Walla Walla River Basin Natural Production Monitoring and Evaluation Project

Summary Report
1999 - 2002

DOE/BP-00013171-1

June 2003

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THE WALLA WALLA BASIN NATURAL PRODUCTION MONITORING AND EVALUATION PROJECT

PROGRESS REPORT
1999-2002

Edited By:

Craig R. Contor

And

Amy Sexton

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

P.O. Box 638
Pendleton, Oregon 97801

Contract Period
September 30, 1998 to December 31, 2002
Project Number 2000-039-00

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U.S. Department of Energy
Bonneville Power Administration
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May 2003

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THE WALLA WALLA BASIN NATURAL PRODUCTION MONITORING AND EVALUATION PROJECT

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INTRODUCTION

The Walla Walla Basin Natural Production Monitoring and Evaluation Project (WWNPME) was funded by Bonneville Power Administration (BPA) as directed by section 4(h) of the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (P. L. 96-501). This project is in accordance with and pursuant to measures 4.2A, 4.3C.1, 7.1A.2, 7.1C.3, 7.1C.4 and 7.1D.2 of the Northwest Power Planning Council's (NPPC) Columbia River Basin Fish and Wildlife Program (NPPC 1994). Work was conducted by the Fisheries Program of the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) under the Walla Walla Basin Natural Production Monitoring and Evaluation Project (WWNPME). Chapter One provides an overview of the entire report and how the objectives of each statement of work from 1999, 2000, 2001, and 2002 contract years are organized and reported. Chapter One also provides background information relevant to the aquatic resources of the Walla Walla River Basin. (Figure 1-1, Tables 1-1 and 1-2). Data and reports from this and previous efforts will be available at http://198.66.210.119/database (summer of 2003). In the future, all data will be available through http://www.umatilla.nsn.us (CTUIR website).

STATEMENTS OF WORK, OBJECTIVES AND ASSOCIATED CHAPTERS

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

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

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

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

Objective C, Chapter 2. Determine age and growth characteristics of natural anadromous salmonids in the Walla Walla River Basin.
1999 Objective 6
2000, 2001 and 2002, Objective 4

Objective D, Chapter 3. Determine natural spawning success, spawning habitat utilization, prespawning mortality, and redds per adult spring Chinook salmon released as adults into Mill Creek and the S.F. Walla Walla River. Conduct preliminary steelhead spawning surveys in Couse Creek and the Upper Walla Walla River.
2000 Objective 3
2001 and 2002, Objective 1

Objective E, Chapter 4. Monitor stream temperatures in coordination with other projects in the Walla Walla River Basin.
1999 Objective 5
2000 and 2001, Objective 3

Objective F. Chapter 5. Collect baseline genetic data from Walla Walla River endemic summer steelhead.
1999 Objective 7
2000 Objective 5

Objective G, Chapter 6. Monitor Adult steelhead and bull trout movements past potential migration impediments and throughout the Walla Walla River Basin with radio telemetry techniques and equipment. Work in cooperation with Oregon Department of Fish and Wildlife (ODFW), Washington Department of Fish and Wildlife (WDFW), the irrigation districts, and the Walla Walla Watershed Council (WWWC).
2001 Objective 7
2002 Objective 5

Objective H, Chapter 7. Coordinate with other agencies and comply with the required administrative processes, reports, applications, proposals and coordination for watershed assessments, master plans, sub-basin plans, Total Maximum Daily Load (TMDL) allocation process, Walla Walla Technical Working Groupt (TWG), Endangered Species Act (ESA) and Walla Walla Fisheries Annual Operations Plan (AOP).
2001 and 2002, Objective 6

Objective I. Chapter 8. Develop a Research, Monitoring and Evaluation Plan for fisheries of the Walla Walla River Basin.
2002 Objective 7

Objective J. Summarize and report data and findings and post data and reports on a website.
2002 Objective 8

GENERAL INFORMATION AND BACKGROUND

Geographic and Vegetative Features
The Walla Walla River originates on the slopes of the Blue Mountains, south and east of Walla Walla, Washington (Figure 1-1, Tables 1-1 and 1-2). The river flows 79 miles in a westerly direction to the Columbia River at RM 315 (hydrologic unit number is 17070102; U. S. Geological Survey , USGS 1989). The Basin is located in northeast Oregon and southeast Washington and has a drainage area of 1,758 square miles. The headwaters on the east side of the basin begin at approximately 6,000 feet (above mean sea level) where precipitation is as much as 65 inches/year (Taylor 1993). The Blue Mountains are dominated by white fir, mixed conifers and shrub under-stories. Grass, shrubs and forbs cover the dryer hill sides. The mountains were created by lifting, faulting and folding of volcanic, sedimentary and metamorphic rock. Multiple layers of middle Miocene basalt flows dominate the parent geologic material of the basin. The rivers and streams have cut steep sided canyons into the layers of rock that form the higher elevations of the Blue Mountains.

The geographic and vegetative features of the basin gradually change from the wetter mountains in the east to the dry farms and range-lands in the west. The range lands in the west are dryer (15 inches/year) and are dominated by bunchgrasses, wild rye and sagebrush. The lower river, west of Walla Walla, has cut a low valley into a broad upland plain called the Deschutes-Umatilla Plateau. The mouth of the Walla Walla River at Wallula Junction is at approximately 340 feet (above mean sea level).

Table 1-1 Approximate river miles (from USGS maps) of land marks and the mouths of streams on the mainstem of the Walla Walla River.

Site	USGS 7.5 Quad.	Stream	Mile
Old Rail Road Bridge	Zanger Junct.	Walla Walla	8
U of I Telemetry Station	Zanger Junct.	Walla Walla	12
9-Mile Ranch	Zanger Junct.	Walla Walla	12
Byrnes Road	Zanger Junct.	Walla Walla	13 - 14
Bridge 399	Zanger Junct.	Walla Walla	15
Wind Mills	Zanger Junct.	Walla Walla	16
Big Bend	Touchet	Walla Walla	17
USGS gauge / Sheep Ranch	Touchet	Walla Walla	18
Touchet Cemetery	Touchet	Walla Walla	20
Confluence Touchet	Touchet	Walla Walla	21
Touchet Bridge	Touchet	Walla Walla	22
Pine Creek	Touchet	Walla Walla	23
Bob W. boat ramp	Touchet	Walla Walla	24
Last Chance Hole	Touchet	Walla Walla	24
Borgens Hole	Touchet	Walla Walla	24
Big Eddy Hole	Touchet	Walla Walla	25
Confluence Dry Creek	Lowden	Walla Walla	26
House Hole	Lowden	Walla Walla	26
Lowden Road	Lowden	Walla Walla	27
Ready-Mix Hole	Lowden	Walla Walla	27
Confluence Dry Creek	Lowden	Walla Walla	27
Macdonald Road	Lowden	Walla Walla	29
Detour Road	College Pl.	Walla Walla	32
Confluence Mill Creek	College Pl.	Walla Walla	33
Swegal Road	College Pl.	Walla Walla	34
Last Chance Road	College Pl.	Walla Walla	35
Burlingame Dam	College Pl.	Walla Walla	36
Confluence Yellowhawk Cr.	College Pl.	Walla Walla	38
Old M-F Hwy	College Pl.	Walla Walla	38
Hwy 11 / 125	College Pl.	Walla Walla	38
Pepper's Bridge	College Pl.	Walla Walla	39
Stateline Road	College Pl.	Walla Walla	40
Tumalum Road	M-F	Walla Walla	40 - 42
Gravel pit / Drive-in	M-F	Walla Walla	43
Nursery Bridge Dam	M-F	Walla Walla	44
Cemetery Bridge	M-F	Walla Walla	45
15th Street	Bolus Hill	Walla Walla	46
Couse Creek	Bolus Hill	Walla Walla	46
Lampsom's	Bolus Hill	Walla Walla	47
Joe West Bridge	Bolus Hill	Walla Walla	48
Lincton Mt. / Cache Hollow	Bolus Hill	Walla Walla	48

Table 1-2. Approximate river miles (from USGS maps) of land marks and the mouths of streams on the mainstem of the S. F. Walla Walla River.

