0.6	0.4	0.2	0.6	1.7	1.2	0.6
8008	0.7	0.7	1.2	1	1.4	1.4	0.5	0.2	0.1	0.6	1.6	1.1	0.6
8009	0.7	0.7	1	1	1.4	1.2	1.2	0.4	0.1	0.6	1.6	1.1	0.6
8010	0.9	0.7	1.2	1	1.5	1.4	0.6	0.4	0.1	0.6	1.7	1.2	0.6
8011	0.7	0.7	1.2	1	1.4	1.4	1	0.4	0.1	0.6	1.6	1.1	0.6
8012	0.7	0.7	1.2	1	1.4	1.4	1.2	0.4	0.1	0.6	1.6	1.1	0.7
8013	0.7	0.7	1	1	1.4	1.2	0.8	0.2	0.1	0.6	1.6	1.1	0.6
8014	0.7	0.7	1	1	1.4	1.4	0.6	0.2	0.1	0.6	1.6	1.1	0.6
8015	0.9	0.7	1	1	1.4	1.4	0.5	0.2	0.1	0.6	1.6	1.1	0.6
8017	0.7	0.7	1.2	1	1.4	1.4	1.2	0.2	0.1	0.6	1.6	1.1	0.6

Time	16:00	16:05	16:10	16:15	16:20	16:25	16:30	16:35	16:40	16:45	16:50	16:55	17:00
Temp (^oC)	28.0	28.0	27.5	27.5	27.0	27.0	27.0	25.0	25.0	24.5	23.5	24.0	24.5
Serial Number													
8018	0.7	0.7	1	1	1.4	1.4	0.5	0.2	0.1	0.6	1.6	1.1	0.2
8019	0.7	0.7	1	1	1.4	1.4	1	0.4	0.1	0.6	1.6	1.1	0.6
8020	0.7	0.7	1	1	1.4	1.2	1.2	0.2	0.1	0.6	1.6	1.1	0.6
8021	0.7	0.7	1.2	1	1.4	1.4	0.8	0.4	0.1	0.6	1.6	1.1	0.6
8022	0.7	0.7	1	1	1.4	1.2	0.8	0.2	0.1	0.6	1.6	1.1	0.6
8023	0.7	0.7	1	1	1.4	1.2	1.2	0.2	0.1	0.6	1.6	1.1	0.6
8025	0.7	0.7	1	1	1.4	1.4	1	0.4	0.1	0.6	1.6	1.2	0.6
8026	0.9	0.9	1.2	1.2	1.5	1.5	1.4	0.7	0.2	0.7	1.7	1.2	0.7

4.2.2 Deployment, Monthly Checks, and Data Recovery

During the 2003 field season, 38 units were deployed and data was recovered from 36 units. During monthly checks, problems were identified at 12 sites. Thermographs were not working at 5 sites; three sites went dry, and thermographs had to be repositioned at 4 sites (Table 20). Three of the units found not working were successfully restarted but no data was recovered from the thermographs deployed in the N.F. McKay Creek (site 18, unit 4906) and the Umatilla River site near Rieth (site 12, unit 8016). One of these units was older and nearing the end of is life span. The units were sent to the manufacture where the data was recovered from unit 8016. The status of data from unit 4906 is pending. Any data recovered from unit 4906 will be processed and posted on the website when it is available.

Table 20. Summary of problems observed with thermographs deployed in 2003 and 2004.

Unit No.	Site No.	Site	River Mile	Date	Comments
4898	28	Meacham Creek First bridge above NF	17.5	19-Aug-03	dry site
7552	30	Meacham Creek Below Butcher Creek	20.5	25-Jul-03	dry site
8023	37	Thomas Creek	0.8	25-Sep-03	stagnant pool, no in-flow
4901	7	Umatilla River Below Feed Cana	28.0	22-Jul-03	out of water, reset
8012	8	Umatilla River @ Stanfield Dam	32.4	10-Jun-03	out of water, reset
8015	11	Umatilla River near Coombs Canyon	47.5	29-Oct-03	unit in mud, reset
8019	21	Umatilla River above Cayuse Bridge	67.7	25-Sep-03	moved unit to avoid spring influence
5602	14	McKay Creek @ Mouth	0.1	28-Jul-03	Unit not working, restarted and reset
7555	1	Butter Creek @ Pine City	20.0	22-Jul-03	unit not working, restarted and reset
7552	12	Umatilla River above Rieth Bridge	49.0	13-Aug-03	unit not working, replaced with 7552
8026	36	N.F. Umatilla River end of trail	4.0	08-Aug-03	unit not working, restarted and reset
4906	18	N.F. McKay Creek @ USGS Gage	0.1	12-May-03	no data from unit
7550	4	Umatilla River at Maxwell	15.3	06-Jul-04	out of water
8010	5	Umatilla River below Stanfield Bridge	21.6	27-Jul-04	unit moved
4901	7	Umatilla River Below Feed Canal at USGS Gage	28.0	26-Jul-04	out of water
8014	10	Umatilla River near Barnhart	42.5	14-Jul-04	partially exposed
5602	14	McKay Creek at Mouth	0.1	26-Jul-04	unit buried
8019	21	Umatilla River above Cayuse Bridge	67.7	13-Jul-04	unit buried
8025	35	N.F.Umatilla River Below Coyote Creek	2.7	06-Jul-04	out of water
8026	36	N.F.Umatilla River end of trail	4.0	06-Jul-04	unit buried

A review of the deployment records, monthly checks, recovery record sheets indicates that it took approximately 6 days to deploy the units in the field and four to five days to conduct the monthly checks in 2003. In 2004 the deployment was spread over a four week period as the lead technician was participating in creel surveys as well as thermograph deployment. The units were checked throughout the deployment for placement, functionality, and accuracy (Figure 49 and Figure 50). Unlike in previous years, not all units were checked during August.

There was a high degree of variability between the hand-held measurements and the temperatures recorded on the temperature loggers. The greatest differences occurred in July and August (Table 21 and Table 22). Some of the error was probably associated with thermal stratification during low flows in the heat of the summer. In addition to the inherent variability of the mini-loggers, we suspect that deeper waters in pools and runs are likely influenced by hyporheic flows that are cooler than the surface waters near the stream margin where the calibrated hand-held thermograph was placed. Much of the temperature variation is thought to rise from site specific variation, month to month changes in flow and thermal stratification, and variability of how the checks were conducted each month. Later in the season, when air temperatures begin to cool (depending on the day), hyporheic flows can be warmer than the surface flows.

Some of the divergence between hand-held readings and instrument readings are related to time. The mini-loggers record water temperature once each hour. Hand-held readings can be up to 30 minutes apart from the mini-logger's readings. Water temperatures have risen by more than 1.5 ^{o}C in one hour in some locations, and could produce a difference up to 0.75^{o}C. Early in the season some instrument reading error was discovered and corrected. Improvements in QA/QC and training have been implemented for the next field season and include ensuring that technicians place the calibrated hand held thermometer within 10 cm of the recording unit during field checks, as well as properly reading and handling the instruments.

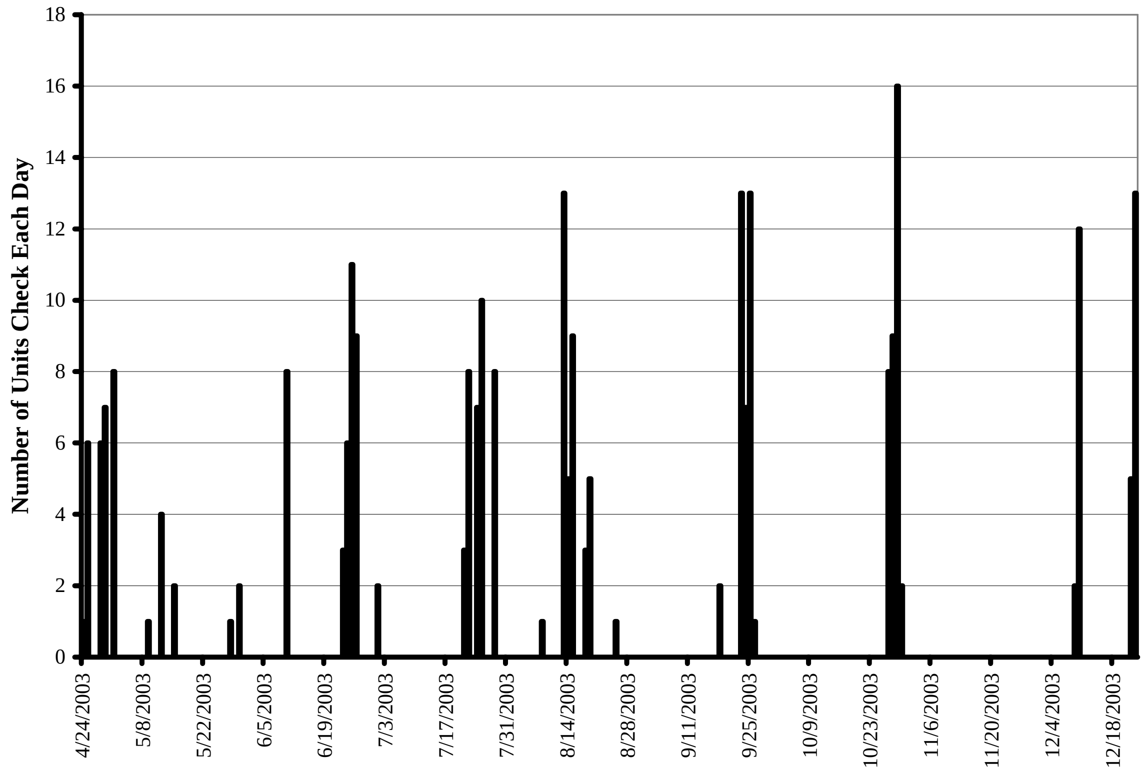


Figure 49. Dates when thermographs were checked during 2003.

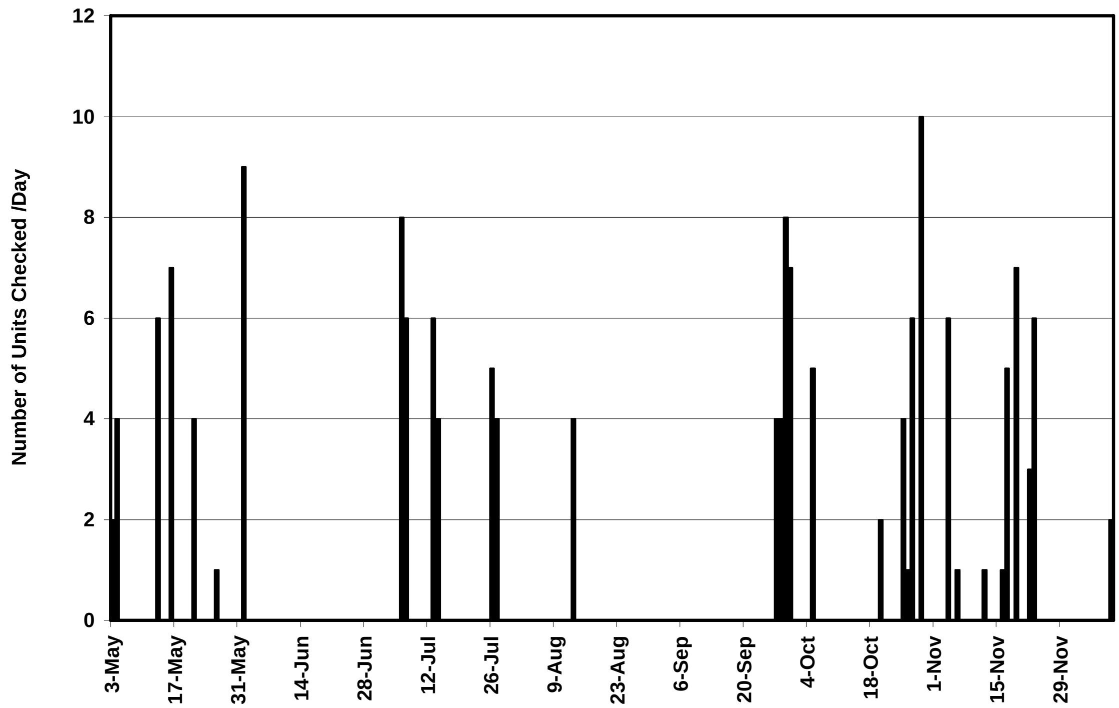


Figure 50. Dates when thermographs were checked during 2004.

Table 21. Maximum, mean, and minimum observed differences (^oC) between the calibrated hand held thermometer and all water temperature loggers combined for each month of deployment.

Month 2003	Maximum Difference	Mean Difference	Minimum Difference	Standard Deviation of Difference
April	1.50	0.49	0.00	0.52
May	1.00	0.42	0.00	0.34
June	1.60	0.62	0.00	0.50
July	4.90	1.08	0.00	0.97
August	4.00	1.04	0.00	0.95
September	2.80	0.86	0.00	0.68
October	2.20	0.96	0.00	0.59
December	3.70	1.42	0.00	0.64
2003 Total	4.90	0.91	0.00	0.76
2004				
May	2.3	1.37	0.1	0.633
Jun	3.5	2.07	1.4	0.731
Jul	2.7	1.16	0	0.593
Aug	1	0.88	0.7	0.150
Sep	2.5	1.48	0.2	0.642
Oct	2.6	1.45	0	0.689
Nov	2.2	1.10	0.1	0.507
Dec	1.7	1.05	0.4	0.919
2004 Total	3.5	1.33	0	0.651

Table 22. The maximum, mean, and minimum observed differences (^oC) between the calibrated hand held thermometer and the individual water temperature loggers combined for the season.