Site	USGS 7.5 Quad.	Stream	Mile
South Fork Telemetry Site	Bolus Hill	South Fork	0.1
Steel Bridge	Blalock Mnt.	South Fork	2
CTUIR Hatchery	Blalock Mnt.	South Fork	4
Cosper's	Blalock Mnt.	South Fork	6
Harris Park	Blalock Mnt.	South Fork	7
Elbow Creek	Blalock Mnt.	South Fork	9
Demaris Cabin	Blalock Mnt.	South Fork	11
Bear Creek	Tollgate	South Fork	12
Burnt Cabin Creek	Tollgate	South Fork	13
Swede Canyon	Tollgate	South Fork	14
Table Creek	Tollgate	South Fork	15
Skiphorton Creek	Tollgate	South Fork	17
Box Canyon Bridge	Tollgate	South Fork	18
Red Rocks	Jubilee Lake	South Fork	19
Reser Creek	Jubilee Lake	South Fork	20

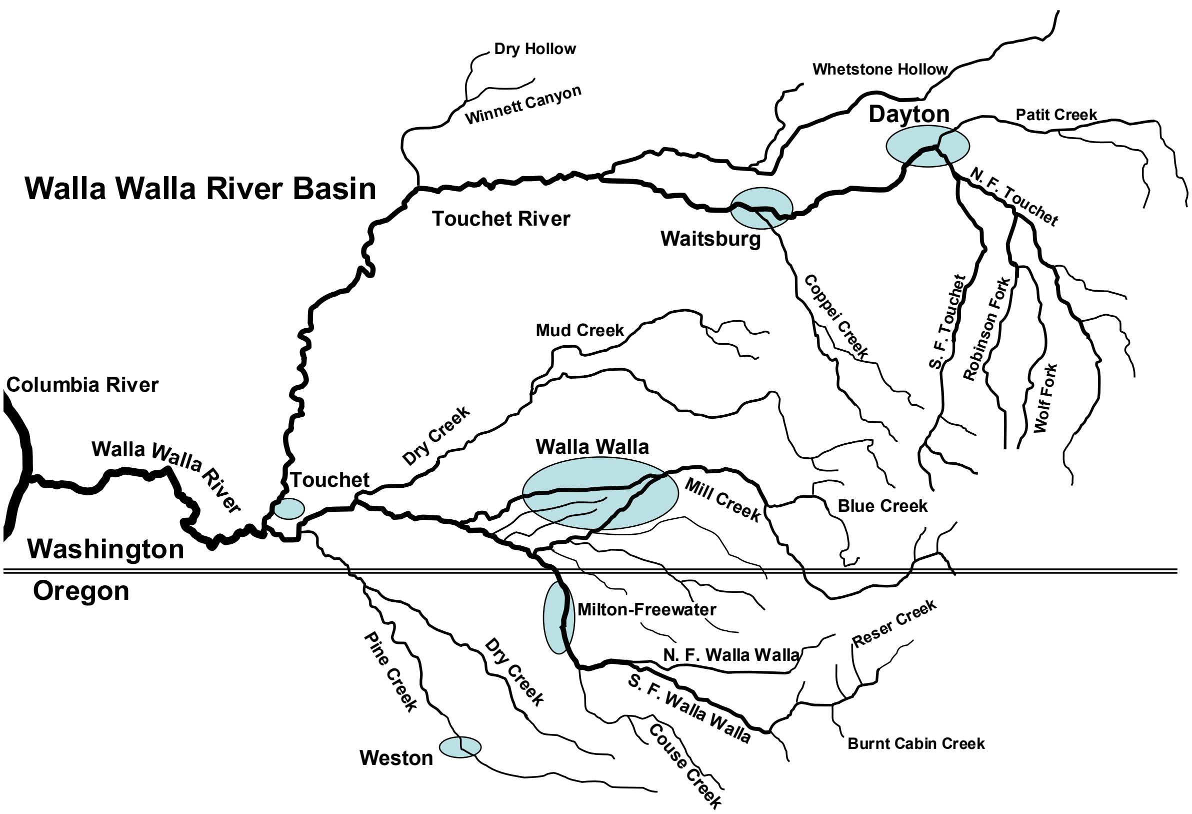

Figure 1-1 Walla Walla River Basin

Historical Background

The current conditions of the watershed reflect the land-use practices that have occurred in the basin throughout its history, (United States Department of Agriculture,USDA 1941). The earliest known inhabitants include three Native American Tribes: the Cayuse, Walla Walla, and Umatilla. The Tribes ceded the land to the United States in the treaty of 1855. The Corps of Discovery, led by Lewis and Clark, came into the valley in 1805. While camped near the mouth of the Touchet River they wrote: "*The hills of this creek are generally abrupt and rocky, but the narrow bottom is very fertile, and both possess 20 times as much timber as the Columbia itself; indeed, we now find, for the first time since leaving Rock fort (the Dalles), an abundance of firewood. The growth consists of cottonwood, birch, crimson haw, red and sweet willow, choke-cherry, yellow currants, gooseberry, the sumac, together with some corn-grass and rushes.*"

The large influx of Euro-Americans to the basin began in the mid-1800's. At that time, timber and brush mixed with grass and forbs were found in the Blue Mountains, bunch grasses in the middle portions of the watershed, and wild rye and sagebrush in the valleys (U.S. Dept of Agriculture, 1941). In 1839, an early explorer near Whitman Mission on the Walla Walla River wrote "*The plain about the waters of this river is about thirty miles square. A great part of this surface is more or less covered with bunch grass*" (Farnham 1839). In 1858, Charles Dickerson, the son of an early settler on Pine Creek (near the city of Milton Freewater, OR), remembered the raw farm land of his childhood as being fertile but covered thickly with clumps of tall rye grass (Caverhill, 1971). Further downstream, Lewis and Clark in 1806 and David Douglas in 1826, noted the surrounding country as being predominated by sagebrush.

Horses were introduced into the Walla Walla Valley from New Mexico in the 1730's. Native American Indians began to make use of them soon afterward. In the mid-1800's, large numbers of domestic cattle, sheep, and draft horses were introduced to the area (USDA 1941). Ultimately the rangelands were overgrazed which led to wide spread soil loss and the replacement of native plants with more competitive exotic plant species.

The earliest noted agriculture in the valley occurred in about 1825 at Fort Nez Perce, near the mouth of the Walla Walla River (Walt Gary, personal communication). In 1839, at Whitman Mission, wheat, corn, onions, melons, and various other crops were all in cultivation (Farnham 1839). Prior to the establishment of Whitman Mission in 1836, the grass covered hills were thought to be only suited for grazing. However, by 1850, small plots of cultivated lands were situated along the river bottoms including some that were irrigated. In the fall of 1863, a farmer sowed 50 acres of wheat on the upland near Weston and the following summer collected an average of 35 bushels to the acre. From this point forward, land was broken out at an accelerated rate and by the late 1870's, Walla Walla County was considered one of the leaders in cultivated grains (USDA 1941).

As agriculture in the Walla Walla Valley continued to expand, so too did the availability of large machinery capable of manipulating the landscape. Harper et al. (1948) indicates that steam-powered tractors were available in Umatilla County (Oregon) in 1904 and 1905, caterpillar-type gasoline-powered tractors were introduced from 1907 to 1909, and diesel oil-burning caterpillar type tractors could be purchased in 1932. Riparian areas were cleared for farming and grazing, and extensive channel straightening had began in the early 1900s and continues today (Figure 1-2.)