Unit	Maximum Difference	Mean Difference	Minimum Difference	Standard Deviation of Difference
2003				
4897	1.1	0.57	0.1	0.403
4898	2.1	0.82	0	0.884
4899	1.1	0.86	0	0.387
4901	1.7	1.09	0.1	0.662
4906	no data			
5600	1.5	0.83	0.4	0.390
5601	2.1	1.11	0.1	0.652
5602	1.7	0.90	0	0.698
7549	2	0.85	0.1	0.771
7550	1.8	0.87	0.1	0.695
7552	1.9	0.75	0	0.819
7554	3.7	1.27	0.6	1.087
7555	3.1	0.85	0	1.073
7557	3	1.39	0.1	0.956
7558	2.1	1.19	0	0.724

Unit	Maximum Difference	Mean Difference	Minimum Difference	Standard Deviation of Difference
8004	1.2	0.73	0.3	0.335
8005	1.9	1.00	0.3	0.535
8006	2.2	0.81	0.1	0.813
8007	3.7	1.49	0.1	1.340
8008	1.5	0.99	0	0.501
8009	1.3	0.77	0	0.482
8010	1.6	0.94	0.3	0.556
8011	1.6	0.73	0.1	0.582
8012	1.9	0.93	0	0.658
8013	1.9	1.06	0.1	0.577
8014	1.7	0.99	0.2	0.570
8015	1.7	1.23	0.5	0.468
8016	no data			
8017	1.6	0.90	0.4	0.476
8018	1.4	0.93	0.5	0.288
8019	1.4	0.69	0.1	0.453
8020	1.9	0.83	0	0.745
8021	4.9	1.90	0	1.908
8022	1.6	0.90	0.2	0.513
8023	1.9	0.94	0	0.902
8024	1.5	0.93	0.4	0.551
8025	1.2	0.72	0.3	0.383
8026	1.5	0.62	0	0.736
2003 Total	4.9	0.91	0	0.758
2004				
4901	3.5	1.90	0.1	1.247
5600	2.4	1.65	1	0.661
5601	2.3	1.68	1.4	0.427
5602	2.6	1.68	1	0.727
7549	2	1.05	0	0.835
7550	2.7	1.70	1.1	0.698
7552	2.2	1.20	0.2	0.711
7555	2	1.14	0.1	0.723
7556	2.5	1.82	1.2	0.540
7557	2	1.42	0.5	0.581
7558	2.3	1.20	0.1	0.922
8004	2.4	1.83	1.3	0.512
8005	2.4	1.72	1.1	0.606
8006	2.2	1.22	0.1	0.811
8007	1.2	0.92	0.6	0.217
8008	2.1	1.68	1.2	0.370
8009	1.6	1.22	0.8	0.356

Unit	Maximum Difference	Mean Difference	Minimum Difference	Standard Deviation of Difference
8010	1.7	0.86	0.1	0.688
8011	1.6	1.06	0.3	0.611
8012	2.5	1.54	0.9	0.586
8013	1.5	1.00	0.2	0.644
8014	2	1.43	0.9	0.512
8015	1.8	1.20	0.6	0.497
8017	2.9	1.50	0.8	0.949
8018	1.6	0.85	0.3	0.614
8019	1.8	1.22	0.4	0.512
8020	2.2	1.26	0	0.805
8021	1.7	1.24	0.5	0.508
8022	2.5	1.30	0.5	0.828
8023	1.5	1.28	1	0.259
8024	1	0.94	0.8	0.089
8025	1.7	1.05	0.4	0.603
8026	1.8	1.2	0.7	0.580
2004 Total	3.5	1.33	0.0	0.651

4.2.3 Water Temperature Data

Hourly data as well as daily and monthly summaries from each thermograph deployment from 1993-2004 are currently available through the CTUIR website http://www.umatilla.nsn.us/database. The website also lists water temperature from other projects with additional data being added regularly. Examples of several 2003 data sets are shown in Figure 51 through Figure 53. Collated water temperature data in Figure 54 provide an overview of Umatilla River maximum water temperatures by river mile for 2003 and 2004.

Figure 55 through Figure 63 display daily mean temperatures for eight of the monitoring sites for the 2003 and 2004 deployments, plus the average daily mean value for all years that data were available for a given date. In some reaches the 2003 temperatures were higher than the 2004 reaches for the same time period. In other reaches these patterns were reversed, and there were no clear or interesting deviations from the mean daily average for all years combined. Results are based only on years when data is available for all years combined for a given day.

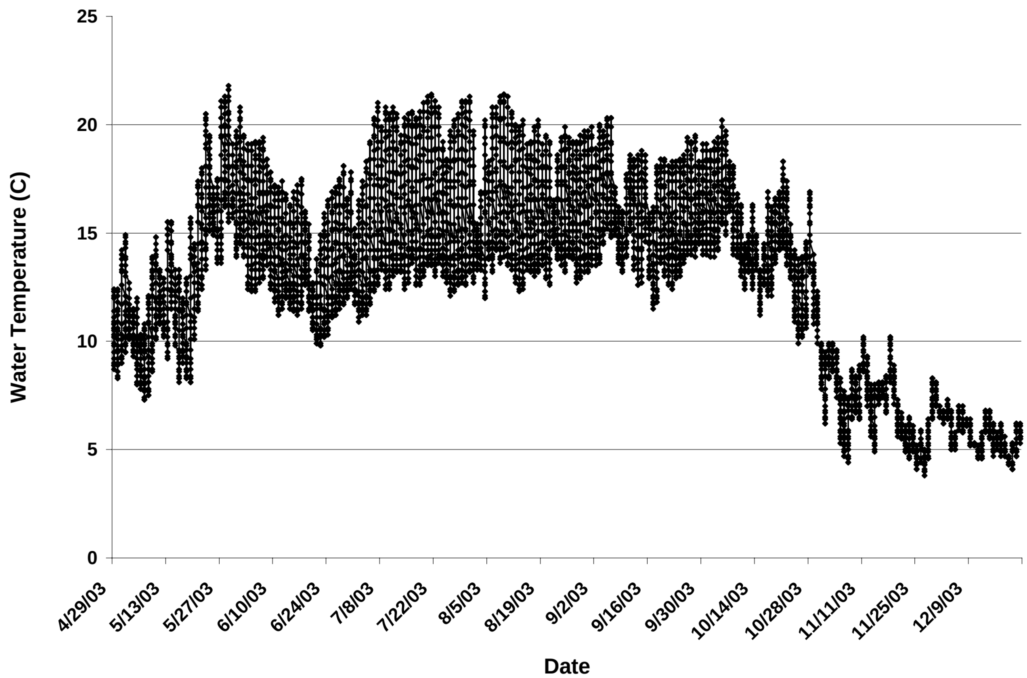


Figure 51. Hourly water temperature data from the Umatilla River at RM 47.5, near Coombs Canyon, April 29 through December 22, 2003.

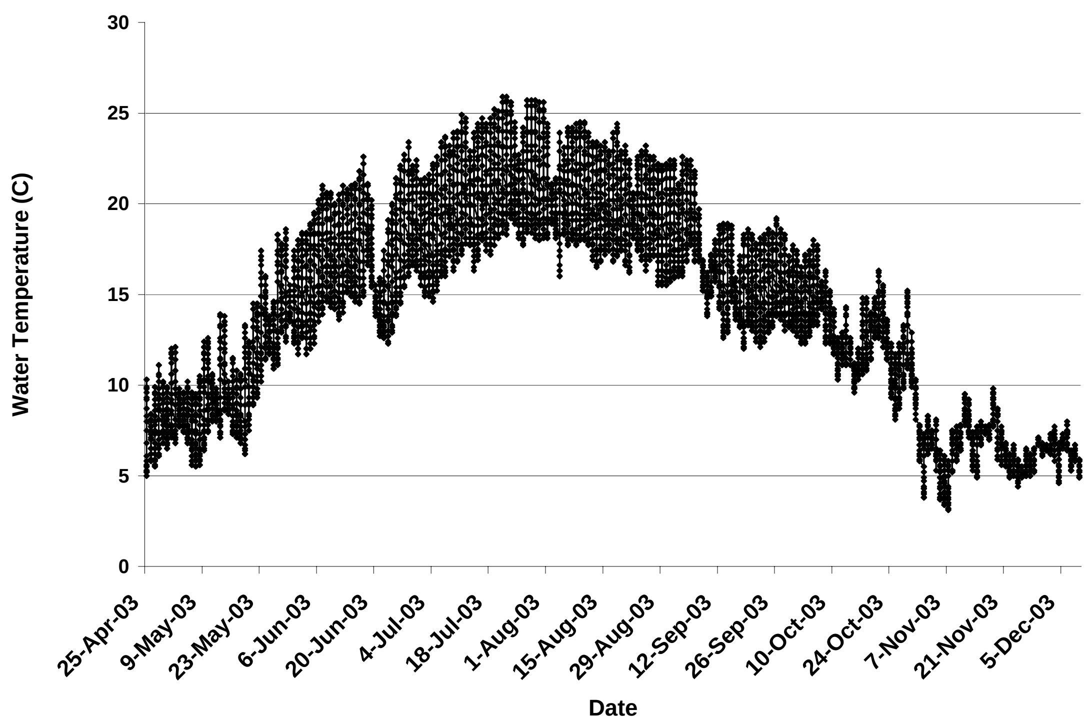


Figure 52. Hourly water temperature data from the Umatilla River at RM 73.1, near Thorn Hollow, April 24 through December 9, 2003.

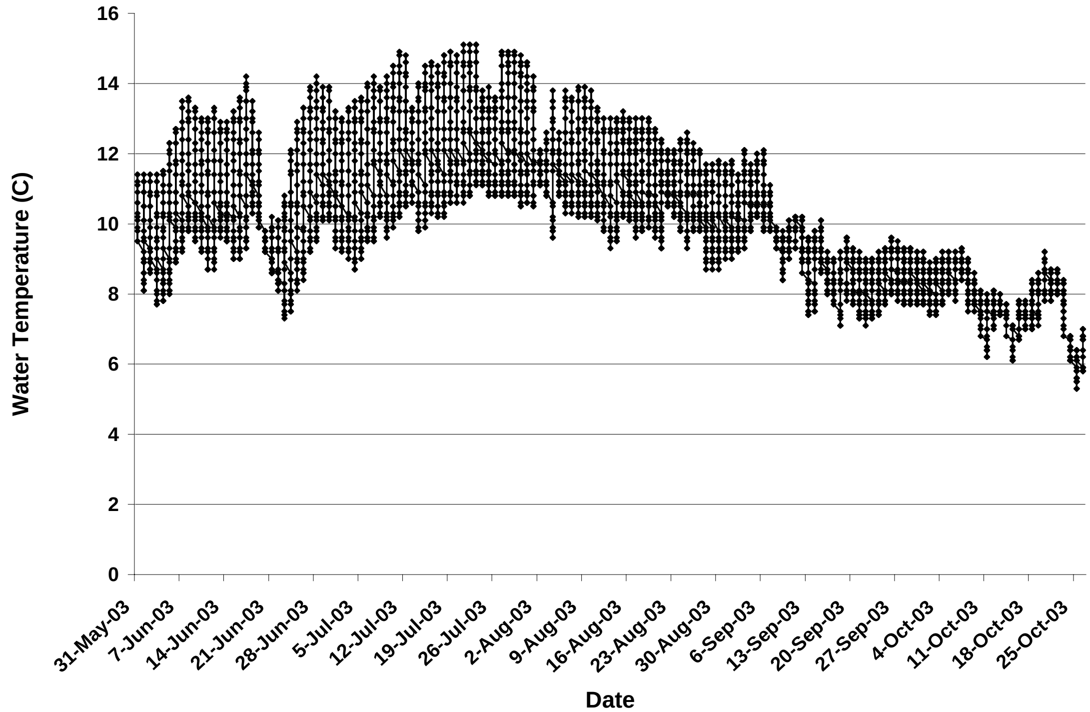


Figure 53. Hourly water temperature data from the N.F. Umatilla River at RM 2.7, below the mouth of Coyote Creek, May 31 through October 26, 2003.

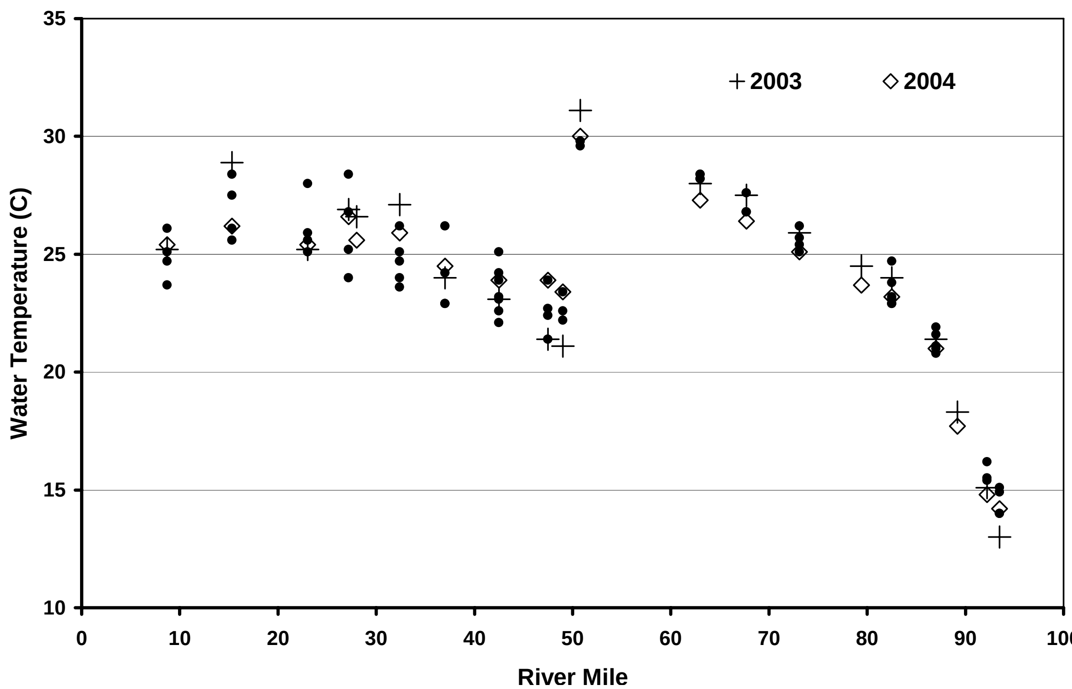


Figure 54. Summary of Umatilla River maximum water temperatures for June-September 2003, (large plus sign), superimposed on 1995-2002 data (small black circles) from locations in the Umatilla River between RM 8.7 and 89.5, and the N.F. Umatilla River at RM 2.7 and 4. (denoted as RM 92.2 and 93.5).

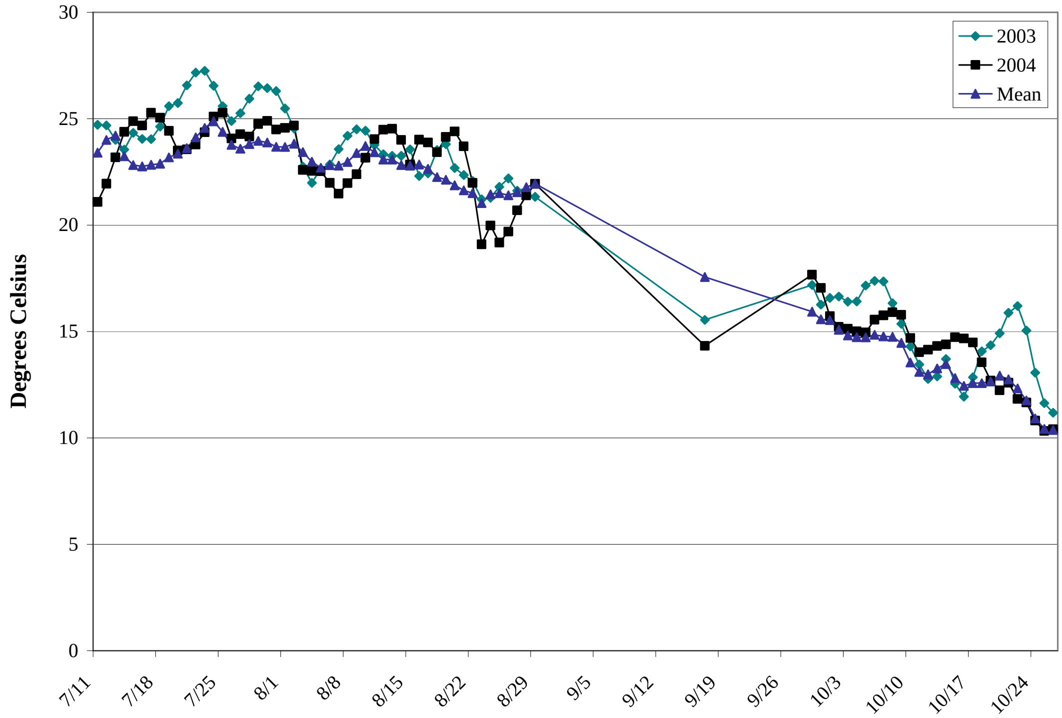


Figure 55. Daily mean temperatures for Umatilla River site #4 at RM 15.3 for the 2003 and 2004 deployments, and grand mean daily average for 1999-2004.