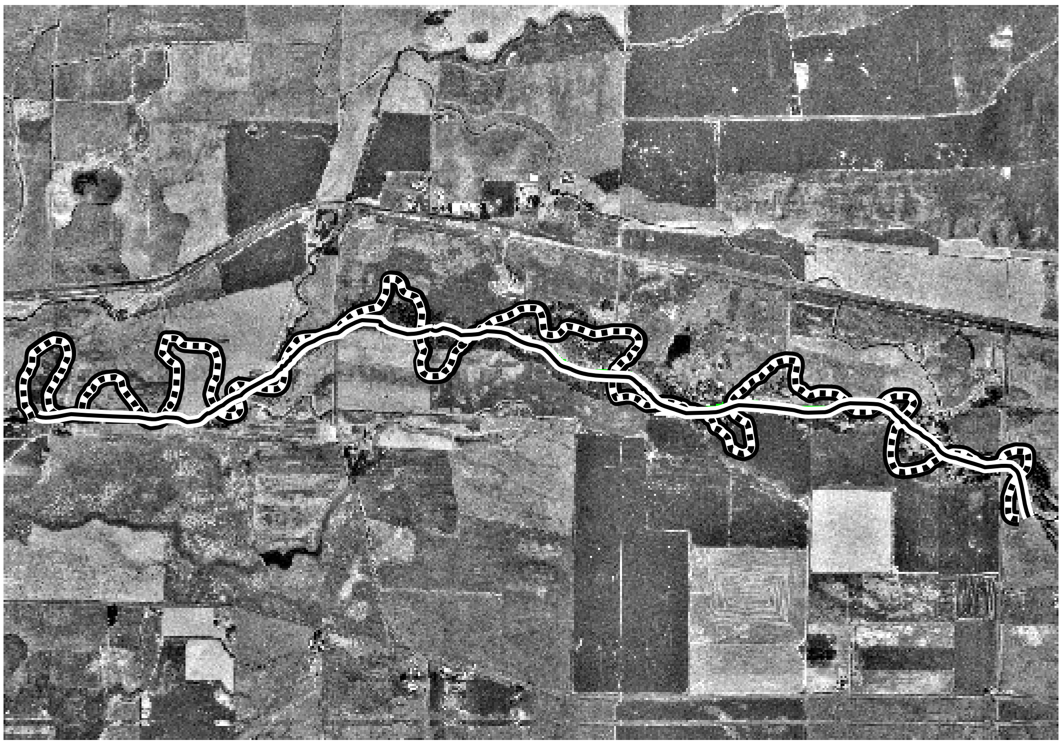

Figure 1-2 Aerial view of Walla Walla River near Lowden Washington depicting stream channel in 1939 (dashed line, 3.8 river miles) and stream channel in 1996 (solid line, only 2.1 river miles).

A scientist named Dice conducted vertebrate studies in the Touchet River Basin from 1904 to 1914 (Kuttel 2000). This information was published in Mudd 1975. Here he wrote: *the animal habitats of southeastern Washington have been greatly altered by the work of man. Farming is extensively carried on in the prairie area and a very large percentage of the land is under cultivation. Irrigation is also practiced in valleys of both prairie and sagebrush areas. All of the land not under direct cultivation has been heavily grazed by cattle and stock. Part of the timber along the streams has been cut down and much of the brush has been cleared away…These changes in the environment have caused great changes in the abundance of the different species of vertebrates* (Dice 1916, cited in Mudd 1975).

Finally, it's important to recognize the impact that over-appropriation of water and inadequate passage conditions has had on the once abundant populations of salmon and steelhead in the Walla Walla River Basin. In 1950, Nielson reported a total of 130 points of irrigation diversion in the basin of which 123 had no protective fish device of any kind. Numerous historical journals report "sacks of smolts" being collected from the cropland fields in the spring outmigration months. Early accounts by local people note that annual returns of spring Chinook salmon reduced dramatically following the construction of nine-mile dam at Reese, Washington in 1905 (Nielsen, 1950, Van Cleve and Ting, 1960). Van Cleve and Ting (1960), while summarizing data for the period of 1935-36, wrote that it would be practically impossible for spring Chinook salmon to ascend the river under the present system of water use.

Fishes of the Walla Walla River Basin
Historical accounts clearly validate the presence of several salmon species in the Walla Walla River that are now extinct. Fall Chinook , chum, coho and sockeye salmon were reported to be present in the basin (Swindell, 1942). Some species such as fall Chinook and chum salmon may have come up from the Columbia River and likely only used the lower portions of the Walla Walla River for spawning. Several historical journals documented healthy populations of spring Chinook salmon in the Touchet River, Mill Creek and the mainstem of the Walla Walla River. The last spring Chinook salmon run of any significance was reported in 1925 (Van Cleave and Ting 1960). In 1955, only 18 spring Chinook salmon were reported in the sport harvest (Oregon Game Commission, 1956 and 1957).

Currently, steelhead, resident redband trout and mountain whitefish are present in the basin in moderate numbers. Spring Chinook salmon have been experimentally reintroduced through adult out-planting. Bull trout persist in the South Fork Walla Walla and in Mill Creek in good numbers. Bull trout are absent or in low abundance in other tributaries such as Couse Creek, the North Fork Walla Walla and other tributaries. The salmonid habitat in the headwaters is in good to excellent condition and could support substantially more anadromous salmonids. Steelhead and bull trout are both listed as threatened under the Federal Endangered Species Act. There are a number of other native and introduced species present in the Walla Walla River Basin (Table 1-3). The records related to the steelhead and rainbow trout stocking are summarized below. Records for stalking exotic species such as smallmouth bass and channel catfish were not researched. Exotic species were either introduced directly into the Walla Walla River during the last 130 years or they colonized the Walla Walla system from introductions elsewhere in the Columbia Basin.

Table 1-3 Fish Observed in the Walla Walla River Basin (Origin codes are: N= Native stock, E=exotic H=hatchery reintroduction with a naturalized sub-population. Location codes are: R= mainstem rivers and T= tributaries. Abundance codes are: A=abundant, C= Common, F=Few, R=Rare and U=Unknown; adapted from James et al. 2001)

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

Stocking History of Hatchery Rainbow Trout and Summer Steelhead

Oregon Trout Stocking History: Tim Bailey (ODFW Fisheries Biologist in Pendleton) provided 13 pages of hatchery stocking data that are summarized in Table 1-4. The rainbow trout planted as catchables (legal size) and/or fingerlings were either "Shasta" which are spring spawners and/or "Cape Cod" stock which are fall spawners (Tim Bailey, ODFW, personal communication). It is possible that other stocks were used as well. There were no records of summer steelhead releases in the Oregon portion of the Walla Walla River Basin. However, the stocking history of the Umatilla included steelhead of Skamania and Idaho stocks in the 1960s (Rowan, 2002). Similar releases may have occurred in the Oregon portion of the Walla Walla Basin.