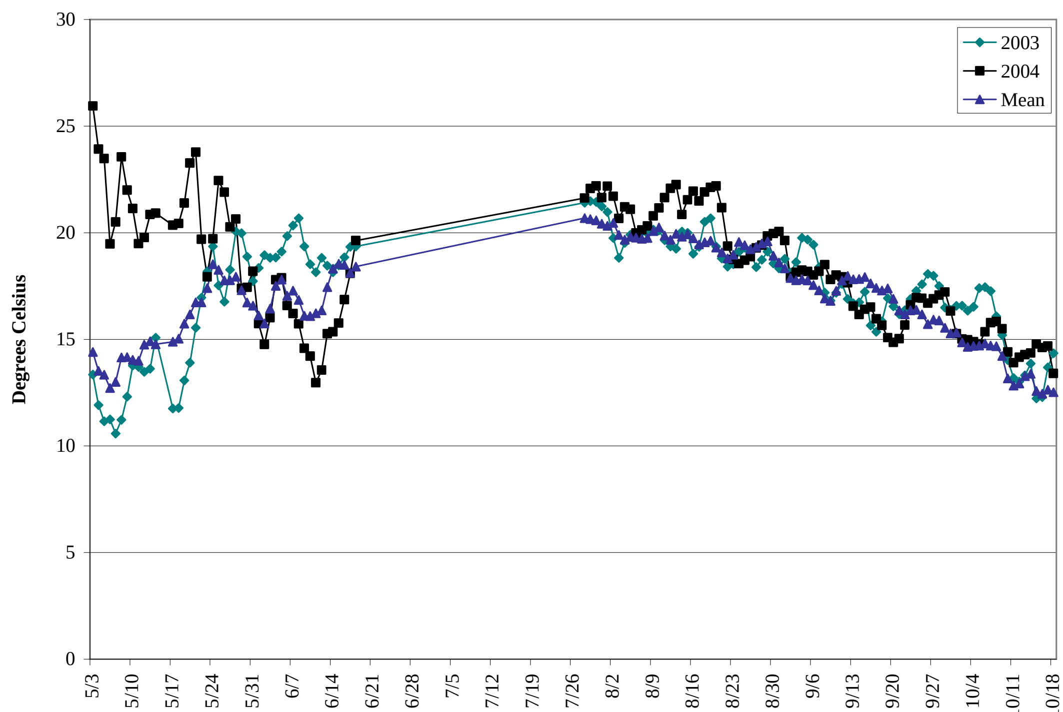


Figure 56. Daily mean temperatures for Umatilla River site #5 at RM 21.6 for the 2003 and 2004 deployments, and grand mean daily average for 1999-2004.

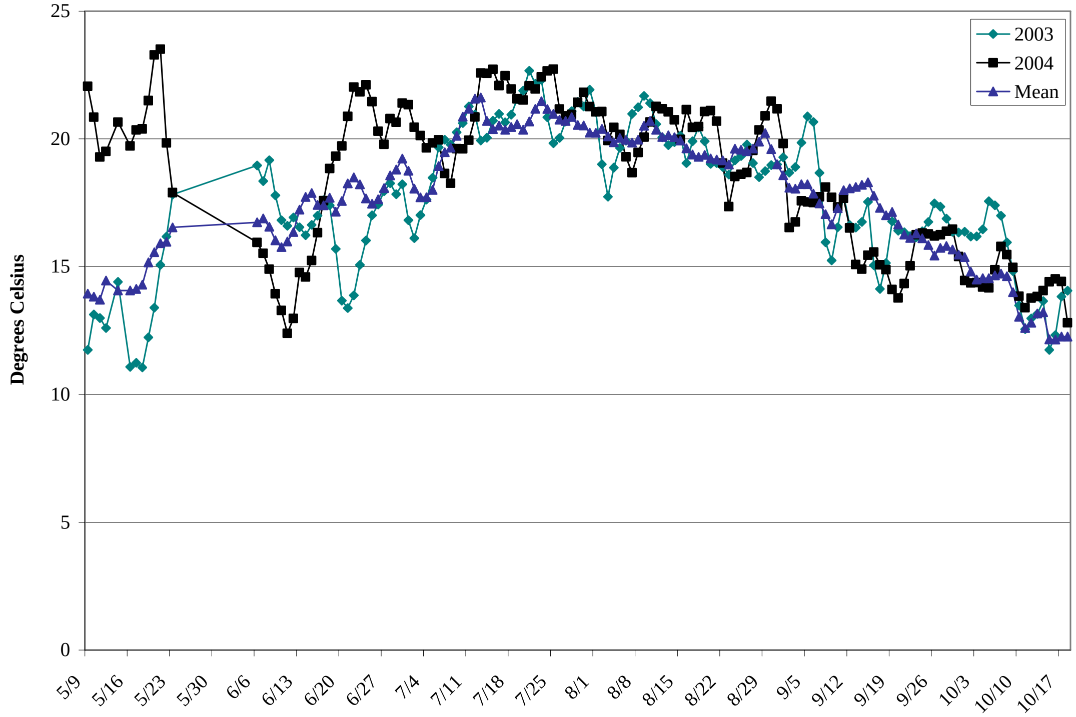


Figure 57. Daily mean temperatures for Umatilla River site #8 at RM 32.4 for the 2003 and 2004 deployments, and grand mean daily average for 1998-2004.

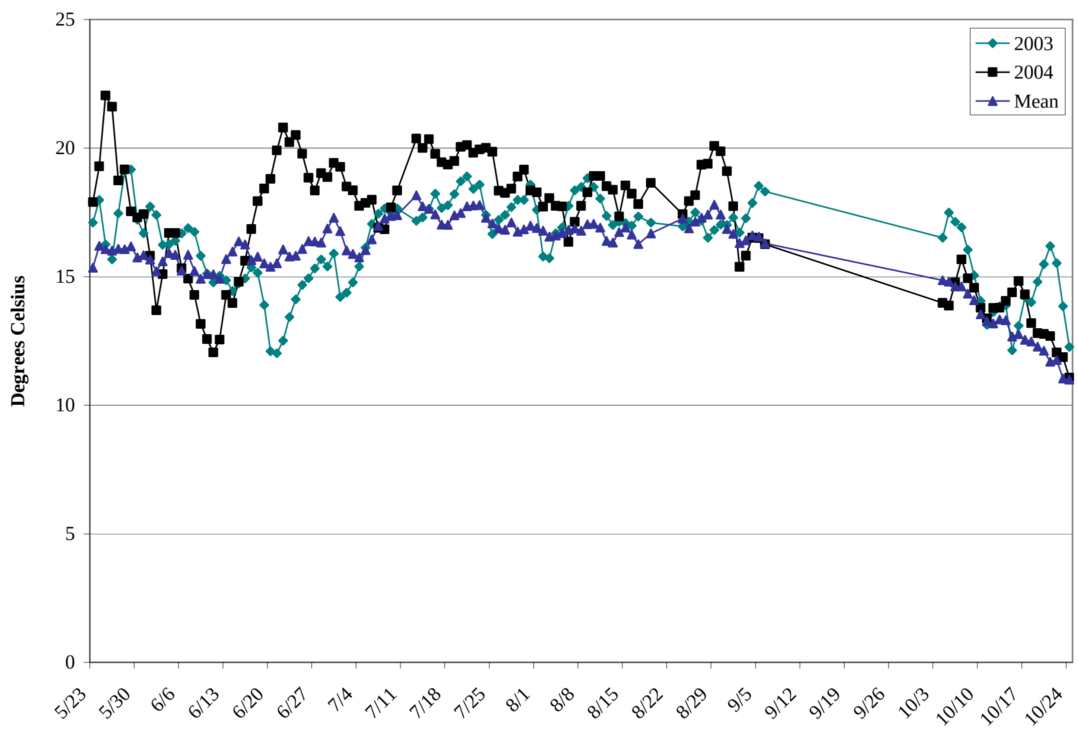


Figure 58. Daily mean temperatures for Umatilla River site #10 at RM 42.5 for the 2003 and 2004 deployments, and grand mean daily average for 1995-2004.

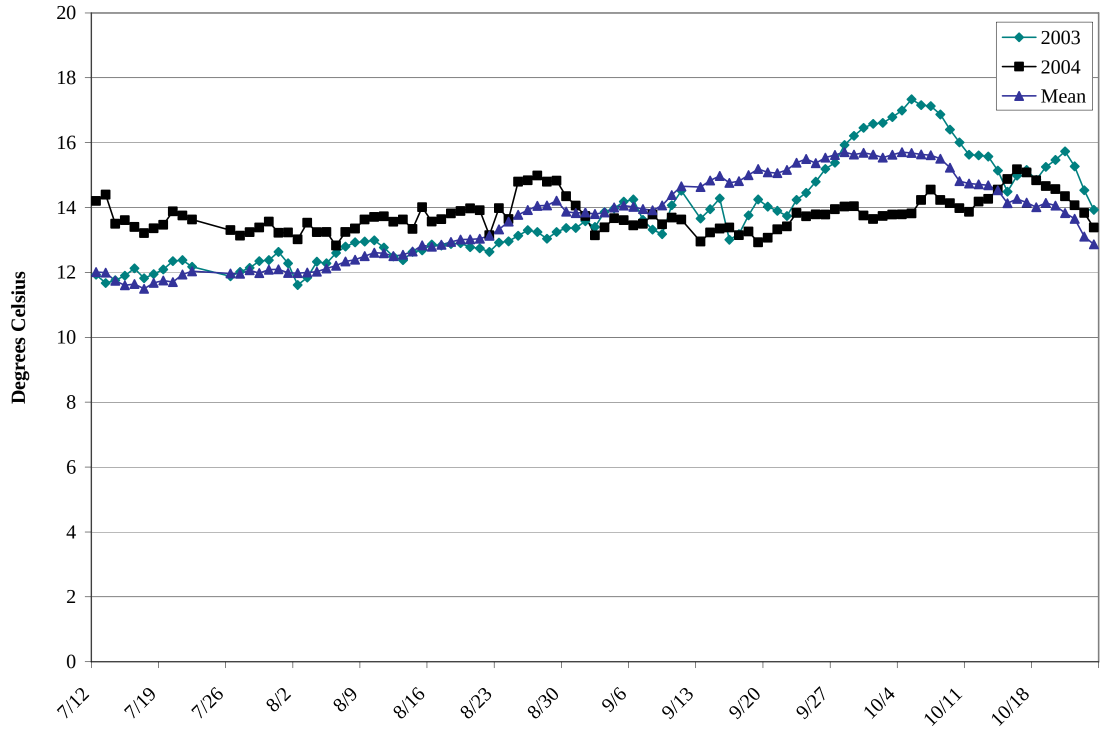


Figure 59. Daily mean temperatures for McKay River site #14 at RM 0.1 for the 2003 and 2004 deployments, and grand mean daily average for 1999-2004.

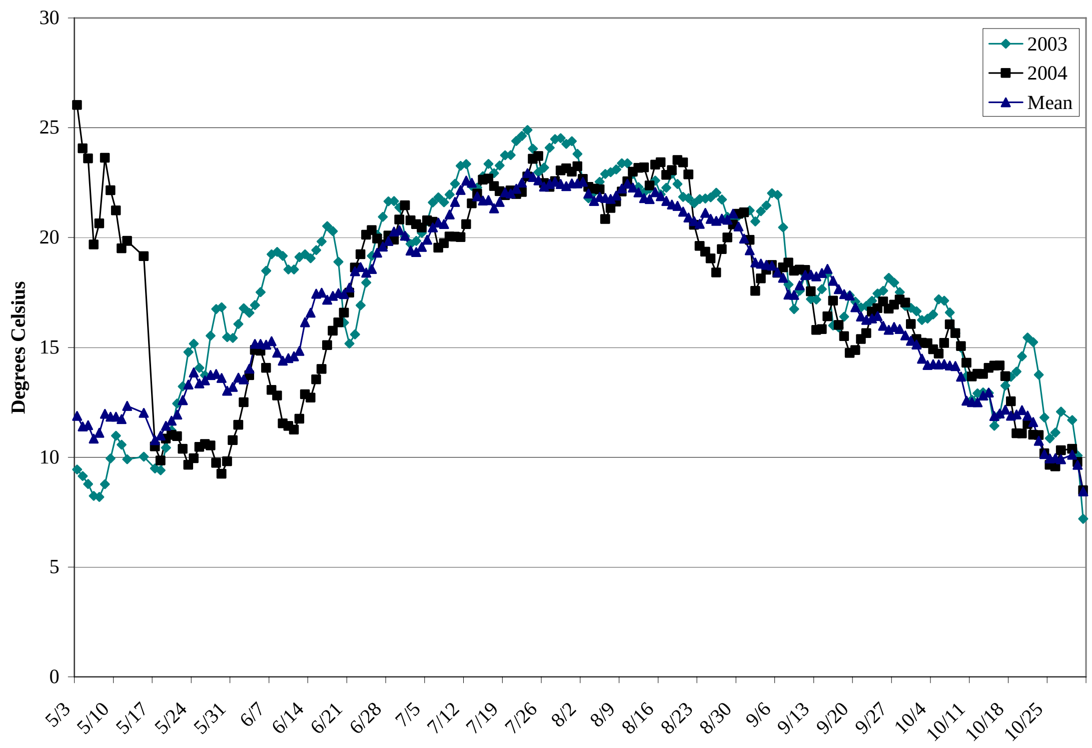


Figure 60. Daily mean temperatures for Umatilla River site #19 at RM 63 for the 2003 and 2004 deployments, and grand mean daily average for 1995-2004.

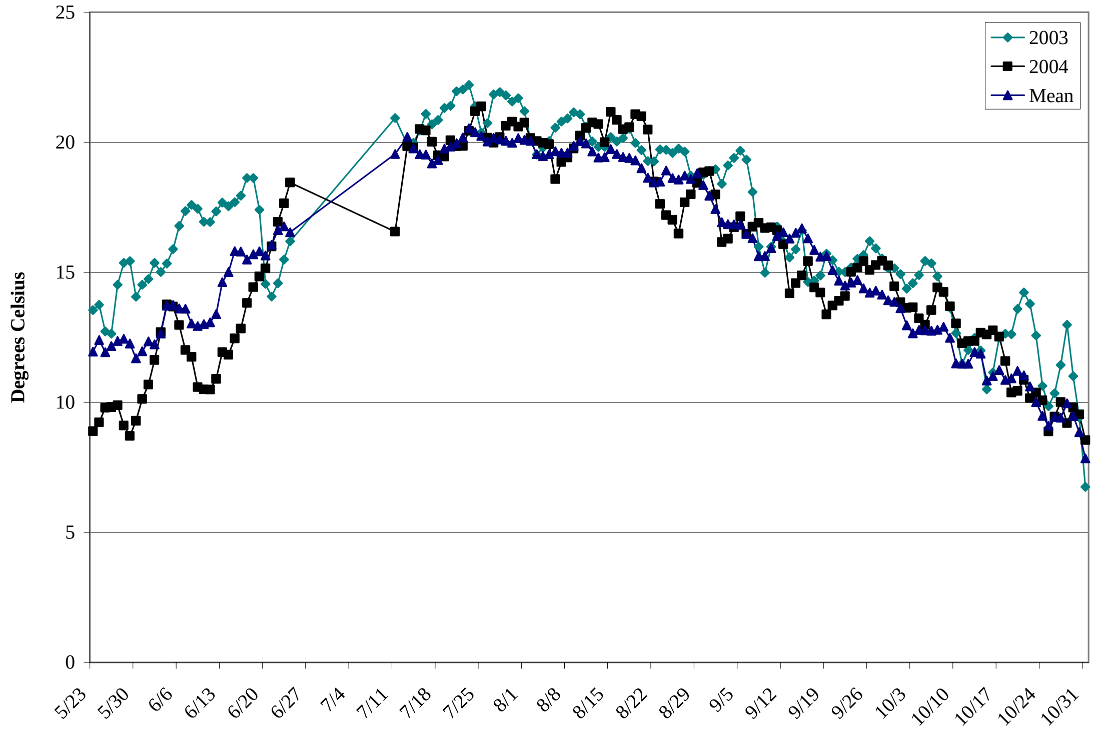


Figure 61. Daily mean temperatures for Umatilla River site #22 at RM 73.1 for the 2003 and 2004 deployments, and grand mean daily average for 1999-2004.