Table 1-4. Summary of rainbow trout stocking records for the Oregon portion of the Walla Walla River Basin from 1946 through 1993**.**

Location	Years	Numbers/Year	Type
Walla Walla River	1946 and 1950	2,800 and 3,000	Legal
Walla Walla River	1954 -1957	1,000 and 6,300	Legal
Walla Walla River	1962-1980	1,400-12,000	Legal
Walla Walla River	1982-1993	5,000 and 13,300	Legal
N.F. Walla Walla	1945 and 1947	4,700-6,600	Fingerling
N.F. Walla Walla	1951-1953	2,500-2,700	Legal
N.F. Walla Walla	1955-1958	1,000-4,000	Legal
N.F. Walla Walla	1962	1,500	Legal
S.F. Walla Walla	1945-1947	1,000-12,400	Fingerling
S.F. Walla Walla	1948 and 1949	3,400 and 3,200	Legal
S.F. Walla Walla	1951-1964	2,500-12,800	Legal
S.F. Walla Walla	1968 and 1969	9,000 and 2,000	Legal

Washington Fish Stocking History: Releases of hatchery fish into the Walla Walla River Basin began in 1936 and included both anadromous and resident forms of *O. mykiss*. Steelhead stocks of unknown origin were introduced into the Walla Walla River Basin from 1936 to 1938, in1953 and from 1968 to 1980 (Gil Lensegrav, WDFW file data, Olympia Office). Since 1983, Wells-Lyons Ferry summer steelhead have been planted in the Walla Walla River Basin. This stock originated from the Columbia River above Wells and was strongly influenced by Snake River summer steelhead at Lyons Ferry Hatchery. Beginning in 2000, WDFW began releasing Touchet River endemic steelhead on a small scale (Table 1-5). Resident forms of *O. mykiss* were also stocked throughout the basin in streams, lakes and ponds from 1937 to present. Since 2000, only lakes and ponds have been stocked with resident trout. Rainbow trout of unknown origin were released before 1981. Records indicate that since 1981, Spokane-McCloud River strain of rainbow trout was the most frequently stocked trout. However, both Goldendale-McCloud and Mission Creek rainbow were also stocked (Table 1-6).

Table 1-5 Steelhead smolt stocking data in the Walla Walla River Basin from 1989 through 2002. Smolts released into Mill Creek are combined with the Walla Walla releases.

Release Year	**Walla Walla**	**Touchet River**	**Touchet Endemics**	**Total**
1989	127,740	158,466		286,206
1990	162,417	446,345		608,762
1991	228,699	148,520		377,219
1992	75,210	95,517		170,727
1993	83,240	110,999		194,239
1994	181,355	119,624		300,979
1995	158,875	120,710		279,585
1996	170,000	134,610		304,610
1997	170,980	142,824		313,804
1998	175,020	125,127		300,147
1999	176,000	124,651		300,651
2000	165,600	124,564		290,254
2001	103,980	102,765	36,487	243,232
2002	99,859	125,391	45,501	270,751
2003 Planned	125,000	100,000	40,000	265,000

Table 1-6 Rainbow trout stocked into the Walla Walla River Basin from 1933-1997.

Stream	**Subbasin**	**Years**	**Stock**
Dry Creek	Walla Walla	1937-1981	Unknown
Dry Creek	Walla Walla	1982-1997	Spokane-McCloud
Spring Creek	Dry Creek	1948-1958	Unknown
Mud Creek	Dry Creek	1944-1955	Unknown
Fern Creek	Walla Walla	1947	Unknown
Little Walla Walla	Walla Walla	1946-1947	Unknown
Pine Creek	Walla Walla	1946-1947	Unknown
Welch Creek	Walla Walla	1949	Unknown
Wright Spring	Walla Walla	1946	Unknown
Mill Creek	Walla Walla	1933-1981	Unknown
Mill Creek	Walla Walla	1982-1997	Spokane-McCloud,
Mill Creek	Walla Walla	1988, 1990, 1995	Goldendale-McCloud
Mill Creek	Walla Walla	1984-1985	Mission Creek
Blue Creek	Mill Creek	1941-1946	Unknown
Blue Creek	Mill Creek	1976, 1980-1982	Unknown
Blue Creek	Mill Creek	1984-1994	Spokane-McCloud
Garrison Creek	Mill Creek	1937-1949	Unknown
Russell Creek	Mill Creek	1948	Unknown
Stone Creek	Mill Creek	1943-1949	Unknown
Thomas Creek	Mill Creek	1948	Unknown
Titus Creek	Mill Creek	1947-1950, 1953	Unknown
Yellowhawk Creek	Mill Creek	1940-1972	Unknown
Touchet River	Walla Walla	1935-1981	Unknown
Touchet River	Walla Walla	1981-1994	Spokane-McCloud
Touchet River	Walla Walla	1998-2000	Spokane-McCloud
Buttolph Creek	Touchet River	1948	Unknown
Coppei Creek	Touchet River	1938-1981	Unknown
Coppei Creek	Touchet River	1984-1994, 1997	Spokane-McCloud
Patit Creek	Touchet River	1944-1949	Unknown
Whisky Creek	Touchet River	1945	Unknown
N. F. Touchet River	Touchet River	1939-1980	Unknown
Jim Creek	N. F. Touchet	1940, 1945, 1949	Unknown
Lewis Creek	N. F. Touchet	1939-1949	Unknown
S. F. Touchet River	Touchet River	1940-1981	Unknown
Burnt Fork	S. F. Touchet	1949	Unknown
Griffin Fork	S. F. Touchet	1949	Unknown
Wolf Fork	Touchet River	1938-1971	Unknown
Coats Creek	Wolf Fork	1941, 1945	Unknown
Whitney Creek	Wolf Fork	1941, 1947	Unknown

Abbreviations Used in this Report

Abbreviations used in this report are defined the first time they are used in each chapter and listed below to eliminate the need to search for the imbedded definitions.

Table 1-7 Primary abbreviations used in this report in all chapters

ANSI	American National Standards Institute
AOP	Annual Operations Plan
BGD	Burlingame Dam
BLDD	Bennington Lake Diversion Dam
BOR	U.S. Bureau of Reclamation, U.S. Department of Interior
BPA	Bonneville Power Administration
^oC	Centigrade (Temperature)
CRITFC	Columbia River Intertribal Fisheries Commission
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
ESA	Endangered Species Act
FX	Fixed Telemetry Receiver Site
GFID	Gardenia Farms Irrigation District
HBDIC	Hudson Bay District Improvement Company
Hwy	Highway
LWWR	Little Walla Walla River, Cemetery Bridge Diversion
M&E	Monitoring and Evaluation
Mt.	Mountain
NBD	Nursery Bridge Dam
NMFS	National Marine Fisheries Service, U.S. Department of Commerce
NPPC	Northwest Power Planning Council
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
O.	*Oncorhynchus*
OWEB	Oregon Watershed Enhancement Board
PIT	Passive Integrated Transponder
RM	River Mile
RM&E	Research, Monitoring and Evaluation
SOW	Statement of Work
U of I	University of Idaho
US	United States
USACE	Army Corpse of Engineers (
USDA	US Department of Agriculture
USGS	US Geologic Survey
USFS	US Forest Service
USFWS	US Fish and Wildlife Service
TMDL	Total Maximum Daily Load
TWG	Technical Work Group
WDFW	Washington Department of Fish and Wildlife Service
WWBWC	Walla Walla Basin Watershed Council

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CHAPTER TWO: JUVENILE SALMONID MONITORING:

THE WALLA WALLA BASIN NATURAL PRODUCTION MONITORING AND EVALUATION PROJECT

PROGRESS REPORT
1999-2002

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INTRODUCTION

The Walla Walla Basin Natural Production Monitoring and Evaluation Project (WWNPME) was funded by Bonneville Power Administration (BPA) as directed by section 4(h) of the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (P. L. 96-501). This project is in accordance with and pursuant to measures 4.2A, 4.3C.1, 7.1A.2, 7.1C.3, 7.1C.4 and 7.1D.2 of the Northwest Power Planning Council's (NPPC) Columbia River Basin Fish and Wildlife Program (NPPC 1994). Work was conducted by the Fisheries Program of the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) under the Walla Walla Basin Natural Production Monitoring and Evaluation Project. Three components are addressed in this chapter including juvenile abundance surveys in summer rearing habitat, smolt monitoring and salmonid age and growth. Data from this and previous annual reports are currently available at http://198.66.210.119/database (summer of 2003). In the future all data will be available through http://www.umatilla.nsn.us (CTUIR website).

Objective Schedule and Tasks

This chapter summarizes juvenile abundance, smolt monitoring and age and growth evaluation activities completed during the contract years from September 30, 1998 through December 31, 2002.

Juvenile Abundance Monitoring

Objective A: Objective 1 in the 1999 and 2000 statement of work (SOW), Objective 2 in the 2001 SOW, and Objective 3 in the 2002 SOW; estimate juvenile salmonid abundance and rearing densities with conventional and proposed sampling methods in selected index sites in the Walla Walla River Basin.

Task A.1 Complete a peer reviewed sample design and protocol for monitoring juvenile salmonid distribution, abundance and rearing densities as recommended by ISRP, in cooperation with ODFW. Examine the utility of using a stratified random panel design as described by Rodgers (2000) and Firman and Jacobs (2001). This was a 2002 task.

Task A.2 Complete sampling at selected index sites and evaluate conventional and proposed sampling methodologies and protocols.

Task A.3 Digitize and summarize capture data, estimate densities and abundance, examine trends, compare methods, report findings and discuss management implications.

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

Smolt Monitoring

Objective B: Objective 2 in the 2002 SOW. Estimate timing and survival of juvenile salmon and steelhead migrating from the headwaters of the Walla Walla River to the lower Columbia River.

Task B.1 Complete a peer reviewed sample design and protocol for monitoring the out-migration of juvenile summer steelhead and spring Chinook[2] salmon in the Walla Walla River Basin (Chapter 8 of this report).

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

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

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

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

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

Task B.7 Report findings and discuss management implications.

Understanding out-migration abundance, timing, and survival of parr and smolts from the headwaters to McNary Dam and the lower Columbia River will assist managers in optimizing instream flow augmentation, passage facility operations and other management actions. Smolt monitoring objectives, methods and protocols were reviewed and updated. Improvements are included in the Chapter 8 of this report and will be refined further through a formal review by local and regional researchers and managers.

The initial smolt out-migration monitoring efforts in the Walla Walla Basin will provide valuable information regarding the timing and survival of smolts. It will also shed light on the success of the adult hatchery spring Chinook salmon that were out-planted to reproduced in the natural habitat.

Information about survival and timing of migrating smolts will be useful in developing and prioritizing restoration efforts. If significantly different survival rates occur between release groups, detailed examinations of passage facilities and other potential problems within the reach may be proposed. Our approach examines larger reaches initially and will include extensive evaluations only where survival problems are indicated.

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

Age and Growth

Objective C: Objective 6 in the 1999 SOW and Objective 4 in the 2000-2002 SOWs. Determine age, growth and life history characteristics of salmon, steelhead and bull trout in the Walla Walla River Basin.

Task C.1 Collect scales from a sub-sample of juvenile and adult, salmon, steelhead and bull trout handled during trapping, electrofishing, artificial spawning, and natural spawning surveys.

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

Task C.3 Read scales and determine age and brood year as well as the years of freshwater and saltwater rearing of naturally produced adult salmon and steelhead and develop parent-progeny histories of wild steelhead.

Task C.4 Digitize and summarize data and report findings.

Scale data can be used to examine trends in growth rates through time and examine potential relationships between growth rates and flows, climatic trends, juvenile salmonid abundance, adult salmon carcass abundance and water temperatures. Information from scale analysis can also be used to understand life histories by determining the freshwater and ocean ages of naturally produced steelhead and spring Chinook salmon.

METHODS

Juvenile Abundance Monitoring

During the period from 1999 through 2002 CTUIR sampled juvenile salmonids at 175 different times and/or locations using a variety of methods (Table 2-2). In this report, we also include some electrofishing data collected by CTUIR in 1993 from the S. F. Walla Walla River and Elbow Creek. Additional collection efforts were focused on salvaging salmonids from dewatered reaches (Table 2-3). At other times we specifically sampled reaches to estimate juvenile spring Chinook densities. Occasionally, efforts simply documented the presence of salmonids at a location. Overall the data represents an assembly of information about fish distributions and abundance from a variety of methods and locations. We consider this information preliminary in the development of a more formal monitoring strategy. It provides general information about distribution and abundance of salmonids in the Walla Walla Basin.

During 1999, 2000 and 2001, we sampled a number of locations in an effort to learn enough about the distribution of salmonids in the basin to establish a sampling strategy in 2002. For the 2002 statement of work, we proposed an RM&E plan that incorporated ISRP recommendations by adopting a stratified-random rotating-panel design modeled after the work of Don Stevens, Tony Olsen, Phil Larsen and Tom Kincaid of the U.S. Environmental Protection Agency, Corvallis, Oregon (Firman and Jacobs, 2001, Jacobs et al. 2001, Jacobs et al 1998). However, concerns by BPA staff about costs, priority and utility of the new method caused further delays. Finally, in early July of 2002, it was agreed that we would examine both electrofishing and snorkeling techniques at selected sites in the Walla Walla Basin to better understand the strengths and weaknesses of both methods in different habitat types. In 2002, our goal was to examine salmonid densities as well as obtain practical information about the various techniques. The information collected by CTUIR may be used to develop a statistically robust design to annually monitor annual salmonid distribution and abundance in the basin. However, managers have not yet prioritized or selected the monitoring action items for the basin. The RM&E plan for the basin is scheduled for the developed of a draft document by the end of 2003 and a final version by the end of 2004.

Fish Density and Catch Per Unit Effort Surveys

Electrofishing

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

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

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

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

A summary of all CTUIR sampling efforts in the Walla Walla are listed by stream and location and method in Table 2-2. The list below outlines CTUIR electrofishing efforts at density, mark-recapture or CPUE sites in the Walla Walla Basin by year:

2002, CTUIR electrofished 8 density and 9 CPUE sites
2001, CTUIR electrofished 11 density sites
2000, CTUIR only electrofished 2 density depletion sites. Both in Tiger Creek at RM 1.1 and 1.4.
1999, CTUIR conducted 2 mark-recapture efforts and 42 density depletion sites.
1993, CTUIR electrofished 65 individual habitat units in Elbow Creek from RM 0. to RM 1.8. (13% of total wetted area), and 9 sites from an unnamed tributary of Elbow Creek (18% of the total area).

Snorkeling

In 2002, we snorkeled the entire area of 16 sties prior to electrofishing (7 density sites and 9 CPUE sites in the Walla Walla Basin. Similar efforts were conducted in the Umatilla River Basin and data from both basins were used to compare techniques. Densities were estimated based on observed numbers. We did not correct for possible double counting or for fish unobserved do to concealment or other factors. Sites ranged from 24 to201 meters in length (Table 2-2). One or two snorkelers counted the number of salmonids at each survey location by habitat unit type. Habitat features were measured after both snorkeling and electrofishing efforts were completed. Snorkelers moved upstream, counting all salmonids in a single upstream pass at a rate of about 100 m/hour. Snorkelers relayed fish-counts either verbally or with hand signals to streamside personnel. Observed salmonids were ranked as either fry, juvenile, or adult based on total length (i.e. ≤ 50mm 51- 200 mm, and ≥ 201 mm. Precise counts were made whenever possible but estimates were made under three basic conditions: 1) occasionally, too may juvenile Chinook were present to allow for accurate counts; 2) general estimates were made for non-salmonid species, and 3) crews sometimes estimated juvenile steelhead numbers if precise counting interfered with the juvenile Chinook counts. When numbers were high, we concentrated on juvenile Chinook abundance because of the adult out-planting experiment. Furthermore, counts for rainbow trout by snorkeling techniques have been shown to be unreliable (Rodgers 2000, Nickelson 1998).

In 2002 CTUIR also snorkeled additional pools with depths greater than forty centimeters (ODFW protocol) from 14 sites, 50 meters long, immediately adjacent to the 16 sites electrofished. Half (14 of 28) of the adjacent sites were not snorkeled because they did not have pool habitat or the pools did not meet the 40 cm depth criteria.

Crews snorkeled 19 additional sites in September 2002 to enhance our understanding about the techniques utility and about salmonid distribution in late summer in flow limited sections of the Walla Walla River and Mill Creek. Crews snorkeled 8 sites in the mainstem Walla Walla from Lowden Road at RM 27 to Highway 11 Bridge at RM 38. Twelve sites were snorkeled in Mill Creek from the mouth up to Rooks Park at RM 11. These sites ranged from 32 to 89 m in length and are summarized in Table 2-2.