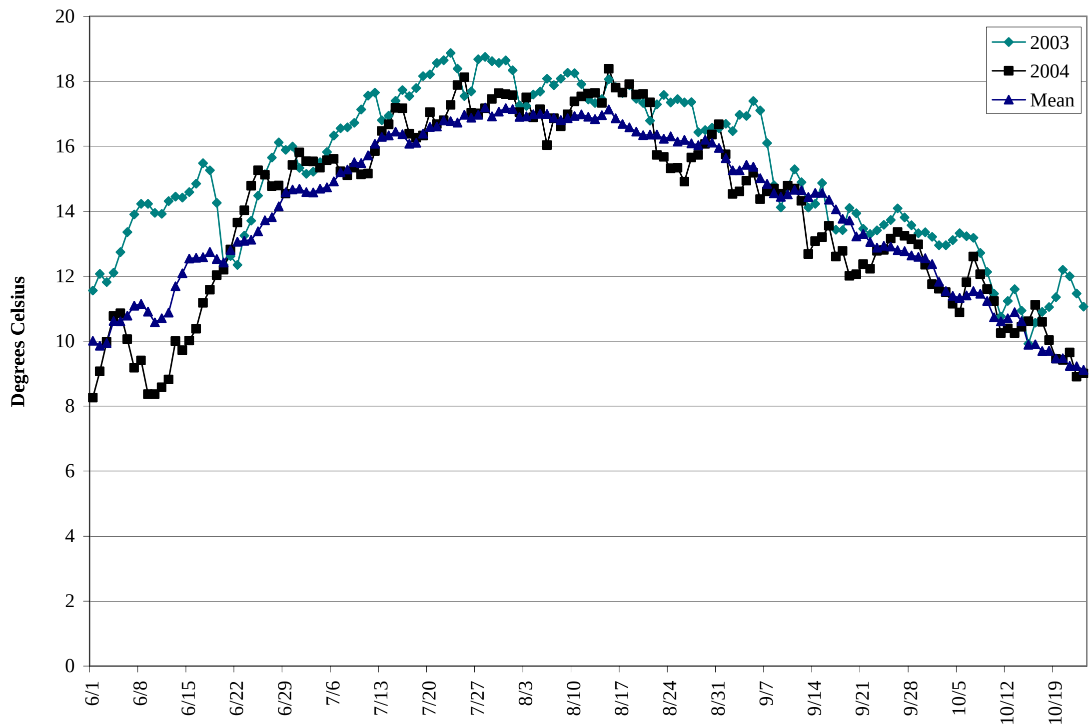


Figure 62. Daily mean temperatures for N.F. Meacham River site #27 at RM 0.5 for the 2003 and 2004 deployments, and grand mean daily average for 1996-2004.

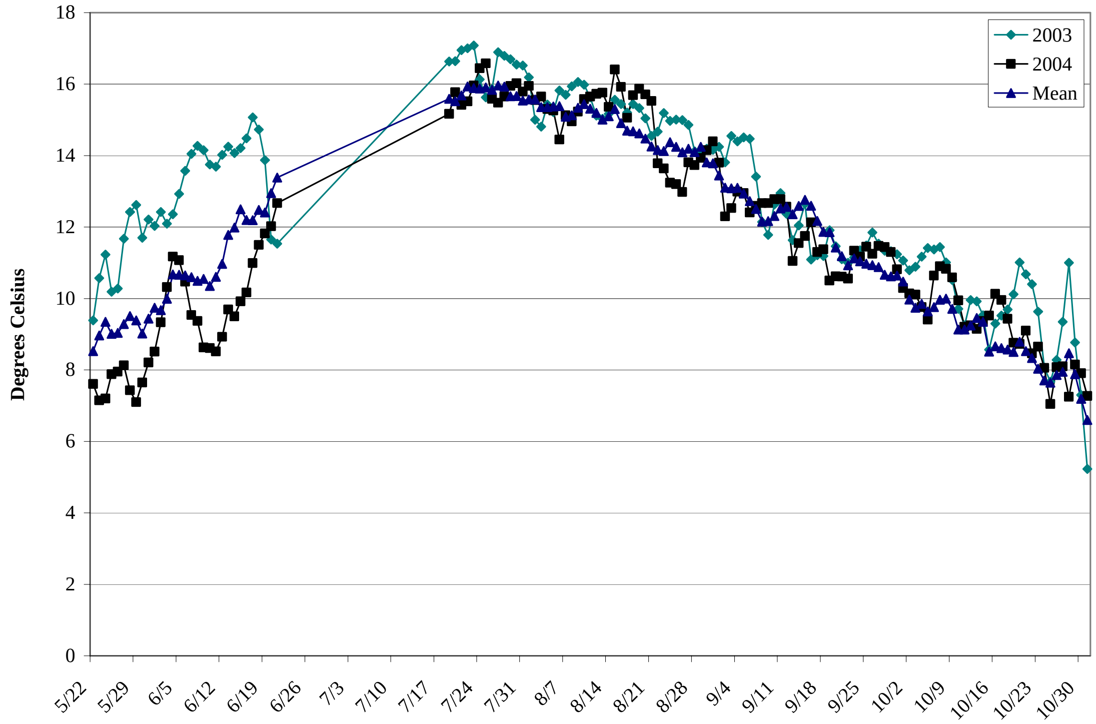


Figure 63. Daily mean temperatures for Umatilla River site #33 at RM 87 for the 2003 and 2004 deployments, and grand mean daily average for 1998-2004.

4.2.4 Temperature Limited Habitat

Water temperatures in the Umatilla River are suitable or marginally suitable for salmonids during the summer in two major sections. The upper reach (RM 80-90) includes the mainstem Umatilla River above the mouth of Meacham Creek; and the lower reach (RM 30-50) includes the river above Feed Canal Dam (site 7) and the Mouth of McKay Creek (site 13). All but the lower reaches of most tributaries in the basin have suitable water temperatures for *O mykiss*. Most Tributaries that enter the Umatilla River above the mouth of Meacham 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 summer steelhead, bull trout, and spring Chinook salmon. The lower Umatilla River (RM 30 -50) is artificially cooler during the summer because cold water is released from McKay Reservoir for irrigation and fish benefits. This lower reach usually has suitable temperatures, but flow can be reduced significantly when flows from McKay Reservoir are minimized or when the cool hypolimnetic water in McKay Reservoir is expended. Note the high water temperatures recorded in May (Figure 54) in the Umatilla River below the mouth of McKay Creel before irrigation and "fish-flow" waters were released from McKay Reservoir. Below Westland Dam (RM 27) near Echo, the Umatilla River is dewatered during most of the summer. From RM 27 down to the mouth, irrigation return flows and natural springs provide some flow with moderating effects on water temperatures.

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, Contor et al. 1996, Contor et al. 1997, Contor et al. 1998, Contor & Kissner 2000, Contor 2003). (Bret 1952, Black 1953) are credited with first reporting water temperatures of 24-25 ^oC as near salmonid's lethal limit. The Umatilla River below the mouth of Meacham Creek (RM 78.9) is often warmer than 24-25 ^oC.

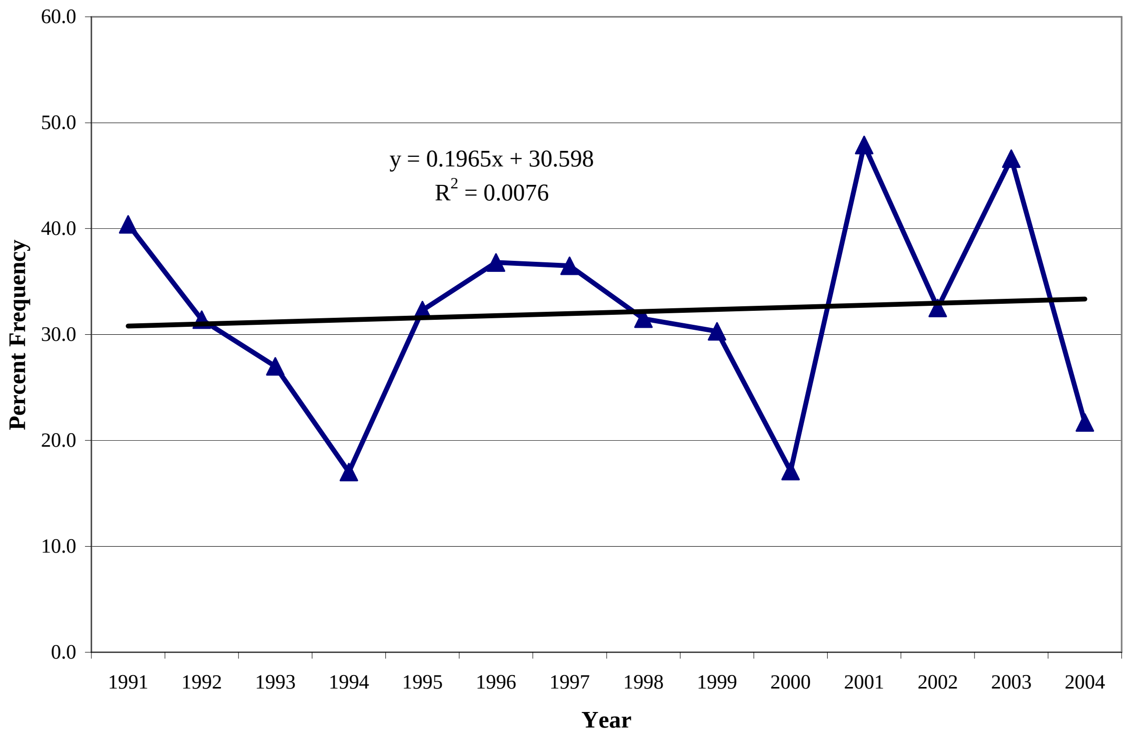


Figure 64. Spring Chinook salmon pre-spawn mortality by year in the Umatilla River, 1991-2004 n=2386.

Pre-spawning mortalities were estimated by examining retained eggs and gonad mass in carcasses found on regularly scheduled spawning grounds surveys. Despite significant increases in overall production, system-wide pre-spawn mortality rates have not decreased during the past decade (Figure 64). Water temperature and survey data show an average pre-spawning mortality of 60-67% in the Umatilla River in the reach below Meacham Creek with an associated maximum July temperature of 25.9 ^{o}C in 2003. During the same year, the pre-spawning mortality estimate was only 4.5% in N. F. Umatilla River with a maximum recorded water temperature in July of 15.1^o C.

Considerable variability in the relationship between estimated pre-spawning mortality and maximum water temperature by reach was demonstrated when combining available summer temperature and pre-spawning data from 1991-2004 for each reach (Table 22,

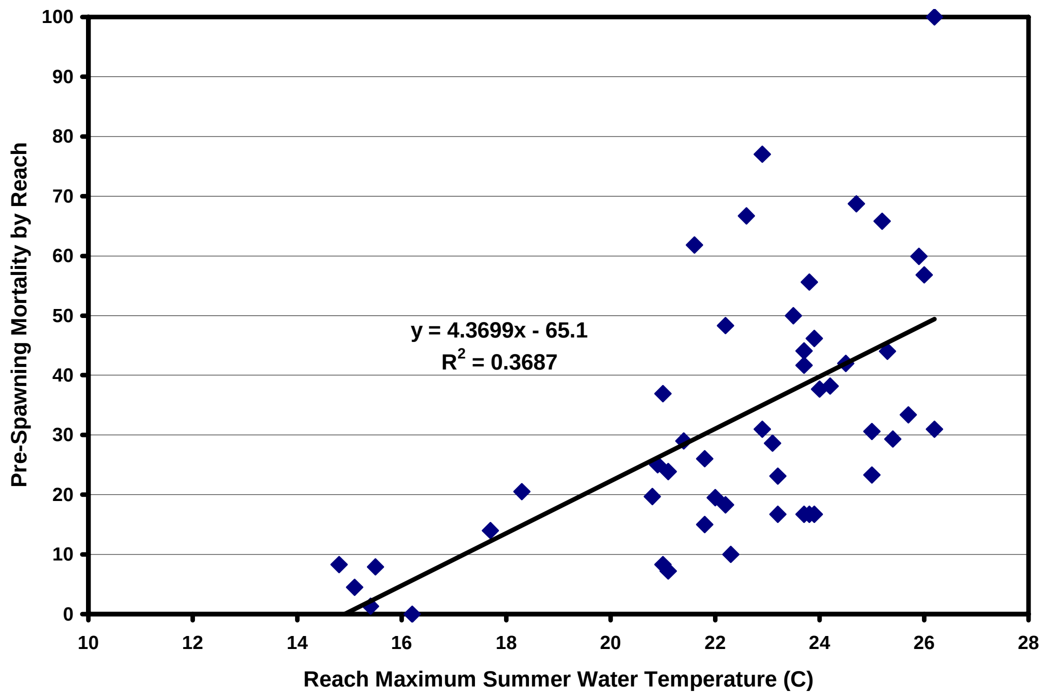
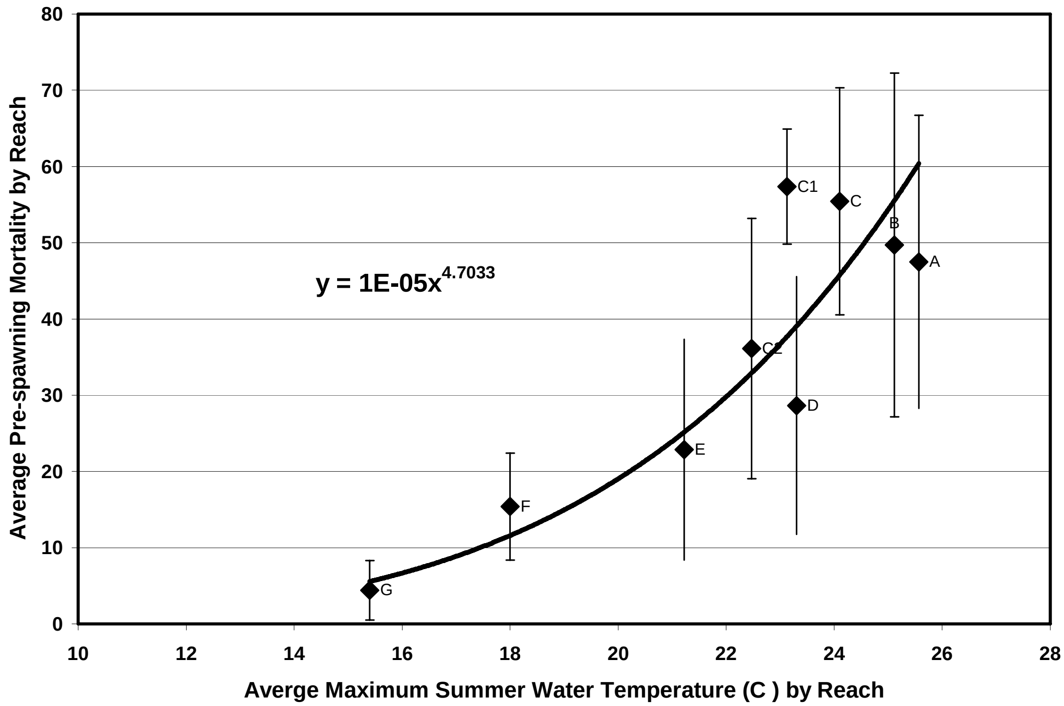


Figure 65 and 68). Variability exists between years and was greatest in the lower reaches where maximum temperatures are above 22 °C. Much of the variation may be an artifact of temperature monitoring and using the single maximum value. The maximum temperature for each reach for the summer does not capture the entire thermal history of the salmon holding in those reaches. Spring seeps and other cool water refuges were found during CTUIR habitat surveys (Contor et al. 1996), Table D-8). The spring seeps in the Gibbon area have been studied extensively by O'Daniel and Poole (in preparation) and were found to be dynamic throughout the summer. These seeps may provide significant thermal variation within a reach.

Other sources of variability in estimating this relationship include thermograph location, angling pressure, and general fish health. Thermographs placed deep in pools can often record water temperatures influenced by cooler hyporheic exchange flows. Thermographs in shallow, calm areas can record higher water temperatures than in pool habitats where adult spring Chinook hold. On some years, salmon have been observed to move rapidly back and forth between different holding areas during the Tribal gaff fisheries in June and July (author's observations during Tribal creel surveys). Finally, migration conditions in the Mainstem Columbia and lower Umatilla River likely provide inconsistent cumulative stress on adult spring Chinook between and within migration years.

There was a strong linear relationship between pre-spawning mortality estimates of spring Chinook salmon by survey reach and maximum water temperatures in 2003 and 2004 (r^2 of 0.874 and 0.542, **Error! Reference source not found.**, (Kissner 2003)). Spawning survey reaches and thermograph locations are displayed in **Error! Reference source not found.**. The relationship between the mean pre-spawning mortality data and the average maximum summer water temperatures by reach was best fit by an exponential function



(

Figure 66). This makes sense as exponential curves are well fit to data that expresses a threshold such as a temperature limit. These results provide a general tool that could be useful for EDT and other modeling processes for estimating restoration potential and examining recovery strategies for the Umatilla River and other systems where spring Chinook were extirpated.

Table 23. Spring Chinook salmon pre-spawning mortality and maximum water temperature data for survey reaches illustrated in Figures 67 and 68.

Year	Thermograph Unit Number	Thermo Site RM	Spawn Survey Area	Spawn Survey Area River Miles	Season Max Temp	Pre-Spawn Mort %
1991	HT3	79.1	C2	79-80	22.3	10
1992	HT2	78.5	C1	76.7-79	23.8	55.6
1992	HT3	79.1	C2	79-80	23.5	50
1992	HT4	81.7	D	80-83.1	23.9	16.7
1993	HT2	78.5	C1	76.7-79	22.2	48.3
1993	HT3	79.1	C2	79-80	20.9	25
1993	HT3	84.7	D	80-83.1	22.2	18.3
1994	HT2	78.5	C1	76.7-79	23.9	46.2
1994	HT3	79.1	C2	79-80	23.2	23.1
1994	HT4	81.7	D	80-83.1	23.7	16.7
1995	HT2	78.5	C1	76.7-79	22.6	66.7
1995	HT4	81.7	D	80-83.1	21.8	15
1996	HT4	81.7	D	80-83.1	22	19.5
1997	HT	76.5	B	73.5-76.7	26	56.8
1997	HT4	81.7	D	80-83.1	25.3	44
1997	33	87	E	83.1-86	20.8	19.7
1998	HT	76.5	B	73.5-76.7	26.2	100
1998	32	82.5	D	80-83.1	23.8	16.7
1998	33	87	E	83.1-86	21.8	26
1998	35	92.2	G	89.5-92.2	16.2	0
1999	22	73.1	A	70-73.5	25.1	
1999	HT	76.5	B	73.5-76.7	23.7	41.7
1999	32	82.5	D	80-83.1	22.9	31
1999	33	87	E	83.1-86	21.1	23.9
2000	22	73.1	A	70-73.5	25.7	33.4
2000	HT	76.5	B	73.5-76.7	25	23.3
2000	32	82.5	D	80-83.1	23.1	28.6
2000	33	87	E	83.1-86	21.1	7.2
2000	35	92.2	G	89.5-92.2	15.4	1.3
2001	22	73.1	A	70-73.5	26.2	31
2001	HT	76.5	B	73.5-76.7	24.7	68.7
2001	32	82.5	D	80-83.1	22.9	77
2001	33	87	E	83.1-86	21.6	61.8
2002	22	73.1	A	70-73.5	25.4	29.3
2002	HT	76.5	B	73.5-76.7	25	30.6
2002	32	82.5	D	80-83.1	24.2	38.2
2002	33	87	E	83.1-86	21	36.9
2002	35	92.2	G	89.5-92.2	15.5	7.9
2003	22	73.1	A	70-73.5	25.9	59.9
2003	HT	76.5	B	73.5-76.7	25.2	65.8
2003	23	79.4	C	76.7-80	24.5	42
2003	32	82.5	D	80-83.1	24	37.7
2003	33	87	E	83.1-86	21.4	29
2003	34	89.2	F	86-89.5	18.3	20.5
2003	35	92.2	G	89.5-92.2	15.1	4.5
2004	22	73.1	A	70-73.5	25.1	
2004	HT	76.5	B	73.5-76.7		37.5
2004	23	79.4	C	76.7-80	23.7	44.1
2004	32	82.5	D	80-83.1	23.2	16.7
2004	33	87	E	83.1-86	21	8.3
2004	34	89.2	F	86-89.5	17.7	14
2004	35	92.2	G	89.5-92.2	14.8	8.3

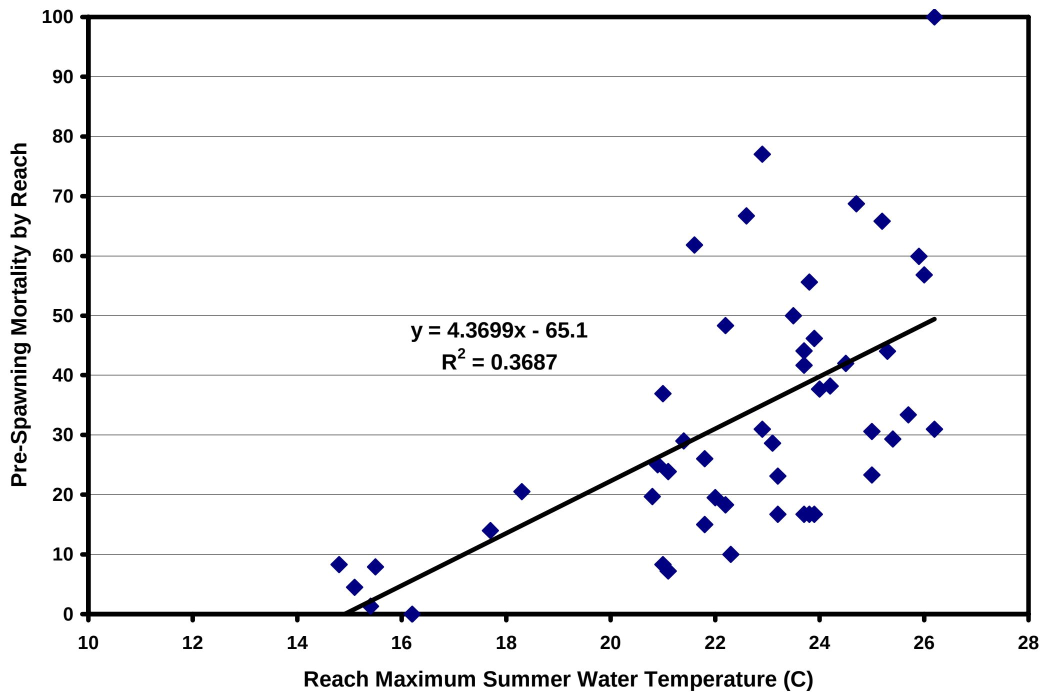


Figure 65. Annual estimated spring Chinook salmon pre-spawning mortalities for each reach plotted against maximum summer water temperatures by reaches for available data from (1991 through 2004, n=49).

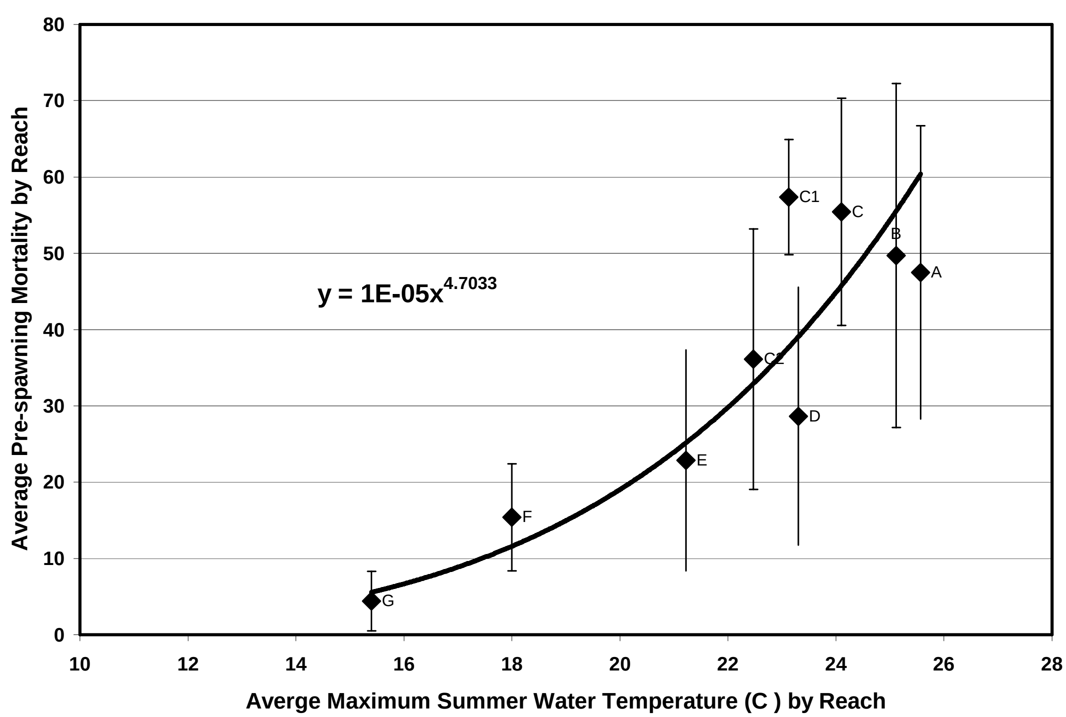


Figure 66. Average spring Chinook salmon pre-spawning mortality data for all years (1991-2004) by reach plotted against average maximum summer water temperatures by reach with ± one standard

deviation in mortality denoted. See Error! Reference source not found. **for a map listing the reach locations (A-G).**

4.2.5 Temperature-limited Habitat Recommendations

In order to increase available spawning and rearing habitat for spring Chinook, stream temperatures will need to be addressed. Habitat restoration efforts designed specifically to reduce summer maximum daily water temperatures should be considered for reaches above and inclusive of spring Chinook salmon spawning areas. Forest, agriculture and livestock management practices should 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. 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 & Krygier 1970, Beschta & Taylor 1988, Hicks et al. 1991, Hostetler 1991). 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 67). In contrast, they did not observe improvement in water temperatures in unprotected reaches above and below the project. 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 & Williams 1998, Hayashi & Rosenberry 2002, Kasahara & Wondzell 2003). For example, in McCoy Creek (of the Grande Ronde Basin) water temperatures were an average of 6 ^{o}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 ^{o}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 grasses. Further moderation in water temperatures is expected through riparian restoration and recovery.

In terms of monitoring recommendations, future calibration tests should include a number of improvements including: 1) a more gradual change in water temperatures at the 30 minute time interval; 2) more space between units so that the bundle of thermographs does not create a residual thermal mass; 3) increase the test time to 120 minutes, and 4) provide more constant water flow and mixing during the entire test. For next field season, we will examine the feasibility of downloading data from each unit during monthly quality control checks with a hand-held field PC. Data from the preceding months could be retained if a unit becomes lost or inactive later in the season. Finally, improvements in protocol, equipment, and training will improve data quality control and assessment.

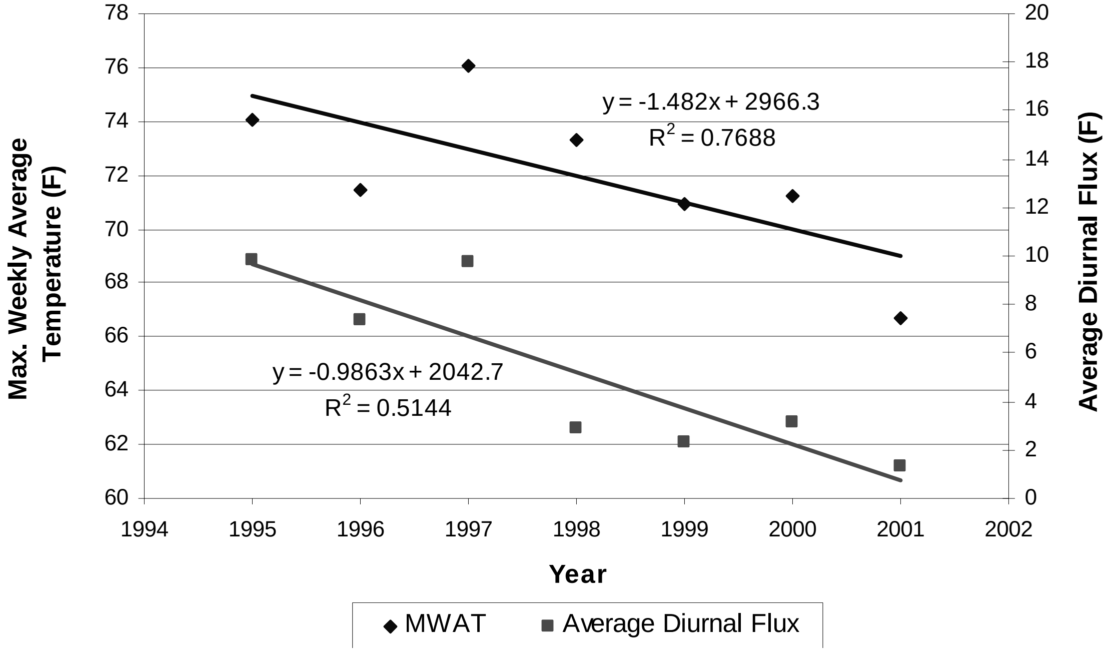


Figure 67. Changes in maximum weekly average temperatures (MWAT) and average diurnal flux in Wildhorse Creek project area at RM 9.5 (from (Shaw & Sexton 2003).