Presence/Absence and Fry Surveys

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

A summary of all CTUIR P/A sampling efforts in the Walla Walla are listed by stream and location and method in Table 2-2. The list below outlines CTUIR electrofishing efforts at presence/absence and fry surveys in the Walla Walla Basin by year

2002, CTUIR sampled seven P/A sites during January in the Little Walla Walla Complex

2001, CTUIR sampled the stream and river margins for the presence of spring Chinook fry at 26 sites

1999, CTUIR sampled 11 P/A sites in Couse, Dry and Pine Creeks.

1993, CTUIR sampled two P/A sites in the S.F. Walla Walla River at RM 2 and 7.5.

Salvage Operations

There are several different types of salvage operations conducted by CTUIR each year. These salvage efforts collectively provide some useful information about the distribution of salmonids in the basin. Larger salvage efforts were conducted on more than three miles of the mainstem of the Walla Walla River below Milton-Freewater. Historically this reach was dewatered at the end of June or the first week of July because of irrigation diversions. ODFW conducted salvage operations for a number of years before CTUIR began assisting with these activities in the 1990s. During 1999 and 2000 the effort included personnel from CTUIR, ODFW and local irrigation districts. Fish were seined or captured with electrofishing equipment and hauled by bucket to a tanker trailer and then transported to a suitable reach with flowing water of suitable water temperatures.

The other salvage operations were minor in comparison to the larger mainstem efforts of the past. Fish can get stranded in the fish bypass facilities at the end of irrigation season. CTUIR has worked cooperatively with irrigators to salvage salmonids cut off from the river between the head-gates and bypass facilities after the head-gates were closed.

Smolt Monitoring
We collected juvenile Chinook salmon and steelhead at two irrigation canal screening facilities and at one 5-ft rotary screw trap as they migrated from the headwaters of the Walla Walla River towards the Columbia River (Figure 2-1). Fish collected during salvage operations were also PIT tagged if time and conditions allowed. We injected Passive Integrated Transponders (PIT tags) into the body cavity of selected fish. Information collected on these fish at Columbia River PIT tag detection sites was used to estimate juvenile salmonid migration timing and minimum survival rates.

Understanding out-migration abundance, timing, and survival of parr and smolts from the headwaters to McNary Dam and the lower Columbia River will provide a baseline for planning and evaluating future restoration efforts, and assist managers in optimizing instream flow augmentation, passage facility operations, and other management actions. Our smolt out-migration monitoring efforts in the Walla Walla Basin will provide valuable information about juvenile production from out-planted adult spring Chinook salmon.

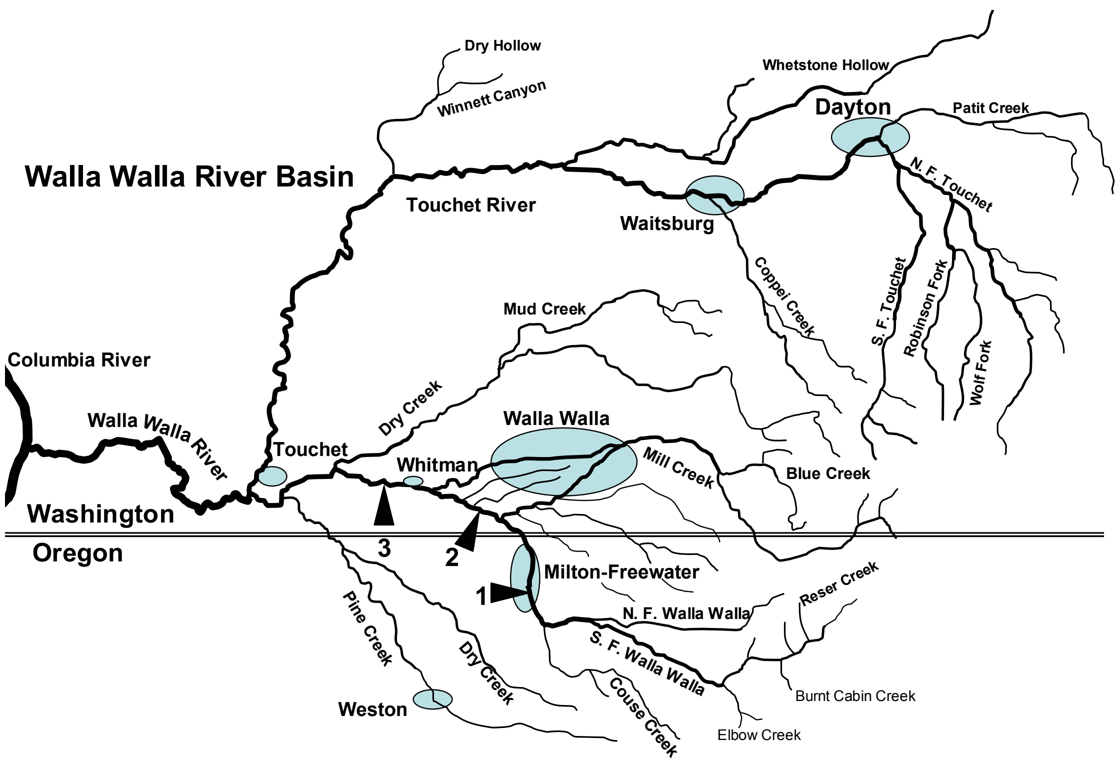

Figure 2-1 Location of the three traps used during the fall of 2001 and the spring of 2002 to collect and PIT juvenile spring Chinook salmon and summer steelhead. Trap 1 was located at the smolt by-pass facility in the Little Walla Walla Diversion (RM 45.9). Trap 2 was located in the ladder at the Burlingame Diversion (RM 36.6). Trap three was a rotary screw trap located downstream from Detour Road Bridge (RM 31.6)

The rotary trap site was located in the Walla Walla River at RM 31.6 near Whitman, Washington. The site was selected based on appropriate water depth and velocity, trap accessibility, suitable anchoring points, trap pullout availability, and landowner cooperation. The site featured a low gradient, riffle-glide with an adjacent scour pool. The main channel where we sampled was approximately 30 feet wide. River depth in the channel ranged from 2-4 feet during the sampling period. We used shoreline trees and rock cribs constructed of railroad ties as anchoring points for the trap. A gravel bar and side channel on the south bank were used to harbor the trap during high flows. Tagged fish were released at the Detour Road Bridge (RM 32.8) to evaluate trapping efficacy.

We also collected juvenile salmonids at the fish trap at the Little Walla Walla River fish screening facility (RM 45.9) in Milton-Freewater and the fish trap at the Burlingame Dam fish screening facility (RM 36.6) in College Place, Washington. At both sites, we collected fish from fish traps maintained by facility operators. We released tagged fish above the traps to provide estimates of trap catch rates. For the Little Walla Walla site, fish were released upstream at the Grove School Bridge in Milton-Freewater (RM 46.3). Releases for the Burlingame site were made at the old Highway 11 Bridge (RM 38.2).

At the Little Walla Walla trap, fish were collected by dip-net after lowering the water level to roughly three feet, then manually crowding fish to one end of the trap. The process was similar at the Burlingame trap except that fish were not crowded to one end but simply dip-netted from the trap once facility operators lowered the water. Upon removal from the trap, fish were examined for marks or injury, and, if selected, retained in a live-well of fresh water. Retained fish were pre-scanned (for the presence of pit tags), measured, and a scale sample was collected from a sub-set.