4.3 Harvest Monitoring

4.3.1 Field Surveys

4.3.1.1 2003 Field Surveys

Our initial surveys in June 2003 showed that considerable fishing effort occurred prior to field monitoring. Of the 65 harvested spring Chinook salmon reported during creel surveys in 2003, 53 were harvested prior to the field interview and reported in the year-to-date harvest category. Of the 65 reported only 8 were caught after June 7. Little fishing effort was observed during July (Figure 68). The fishery was closed on July 14, 2003, two weeks before the end of scheduled monitoring.

From May 1 through July 14, 2003 there were approximately 1360 daylight hours. Creel surveyors monitored eight designated survey reaches for 104 hours. They observed 20 fishermen that reported fishing for 59 hours and harvesting 12 spring Chinook. The 104 hours of monitoring represents 7% of the daylight fishing time. The 12 harvested salmon observed during the 104 hours is expanded to a simple estimate of 157 spring Chinook harvested for 2003. This estimate assumes, on average, that effort and catch were steady throughout the season. Based on known fishing effort, and reported year to date catch, this assumption was probably violated especially given that there was no creel monitoring prior to June 5, 2003. Combining individual survey-reach catch-per-unit-effort data and observed fishing effort provided an estimate of 206 spring Chinook salmon harvested for

2003. This estimate does not include harvest prior to June 5, but it is closer to the estimate of 237 derived from the post season telephone interviews (Table 25).

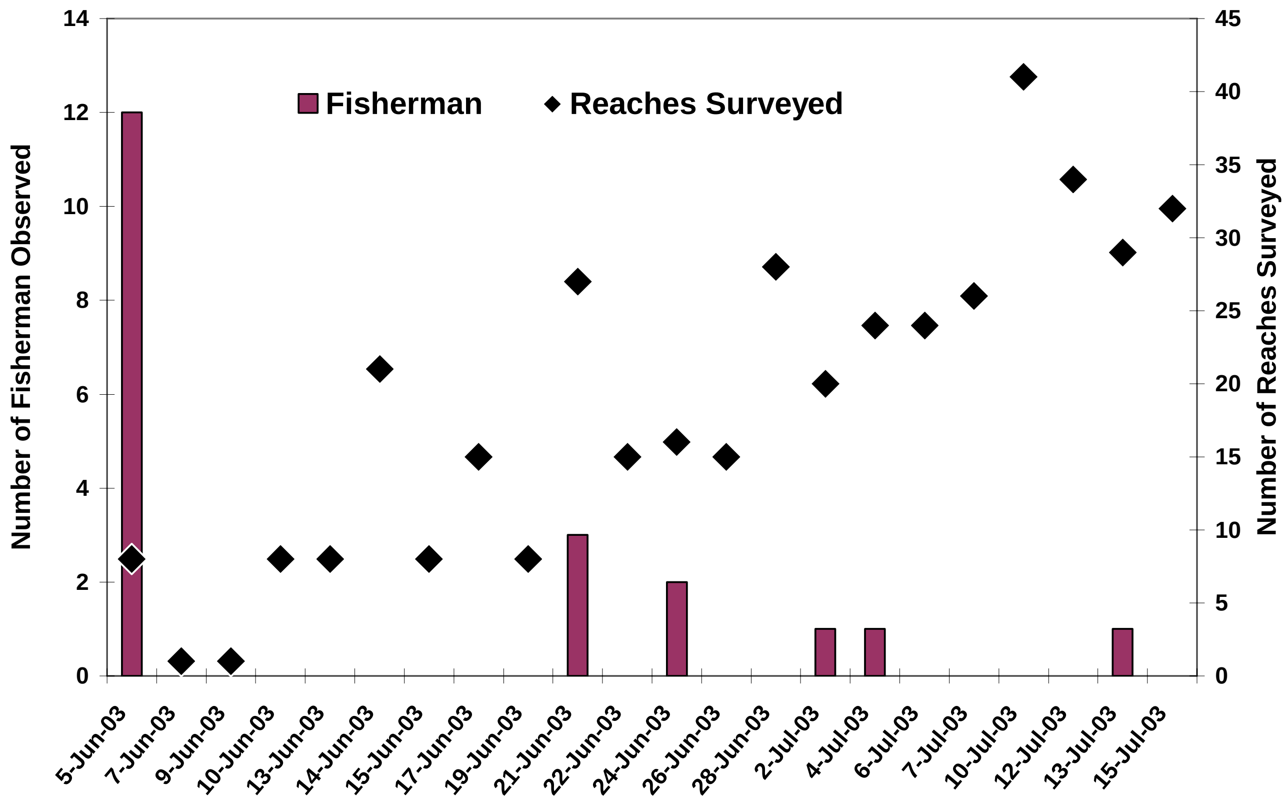


Figure 68. Fishing monitoring effort and survey sample size reported as the number of reaches surveyed (diamonds) and the number of spring Chinook fishermen observed during the period (columns).

4.3.1.2 2004 Field Surveys

During the 79 day spring chinook open season (May 1-July 18, 2005), field surveys were performed 37 of 79 (47%) days (Figure 69). Surveys were conducted on 21of 55 (38%) weekdays, 13% of weekday timeslots, and 16 of 24 weekend days/timeslots (Figure 70). The total duration of daylight time during the open season was 1,209 hours and four minutes. We surveyed in the field for 238 hours, 24 minutes and 57 seconds. This represented one-fifth of the total daylight time. Interviews were conducted with 83 fishermen. The anglers reported harvesting 19 hatchery produced spring Chinook salmon and two naturally produced Chinook.

Angler effort was concentrated in particular reaches, as 88% of individuals observed were located in reach three and four (Figure 71 and Figure 72). An estimated 73% of all spring Chinook harvest occurred in this area. Reach six was an efficient reach for anglers as 6% of the total effort netted 25% of the total catch. An estimated that 2,858 angler trips were taken during the open spring Chinook season. This estimate accounted for cases when one angler made several fishing trips.

Timing of catch reported during field surveys showed that all spring Chinook were caught during a 47 day period between May 9 and June 24. Of the salmon caught, 76% (16) were from reach four and 24% (5) from reach three. Fork lengths of captured fish ranged from 580-915mm and averaged 778mm. Mid-eye to hypural plate (MEHP) measurements ranged from 470-745mm and averaged 638mm. Weights varied from 1.8-7.8kg and averaged 5.0kg.

Based on field surveys it took a Tribal angler 5.8 hours on average to catch a spring Chinook salmon. Successful anglers took 16 hours to harvest a naturally produced salmon and 1.7 hours for a hatchery stock. When combining effort data from both successful and unsuccessful anglers, the catch rate decreased to one wild fish every 60.8 hours, and 6.4 hours for hatchery stock. Summer steelhead were comparatively rare during the spring Chinook fishery. Based on creel interviews harvest and effort were positively correlated for spring Chinook, but not for summer steelhead (Figure 73).

Combining effort and harvest data provided an estimate of 416 hatchery Chinook and 44 natural spring Chinook salmon harvested for 2004. The calculation for estimation was performed under the assumption that effort and harvest were alike for days surveyed versus those not surveyed. Adult return numbers for the Umatilla River spring Chinook salmon run during the 2004 migration year were 2,552 (86%) hatchery and 414 natural fish. In addition, 246 hatchery jacks and 24 naturally produced jacks were reported. A close correlation was reflected in harvest as 19 of 21 (90%) salmon caught were hatchery stock and two were of natural origin. This suggests that catchability between hatchery and natural Chinook stock in the Umatilla River may be similar. Due to the small sample size of only 0.7% of the 2004 total run being caught, it is difficult to draw a solid correlation. We will continue to monitor this relationship in future years.

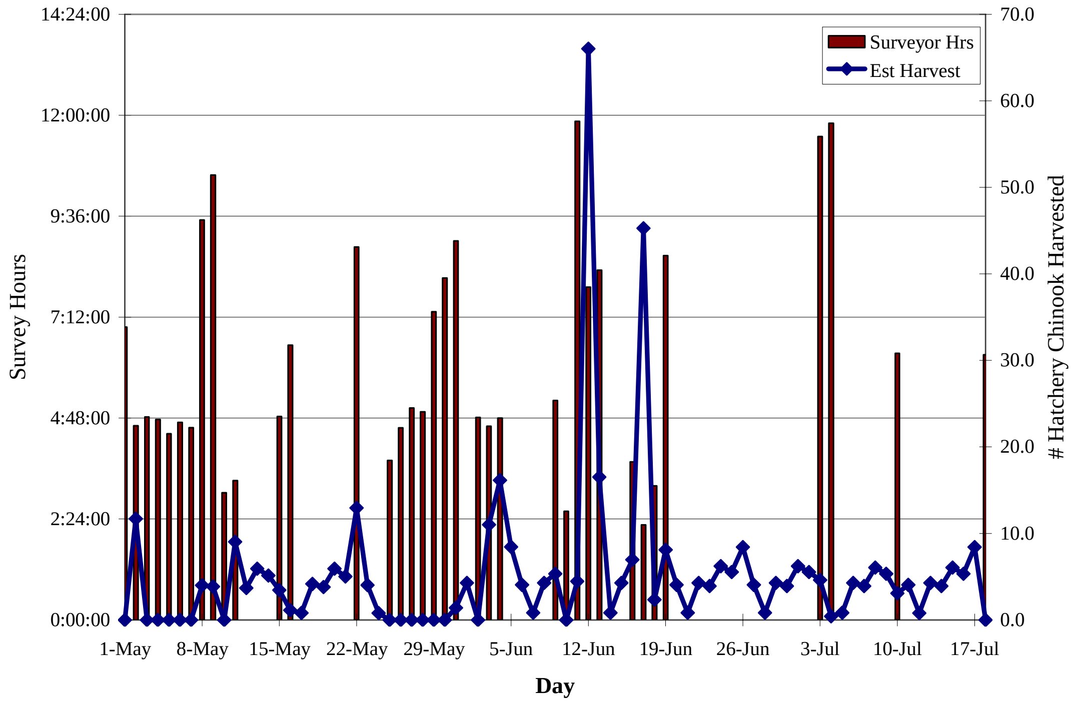


Figure 69. Creel survey effort and estimated harvest during the 2004 spring Chinook fishery.

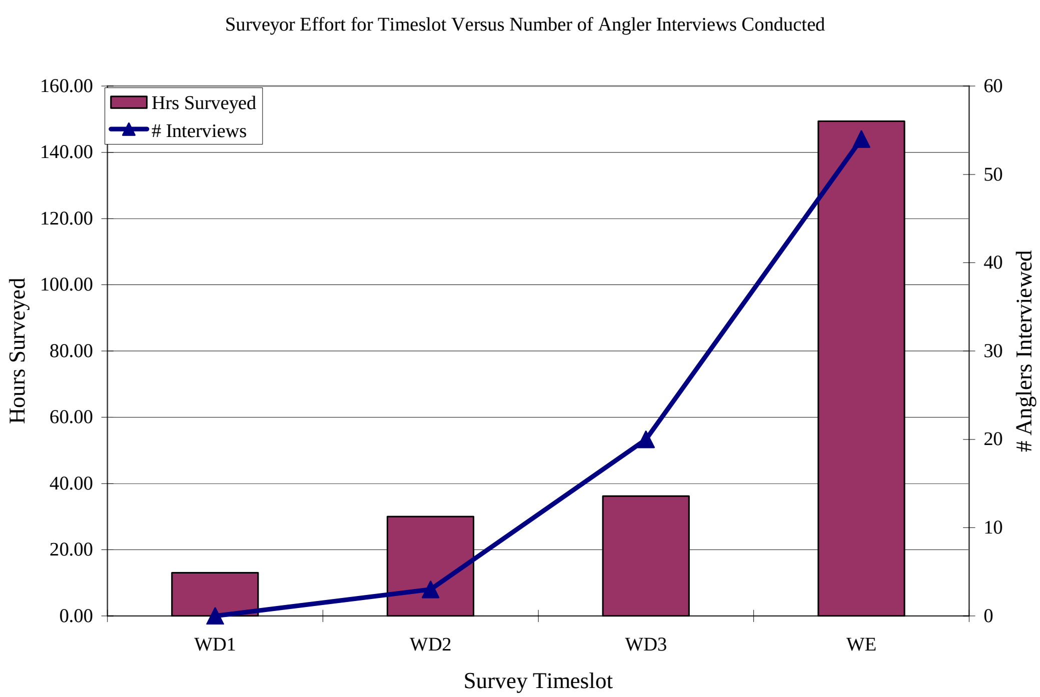


Figure 70. Survey effort and number of interviews by timeslot (weekday morning (WD1), afternoon (WD2), evening (WD3), and weekend/holiday shifts).

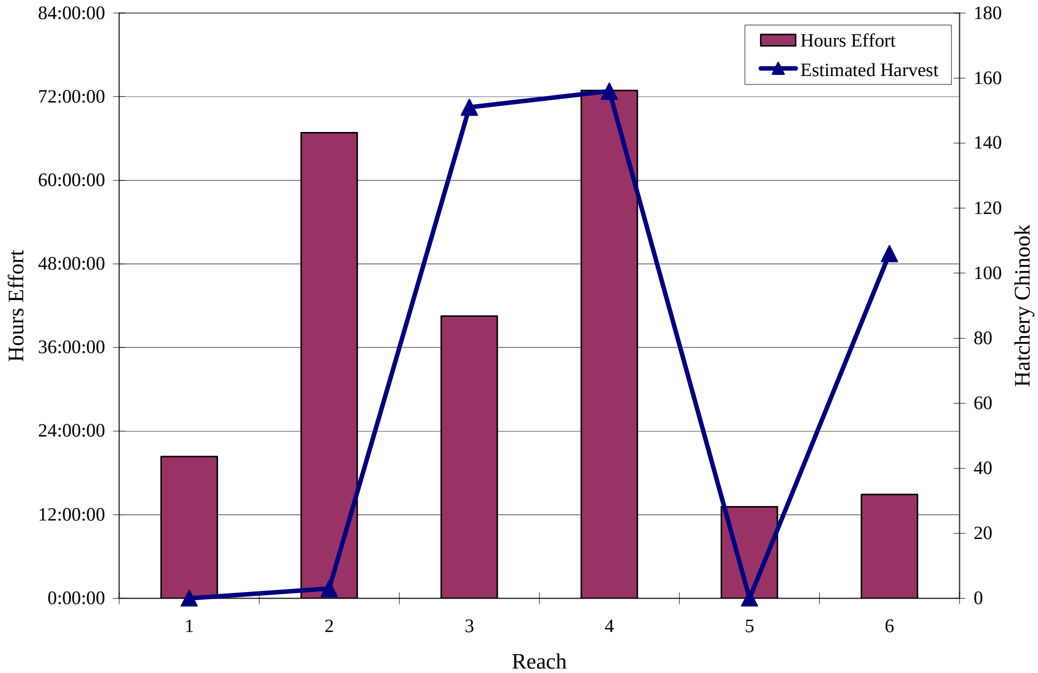


Figure 71. Hours of survey effort and estimated hatchery Chinook harvested by survey reach during the 2004 season. See Figure 9 and Table 9 for the reach descriptions.

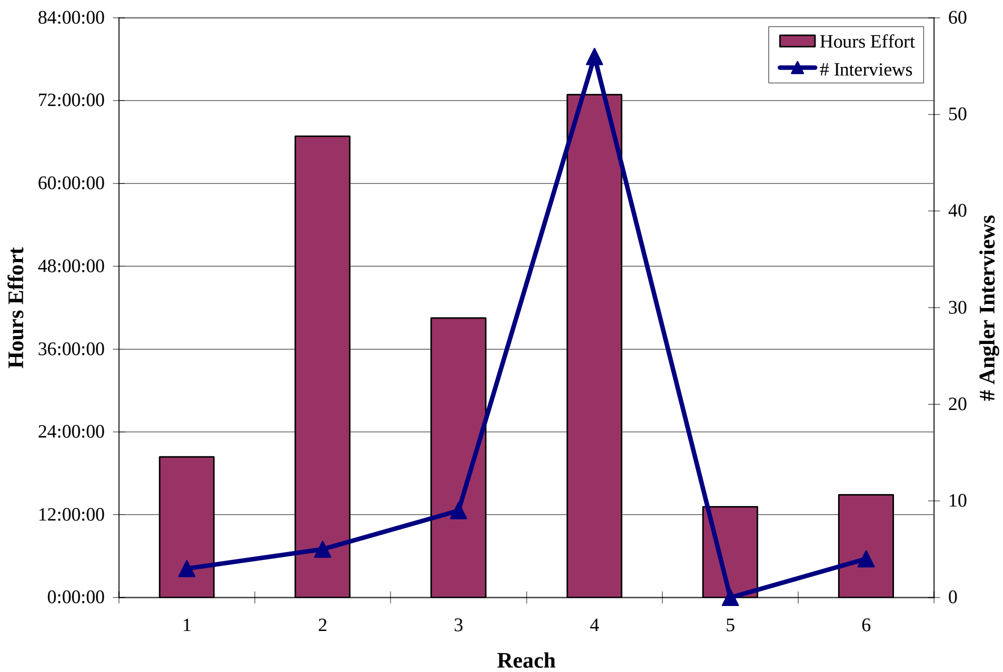


Figure 72. Hours of survey effort and estimated harvest by survey reach. See Figure 9 and Table 9 for the reach descriptions.

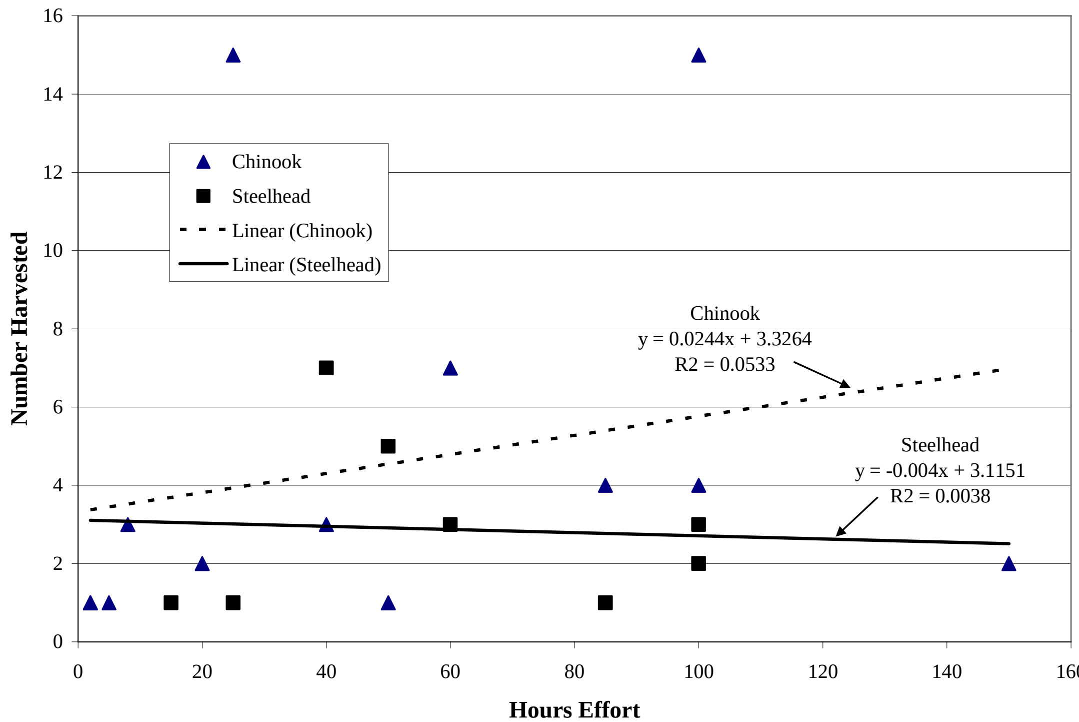


Figure 73. Hours of effort vs. number of fish harvested for summer steelhead and spring Chinook based on field creel interviews.

4.3.2 Post Season Interviews

4.3.2.1 2003 Post Season Interviews

As outlined in the 2003 statement of work, CTUIR did not conduct creel surveys to estimate summer steelhead harvest. However post season interviews did provide some assessment for the annual harvest of summer steelhead, bull trout, rainbow trout, mountain whitefish, lamprey, spring Chinook salmon, fall Chinook salmon and coho salmon (Table 24). During the interviews we contacted 95 anglers of which 28 reported catching 126 adult spring Chinook from the Umatilla River (Table 25). Expanded Tribal harvest estimates for spring Chinook salmon derived from postseason interviews was 234 from the Umatilla River, 2003. Steelhead, coho and fall Chinook harvest estimates relied solely on the postseason interviews.

Table 24. Summary of postseason interviews of the Tribal fisherman in 2003.

Number of Fisherman	Tribal Fisherman Non-Columbia River	Percent
179	Fisherman Listed	100
84	not contacted	46.9
95	contacted	53.1
Of the 95 Fisherman Contacted		
28	reported fishing *	29.5
67	reported not fishing**	70.5
7	fished two basins	7.4
1	fished in three basins	1.1
23	reported catch	82.1
2	reported catch in two basins	7.1
5	reported no catch	17.9
22	caught CHS	78.6
8	caught STS	28.6
3	caught RBT	10.7
2	caught Bull	7.1
2	caught MTW	7.1

* in target basins (Granite, Imnaha, John Day, Lookingglass, Umatilla, Walla Walla)
** or fishing in non-monitored areas (Columbia et al.)

Post season surveys were not randomly derived because a complete list of Tribal members was not available for a random or stratified random draw from the contact list. Instead, contacts were made from a list of known Tribal fisherman compiled from a number of years of creel surveys. Given these constraints, the harvest estimate may be influenced by the violation of three assumptions: 1) the list of Tribal fisherman was representative; 2) harvest was equal between fisherman interviewed and fisherman not interviewed, and 3) tribal fisherman reported actual harvest accurately even though they were interviewed one to nine months after the fishery. The first two assumptions were probably not met but there is no measure of the degree of violation from which to apply expansion factors. The second assumption is likely not true because local fisherman have greater opportunity for both fishing and being contacted in contrast to fisherman living outside of the area. The third assumption was probably not met even though salmon and steelhead are larger, and more likely to be remembered than trout.

Table 25. Summary of reported and expanded catch derived from postseason interviews of Tribal fisherman, 2003.

Reported Catch Location	Spring Chinook	Fall Chinook	Coho	Steelhead	Rainbow Trout	Bull Trout	Mountain Whitefish	Lamprey
Granite	1							
Imnaha	1							
John Day	0							
Lookingglass	0							
Umatilla	124			57	38	24	3	
Walla Walla	0							
Fisherman n	22	0	0	8	5	2	2	0
Total	126	0	0	57	38	24	3	0
Expansions (of known fishermen only)								
Granite	2							
Imnaha	2							
John Day	0							
Lookingglass	0							
Umatilla	234	0	0	107	72	45	6	0
Walla Walla	0							
Total Catch	237	0	0	107	72	45	6	0

Table 26. Allocation of effort by fishing areas reported during the 2003 postseason phone interviews.

Number of Fisherman	Fishing Location (non-Columbia River)	Percent
2	Granite	5.4
2	Imnaha	5.4
3	John Day	8.1
2	Lookingglass	5.4
27	Umatilla	73.0
1	Walla Walla	2.7
37	Total	100.0

4.3.2.2 2004 Post Season Interviews

Post season interviews were conducted from December 10, 2004 to March 10, 2005. We successfully interviewed 146 (73%) persons from a list of 202 traditional Tribal anglers. Eighty-two (56%) individuals reported angling in one or more basins (Table 27) and 94 reported successful harvest of salmonid species (Table 4). Most (57%) interviews were conducted in person and (43%) were contacted via telephone. Also, we were unable to contact a portion of Tribal fisherman, of which, several were avid anglers.

Table 27. Summary of postseason interviews of Tribal fisherman, 2004.

Number	Tribal Fisherman	Percent
202	Quanity on Contact List	100
56	Not Contacted	27.3
146	Contacted	72.7
64	Did not fish	31.7
82	Fished	40.6
24	Fished Multiple Basins	11.9
58	Fished Umatilla Basin only	28.7
45	Caught CHS	22.3
23	Caught STS	11.4
15	Caught MWF	7.4
11	Caught BT	5.4
0	Caught Lamprey	0

Table 28. Summary of reported catch based on postseason phone interviews of Tribal fisherman.

Location	Umatilla	John Day	Grande Ronde	Walla Walla	Total
Number of Trips	858	41	36	10	945
Number of Hours	3412	338	206	80	4036
Spring Chinook Catch	251	31	14	0	296
Fall Chinook Catch	12	2	0	0	14
Coho Catch	10	1	0	0	11
Summer Steelhead Catch	75	0	23	2	100
Rainbow Trout Catch	704	24	6	0	734
Bull Trout Catch	62	2	8	2	74
Mountain Whitefish Catch	68	0	0	0	68
Lamprey Catch	0	0	0	0	0

The total hours angling effort for all basins was 964 trips for a total of 4086 hours. Anglers averaged 46 hours of annual effort and 4.2 hours per trip. Most (48%) fisherman fished by rod and reel, 26% gaff, 24% combined both rod and reel and gaffing techniques and 2% used dip-netting as a tertiary method. The tribal harvest estimates for all basins combined were as follows; 292 spring Chinook salmon, 100 steelhead, 14 fall Chinook and 11 coho. In addition, 734 rainbow trout, 74 bull trout and 68 whitefish were also reported as catch but most were released.

The Umatilla Basin was the primary fishing area for CTUIR members. Anglers made 877 trips totaling 3462 hours and reported the following harvest; 253 spring Chinook salmon, 74 steelhead, 22 fall Chinook and 10 coho. An additional 112 spring Chinook, 19 steelhead, 8 fall Chinook and 4 coho were reported as catch and release. These fish were not included in the harvest estimate. Delayed mortality may be significant due to the capture stress and marginal water quality, but to what degree is unknown. In addition, 704 rainbow trout, 62 bull trout and 68 whitefish were also reported as catch but most were released (
Table 28). The harvest and catch values obtained from postseason interviews were unexpanded and considered conservative.

The John Day basin was the secondary fishing location for CTUIR members based on effort. Anglers reported spending 338 hours during 41 trips. Harvest totals reported were; 31 spring Chinook salmon, 2 fall Chinook and 1 coho. In addition, 24 rainbow trout, and 2 bull trout were reported as catch but most were released. The Grande Ronde Basin was the third most popular fishing destination as Tribal anglers spent 206 hours during 36 trips. Harvest totals reported were; 23 steelhead and 14 spring Chinook salmon. Anglers also reported catching 8 bull trout and 6 rainbow trout, most were released. The Walla Walla Basin received very little fishing pressure from CTUIR members. One Tribal angler reported fishing ten times for 80 hours. The angler reported harvesting two adult steelhead and releasing two bull trout. Based on the postseason interviews spring Chinook harvest was positively related to angler effort (Figure 74). As with the data derived from field creel interviews, the relationship was flat for summer steelhead.

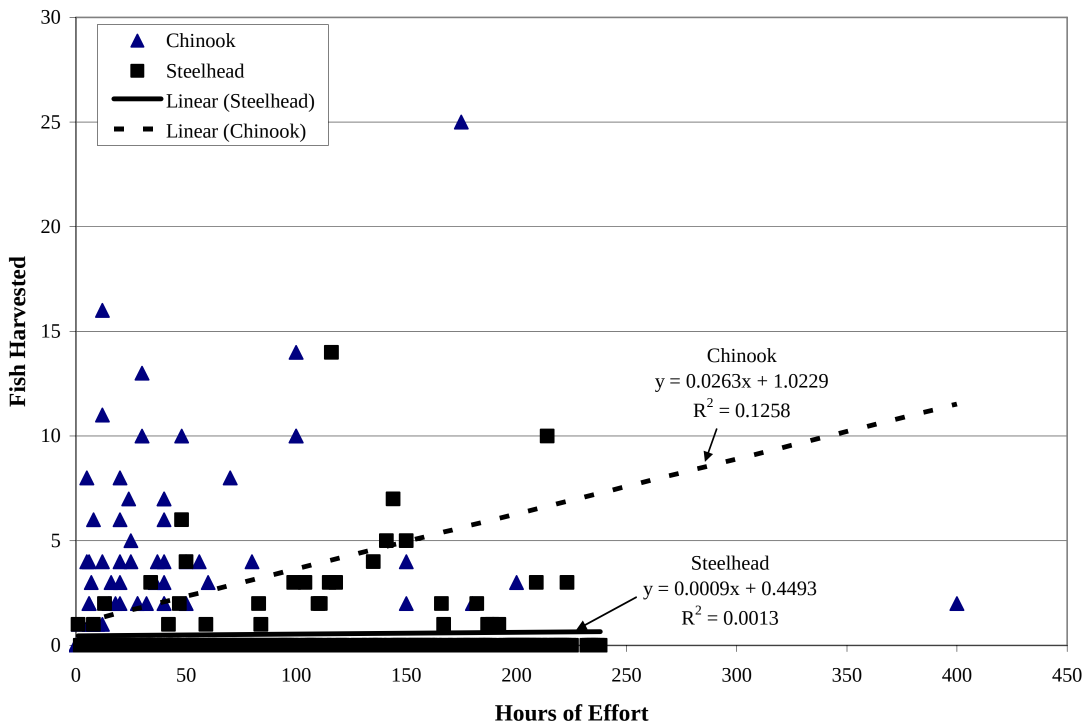


Figure 74. Relationship between effort and harvest by Tribal fisherman based on 2004 postseason phone interviews.