We PIT-tagged Chinook greater than 70 mm and steelhead greater than 110 mm. Bull trout were not PIT-tagged or anesthetized. We anesthetized fish with MS-222 (tricaine methane-sulfonate) and PIT-tagged by hand using sterile syringes. Syringes were rotated after each use and kept in a bath of 80% denatured methyl alcohol. PIT-tagged fish were held up to three hours for observation and released. Tagging crews submitted the appropriate tagging files to PTAGIS according to established procedures (Stein, 1999).

Age and Growth

During electrofishing and trapping, scale samples were collected from a subset of juvenile and resident salmonids, including bull trout. Each sample contained five or more scales taken from the preferred area (e.g. just above the lateral line between dorsal and anal fin). Scales were mounted in the field onto clear Mylar envelopes. Stream name, site, date, species, and fork length were recorded on the Mylar. No additional handling or mounting was required before reading. Scales were analyzed by CTUIR staff under a microfiche reader at magnifications of 42-72 times. One or two readers examined all scales. Difficulties in age interpretation were examined; if a clear interpretation was not determined, the sample was eliminated. We use the European method of age designation. An age designation of 2.2 denotes a fish that migrated from freshwater during its second year of life, spent two winters rearing in the ocean and returned to spawn at age four.

RESULTS AND DISCUSSION

Juvenile Abundance Monitoring

Comparison of Monitoring Methods:

Snorkeling and electrofishing techniques both provided adequate documentation for the presence of salmonids throughout the basin. However the density estimates produced by both techniques were inconsistent. Figures 2-2 and 2-3 are plots of the Chinook and steelhead densities at 35 sites using both techniques during 2002. Sites sampled in the Umatilla River Basin are included in these figures because one objective for 2002 was to compare techniques. Data from the Umatilla Basin increases the sample size. The electrofishing techniques included lower voltage settings with an emphasis in reducing injury to listed fish. To improve the value of the comparison, crews made an effort to use techniques that would be employed in a long term monitoring program in the presence of listed species. Block nets were not used when electrofishing the larger sties so some density data only represents a portion of salmonids present. While electrofishing techniques were not optimized for catch, we expect that considerable variation between snorkeling and electrofishing would still occur with the more traditional aggressive electrofishing techniques as reported by Rogers et al (1993). Snorkeling appeared to be a better method for counting Chinook in 13 of 16 sites. Chinook densities estimated by snorkeling ranged from 2 to 32 times greater than electrofishing estimates of the same site. Snorkelers observed Chinook at two sites where no Chinook were collected with electrofishing techniques. Electrofishing estimates of Chinook were greater than snorkel estimates in only two sites (Figure 2-2). For steelhead, electrofishing density estimates were higher at 19 of 35 sites (up to 6 .4 times greater at those sites). However, of the 16 sites with a higher steelhead estimate from snorkeling, one estimate was 85.8 times greater than the electrofishing estimate (Figure 2-3).

In recognition of the variability of sample bias and error for salmonid density estimates between species, habitat types and stream sizes for a given method, CTUIR originally planned to establish a monitoring design that incorporated fixed index sites using fixed methods to monitor trends in juvenile salmonid abundance through time. Because habitat features can change and therefore change the sample error for a given reach, CTUIR also planned to intentionally select more stable sites and measure habitat features each year to account for that source of variation. This strategy attempted to minimize sources of variation but could only provide trend data for juvenile salmonids. However, this strategy has been criticized by ISRP and it may be more important to know basin-wide juvenile salmonid abundance with large confidence levels. Overall, CTUIR's original perspective was that it would be better and cheaper to obtain smaller confidence intervals in the trend of juvenile salmonid abundance at specific sites and use this information in combination with adult return data to monitor basin-wide population status.

Less intensive presence/absence surveys were planned to augment the fixed index site data to provide information about changes in salmonid distribution. Additional monitoring plans were also developed for specific habitat restoration sites to evaluate the effectiveness of the project (such as the Blue Creek and Rainwater projects). This monitoring strategy was judged to be inadequate by ISRP. However, based on CTUIR observations, it appears that

ISRP's recommendation would also be inadequate. Monitoring salmonid distribution and abundance in the basin and evaluating specific habitat restoration projects will require more than just snorkeling pools greater 40 cm in depth at 50 different sites randomly selected each year as ISRP suggests. The e-map technique may provide suitable information at the regional level, but it may not be adequate for local management information needs.

Overall, any single monitoring technique will be inadequate to accurately enumerate fish in multiple habitat types, species and/or life history stages. Snorkeling is clearly unsuitable in poor water clarity and in shallow habitat. Sample error is inconsistent between habitat units for a variety of reasons. For example, in any give habitat type a large but variable proportion of the juvenile salmonids can be concealed in various types of cover. Concealment cover is different in each habitat unit and fish will use the cover differently throughout the day and season. Furthermore, backpack electrofishing can be harmful to fish and ineffective in larger habitat units because fish can easily avoid the gear. Until management information needs are clearly defined and prioritized, it will be impossible to develop a statistically robust and cost effective RM&E program that is acceptable to both local and regional mangers.

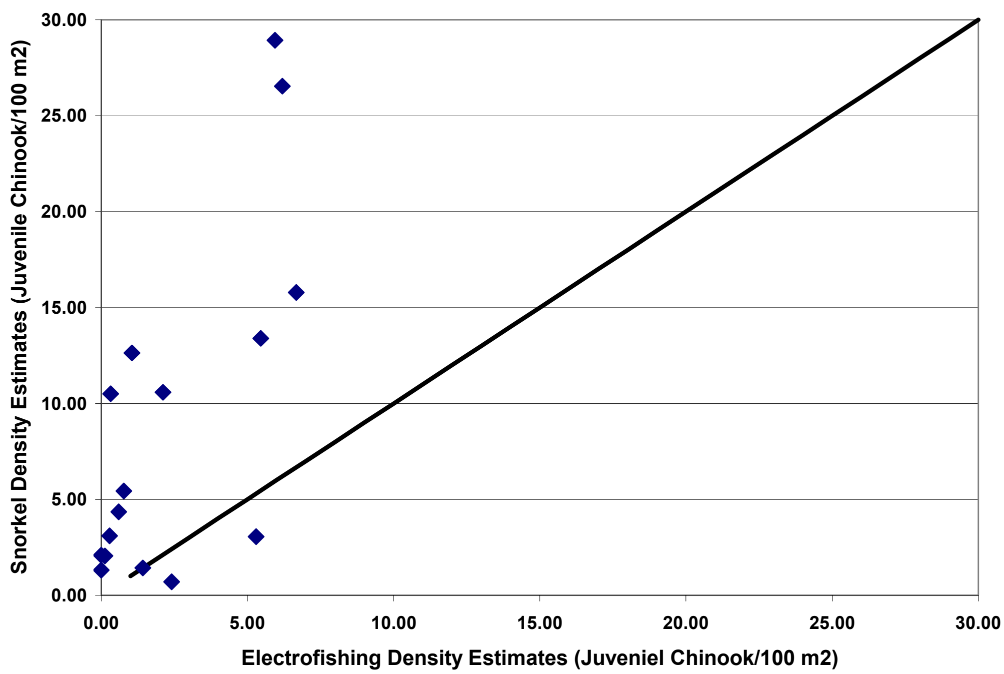

Figure 2-2, Densities of juvenile spring Chinook salmon estimated by snorkeling and electrofishing at the same site during the summer of 2002 in both the Umatilla (6 sites) and Walla Walla Basins (10 sites).