4.3.3 Recommendations

4.3.3.1 2003 Harvest Monitoring Recommendations

To better evaluate harvest benefits of the Umatilla Salmonid Restoration Project and estimate remaining adults available to spawn, CTUIR M&E staff recommends improving and expanding efforts. During 2003, there was no field coverage of the entire steelhead fishery or the early portion of the spring Chinook salmon fishery. While harvest estimates were made for 2003, they are considered inadequate and do not include standardized measures of variance and variability. The spring Chinook salmon harvest monitoring plan included a staff biologist to work with the technicians in the field to estimate harvest on a weekly basis so fisheries managers could optimize harvest opportunity without exceeding harvest quotas. During 2003, a supervising biologist was not available, so it was not possible to keep abreast of the harvest and provide expanded weekly harvest estimates. Interest in salmon fishing in the Umatilla River waned during the last four weeks of the season and total harvest did not approach the quota. Fishing effort and interest have not been consistent from year to year, and over- or under-harvest could be a possibility in the future if appropriate staff and equipment are not available to provide timely updates to managers.

4.3.3.2 2004 Harvest Monitoring Recommendations

The 2004 creel monitoring effort was improved somewhat based on the 2003 staff recommendations. Greater coverage of the Chinook fishery was achieved, and most of the effort was overseen by a project biologist. It was not possible in 2004 to provide real-time expansions of the harvest.

To improve the accuracy of our Tribal harvest data further the project will need to institute a number of changes to our standard operational procedure for the upcoming 2005 creel season. The survey equipment will be updated with Data Plus DOS version 1.83. Harvest monitoring estimates will be improved by conducting more thorough interviews. Increased attention will be devoted to clearly differentiating between fish caught and released and fish harvested. Angler effort will be recorded to the nearest tenth of an hour to improve the accuracy of several calculations.

Staffing requirements will be changed by adding another part time technician and reducing the field role of the biologist. Data proofing and downloading will be done upon the completion of each survey day. This practice reduces the need for the surveyor to make hand written backups, which will be discontinued. We will also develop increased capacity to produce and deliver up to date harvest estimates throughout the season by developing a relational database that can make these expansions on the fly. This system will allow updated estimates to be reported to management frequently and will provide data trends to facilitate educated adaptive management decisions. The knowledge gained form the reports will be most valuable towards optimizing Tribal harvest opportunities without exceeding harvest quotas.

We will intensify our steelhead monitoring by reinstituting field surveys and continuing with postseason efforts. Post season interviews will be carried out closer to the end of the fishing season to improve data accuracy. The interviews will be more precise towards clear differentiation between harvest and catch. The CTUIR will also mail out a salmonid harvest survey form to every enrolled member of CTUIR. This effort will consist of several thousand mailings which will improve our angler contact success. Included in the mailing will be educational information and a postage-paid return envelope, to promote response. This exercise will also update and expand our interviews to additional traditional Tribal anglers.

Investigation of delayed mortality rates for salmonids that were injured by gaffing or other fishing methods should be considered. This knowledge would enable managers to make educated decisions on whether or not to count a portion of the released fish against the harvest quota due to delayed mortality considerations. Closure of Meacham Creek to salmon fishing is recommended due to low numbers of adult returns and the unfavorable conditions that make adult salmon vulnerable in this shallow tributary.

Tribal and non-Tribal harvest has been, in general, increasing since the reintroduction of spring Chinook to the Umatilla River (Table 29). The Tribal harvest monitoring objective is focused on documenting the presentation of harvest opportunities to Tribal members, and the successful exercise of those opportunities in terms of actual upriver catch. To that effect the harvest monitoring objective appears to have been and continues to be achieved. As spring Chinook stock continues to increase the documentation of harvest success will become increasingly difficult statistically because the annual change in the amount of harvest will, by definition, represent a smaller fraction of the total harvest through time. It is imperative that harvest monitoring methods, technologies, and level of effort continue to be revised to keep pace with the changing landscape. To date it appears that these challenges have been overcome.

Table 29. Umatilla River spring Chinook salmon harvest 1988-2004.

Run Year	Run Size[1/]	Non-Indian Harvest[2/]			Indian Harvest	
		Number	% of Run	Below 3MD	Number	% of Run
1988	13	------------------No Fishery------------------				
1989	164	------------------No Fishery------------------				
1990	2,190	20	0.9%	----	No Surveys	
1991	1,330	23	1.7%	----	82	6.2%
1992	464	------------------No Fishery------------------				
1993	1,221	18	1.5%	----	176	14.4%
1994	271	------------------No Fishery------------------				
1995	470	------------------No Fishery------------------				
1996	2,273	206	9.1%	----	167	7.3%
1997	2,196	31	1.4%	----	187	8.5%
1998	429	------------------No Fishery------------------				
1999	1,974	4	0.2%	----	110	5.6%
2000[3/]	4,777	584	12.3%	75.6%	695	14.5%
2001[3/]	5,028	543	10.8%	85.2%	247	4.9%
2002[3/]	5,882	749	12.8%	85.2%	245	4.2%
2003[3/]	4,424	688	15.6%	84.0%	160	3.6%
2004	3,535	299	8.4%	93.9%	460	15.5%

1/ Run size number is adults and jacks returning to mouth (TMFD counts plus below TMFD harvest estimates.)
2/ Below 3MD refers to percent of total Non-Indian harvest that occurred below Threemile Dam.
3/ NOTE: During last four "big run" years (2000-2003), average percent of run harvested per year has been Non-Indian at 12.9% and Indian at 6.8%. This is due in part to previous lower harvest buy Non-

Indian fishers, and the subsequent opening of a lower river fishery.

4.4 Coordination and Planning

The 2003-2004 contract period included a variety of coordination and planning activities. To begin with, the Umatilla Management, Monitoring, and Evaluation Committee (UMMEOC) reinstated monthly meetings. These meetings facilitate communication and collaboration among the co-management entities including CTUIR, ODFW, BOR, BLM, USFWS, NMFS, and BPA. Throughout the two year period a number of pressing management and monitoring activities were planned, discussed, implemented, and reported upon. This increased level of communication appears to have brought in a new phase of increased collaboration in the system.

CTUIR personnel played a pivotal role in the development of the Umatilla Subbasin Plan (SBP). Biologists populated the Ecosystem Diagnosis and Treatment (EDT) model used to produce the quantitative assessment and aquatic management plan sections of the SBP. The project leader and M&E supervisor coordinated the review, data preparation, writing, and presentation components of the plan. The final product was noted as one of the regions most holistic, comprehensive, and forward thinking SBP's, and has been used in a variety of planning actions since its publication.

In addition CTUIR staff participated in small-scale review, comment, and contribution to a number of plans, proposed actions, and Biological Opinions. UBNPMEP staff continued to work in the community as lead biologists, and coordinated communication and collaboration among a number of federal, state, county, and academic institutions. UBNPMEP continue to work with the federal authorities on bull trout recovery (www.pacific.fws/bulltrout), and have begun to participate in salmon recovery (www.salmonrecovery.gov). Finally, UBNPMEP worked closely with ODFW staff to develop and submit for a review a comprehensive RM&E plan for Umatilla steelhead and Chinook. While ISRP did request some edits to that document, the reviews were overwhelmingly positive. That comprehensive document will be edited and re-submitted during the 2005 contract period, resulting in a finalized ten to fifteen year guiding document for Umatilla Basin RM&E, including those activities that are associated with the impending Phase III flow restoration activities.

5 Future Work

In general UBNPMEP staff must begin to work more closely with ODFW, USFWS, NMFS, and BOR to develop RM&E proposals in the context of Provincial and ESU-focused monitoring and evaluation plans. To date activities have been focused more exclusively at the subbasin level of aggregation. This perspective, while interesting, satisfies neither the federal data requirements, nor the action/project-level information needs. In the context of the comprehensive RM&E plan, and the 2007 funding cycle, staff will work towards the development of a hierarchical M&E project that addresses information needs a the reach, watershed, subbasin, and province levels of aggregation. We will finalize the standardization of research methodologies, and complete draft relational databases for all biological metrics to facilitate data management, analysis, evaluation, and dissemination locally and regionally.

UBNPMEP Objectives and Tasks do not currently include the sampling or handling of juvenile fish. It is imperative that juvenile fish surveys be reinstated in the Umatilla to satisfy the long-term M&E requirements stated clearly by BPA, NMFS, USFWS, and ODFW. Currently it is impossible to determine the status and trend of parr or pre-smolts, to evaluate the effectiveness of habitat actions on juvenile fish abundance, or to participate in salvage activities. The 2007 funding request will consist of a re-organization of RM&E activities including comprehensive regionally-coordinated juvenile fish sampling/handling/salvage objective and tasks. Outmigrant estimates of naturally reared Umatilla steelhead and Chinook have proven difficult to obtain by ODFW. This important metric completes the smolt-adult-redd life-cycle model that is the backbone of tributary salmon analysis and evaluation.

Headwater tagging is an effective method for increasing the power of outmigrant monitoring activities, and should be pursued beginning 2007. Efforts to expand these actions are discussed in the comprehensive RM&E plan along with a number of improved and expanded M&E activities.

6 Acknowledgements

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7 Literature Cited

Beschta, R.L. & R.L. Taylor. 1988. Stream temperature increases and land use in a forested Oregon watershed. Water Resources Bulletin 24: 19-25.

Black, E.C. 1953. Upper lethal temperatures of some British Columbia freshwater fishes. Journal of the Fisheries Research Board of Canada 10: 196-210.

BOR. 1988. Umatilla Basin Project, Oregon. *In:* D.o.I. Pacific Northwest Region. Bureau of Reclamation (ed.), Boise, Idaho.

Bret, J.R. 1952. Temperature tolerance in young pacific salmon, genus Oncorhynchus. Journal of the Fisheries Research Board of Canada 9: 265-323.

Brown, G.W. & J.T. Krygier. 1970. Effects of clearcutting on stream temperature. Water Resources Research 6: 1133-1140.

Childs, A. 1999. CTUIR Grande Ronde River Basin Watershed Restoration Program: McCoy Creek/McIntyre Creek Road Crossing. pp. Report submitted to BPA, Project Number 199609300. 33 pages., Confederated Tribes of the Umatilla Indian Reservation, Department of Natural Resources, Pendleton, Oregon.

Contor, C.R. 2003. Umatilla Basin Natural Production Monitoring and Evaluation Project. pp. 289, Confederated Tribes of the Umatilla Indian Reservation.

Contor, C.R., E. Hoverson & P. Kissner. 1995. Umatilla Basin Natural Production Monitoring and Evaluation. pp. 127, Confederated Tribes of the Umatilla Indian Reservation, Pendleton, Oregon.

Contor, C.R., E. Hoverson & P. Kissner. 1998. Umatilla Basin Natural Production Monitoring and Evaluation. pp. 83, Confederated Tribes of the Umatilla Indian Reservation, Pendleton, Oregon.

Contor, C.R., E. Hoverson, P. Kissner & J. Volkman. 1996. Umatilla Basin Natural Production Monitoring and Evaluation. pp. 153, Confederated Tribes of the Umatilla Indian Reservation, Pendleton, Oregon.

Contor, C.R., E. Hoverson, P. Kissner & J. Volkman. 1997. Umatilla Basin Natural Production Monitoring and Evaluation. pp. 93, Confederated Tribes of the Umatilla Indian Reservation, Pendleton, Oregon.

Contor, C.R. & P. Kissner. 2000. Umatilla Basin Natural Production Monitoring and Evaluation. pp. 65, Confederated Tribes of the Umatilla Indian Reservation, Pendleton, Oregon.

CRITFC. 1996. Wy-Kan-Ush-Mi Wa-Kish-Wit - Spirit of the Salmon Subbasin Plans, Portland, Oregon. 114 pp.

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

CTUIR & ODFW. 2001. Umatilla Subbasin Summary, Northwest Power Planning Council. www.nppc.org.

CTUIR & ODFW. 2004. Umatilla Subbasin Plan, Northwest Power Planning Council. www.nppc.org.

Currens, K.P. & C.B. Schreck. 1995. Final Report. genetic analysis of Umatilla River rainbow trout., Oregon Cooperative Fishery Research Unit, Department of Fisheries and Wildlife, Oregon State University,, Corvallis, Oregon 97331-3803.

Fraser, B.C. & D.D. Williams. 1998. Seasonal boundary dynamics of a groundwater/surface-water ecotone. Ecology 79: 2019-2031.

Hayashi, M. & D.O. Rosenberry. 2002. Effects of ground water exchange on the hydrology and ecology of surface water. Ground Water 40: 309-316.

Hicks, B.J., J.D. Hall, P.A. Bisson & J.R. Sedell. 1991. Responses of Salmonids to Habitat Changes. American Fisheries Society, 5410 Grosvenor Ln. Ste. 110 Bethesda MD 20814-2199.

Hostetler, S.W. 1991. Analysis and modeling of long-term stream temperatures on the Steamboat Creek Basin, Oregon: Implications for land use and fish habitat. Water Resources Bulletin 27: 637-648.

Kasahara, T. & S.M. Wondzell. 2003. Geomorphic controls on hyporheic exchange flow in mountain streams. Water Resources Research 39: 1-14.

Kissner, P. 2003. Chapter 4, Adult Returns, Spawning and Life History Characteristics. *In:* C. Contor (ed.) Umatilla Basin Natural Production Monitoring and Evaluation Project Progress Report, 1999-2002, Confederated Tribes of the Umatilla Indian Reservation, Report submitted to Bonneville Power Administration, Project NO. 1990-005-01.

Malvestuto, S.P. 1996. Sampling the Recreational Creel. pp. 591-623. *In:* B.R. Murphy & D.W. Willis (ed.) Fisheries Techniques, American Fisheries Society, Bethesda, Maryland.

Mertes, L.A.K. 1997. Documentation of significance of the perirheic zone on inundated floodplains. Water Resources Research 33: 1749-1762.

Narum, S.R., C. Contor, A. Talbot & M.S. Powell. 2004. Genetic divergence of sympatric resident and anadromous forms of Oncorhynchus mykiss in the Walla Walla River and Columbia River Basin, USA. Journal of Fish Biology 65: 471-488.

NPPC. 1994. Columbia River Basin Fish and Wildlife Program. pp. 246.

NPPC. 2004. Draft Research, Monitoring, and Evaluation Plan. pp. 74.

ODFW and CTUIR. 2004. Umatilla Basin Annual Operation Plan, Pendleton, Oregon.

Saul, D., C. Rabe, A. Davidson & D. Rollins. 2001. Umatilla and Willow Creek Subbasin Summary. pp. 361. *In:* Ecopacific (ed.) Prepared for the Northwest Power Planning Council.

Schwartz, J.D.M. & W. Cameron. Under Revision. Comprehensive Research, Monitoring, and Evaluation Plan for Umatilla Steelhead and Chinook. pp. 187 Prepared for the Bonneville Power Administration, Confederated Tribes of the Umatilla Indian Reservation and the Oregon Department of Fish and Wildlife., Pendleton, Oregon.

Shaw, R.T. & A. Sexton. 2003. Umatilla River Basin Anadromous Fish Habitat Enhancement Projects, 2001 Annual Progress Report Report submitted to Bonneville Power Administration, Project Number 1987-100-01. 45 pp.

Swindell, E. 1941. Historic fishing sites of the Columbia River Basin Tribes.

Walker, G.W. & N.S. MacLeod. 1991. Geologic Map of Oregon. *In:* U.S.D.o.t.I. U.S. Geological Survey (ed.), U.S. Geological Survey Map Distribution, Box 25286, Federal Center, Denver, CO 80225.