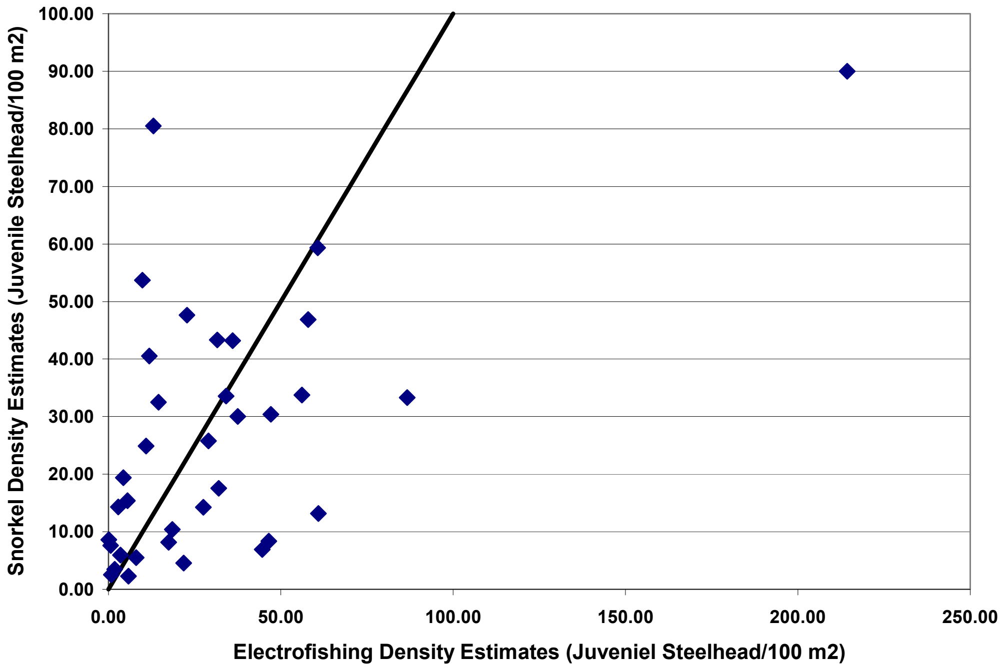

Figure 2-3, Densities of juvenile summer steelhead estimated by snorkeling and electrofishing at the same site during the summer of 2002 in both the Umatilla (20 sites) and Walla Walla Basins (15 sites).

Spring Chinook Salmon Reintroduction:
Adult spring Chinook salmon were out-planted into Mill Creek and the S.F. Walla Walla River to spawn naturally as summarized in Chapter 3. CTUIR conducted fish surveys to document the distribution and abundance of parr naturally produced by the out-planted adults. Table 2-1 summarizes the number of sites where juvenile Chinook were observed in target areas by year. Target rearing areas included Mill Creek above Seven Mile Bridge, the mainstem of the Walla Walla above the state line, and all of the S.F. Walla Walla. Summer densities of observed Chinook outside of the target areas were relatively low but they do illustrate that perhaps more of the basin is suitable for Chinook rearing than originally estimated. Locations outside the target area with Chinook include the lower N.F. Walla Walla, the lower mainstem down to Burlingame Diversion at RM 38 and lower Mill Creek down to Rooks Park. Managers may want to consider long term plans to enhance and protect spring Chinook summer and winter rearing habitat below Milton-Freewater. Channel morphology restoration and riparian rehabilitation are the primary needs for much of the basin. Specifically the river lacks juvenile summer and winter rearing habitat, adult holding habitat, and habitat complexity in general.

Densities of Chinook are plotted in Figure 2-4 in relation to the approximate river miles from the confluence of the Walla Walla River with the Columbia. Chinook parr are abundant from Milton-Freewater to the headwaters where some of the highest densities were recorded. It is clear that the out-planted hatchery reared adult spring Chinook successfully reproduced progeny to at least the parr stage. While spawning and production of parr are important life-history stages, adult returns will be the primary measure of reproductive success of the out-planting experiment. Natural Chinook produced from the out-planted adults are expected to begin returning in 2003 as jacks with the first adults returning in 2004.

Table 2-1 Summary of fish survey sites where naturally produced juvenile spring Chinook salmon were observed after adults were out-planted to spawn naturally in Mill Creek and the S.F. Walla Walla River.

	1993	1999	2001	2002
Total Sites (including paired or successive sites)	76	57	39	77
Total Sample Areas	4	47	34	42
Sites in Target Area	76	4	22	34
Sites in Target Area with Chinook	0	2	21	33
Sites Outside of Target Area	0	55	17	43
Sites Outside of Target Area With Chinook		0	3	5
Total Chinook Observed in All Sites	0	4	464	1764
Total Sites With Chinook	0	2	24	38

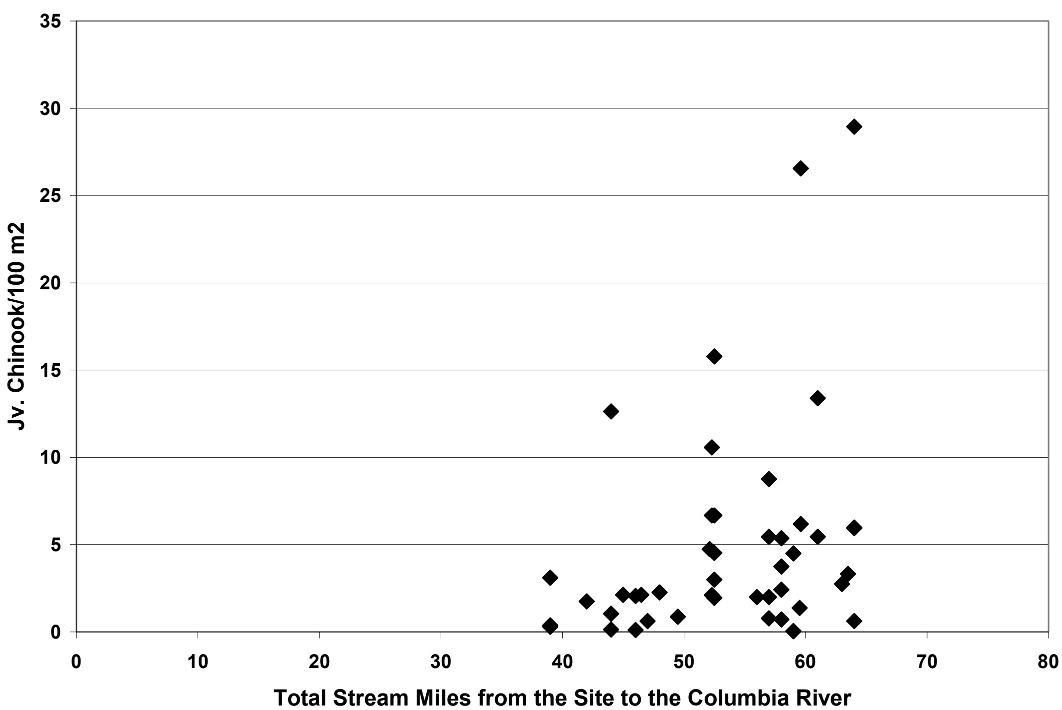

Figure 2-4 Densities of juvenile spring Chinook observed during fish surveys in the Walla Walla River and tributaries plotted by the approximate number of stream miles from the confluence of the Walla Walla River with and the Columbia River.

General Fish Abundance Surveys:

In addition to Chinook, we recorded the number of other fish observed during fish monitoring efforts in the Walla Walla River Basin (Table 2-2). Juvenile steelhead were observed in high densities in Couse Creek, Pine Creek, S.F. Walla Walla, S. F. Touchet and Griffin Creek (Figures 2-5 and 2-6). Salmonids were absent or observed at low densities in the lower reaches of stream where low flows and warm water temperatures were common. The high densities observed in Couse Creek were composed of mostly age 0+ parr in short flowing reaches and isolated pools. The low summer flows in Couse Creek concentrated fish at higher densities in the remaining wetted habitat. High salmonid densities during the summer may or may not relate to adult returns in subsequent years. Bull trout and mountain whitefish had smaller abundances and smaller ranges of distribution. Mountain whitefish were the least common salmonid observed. We only observed mountain whitefish at 11 of 176 sites (Table 2-2). This data provides a useful overview of distribution and abundance and is suitable for EDT and similar processes. The data has limitations for comparison and hypothesis testing because data was generated through a variety of techniques over the years.

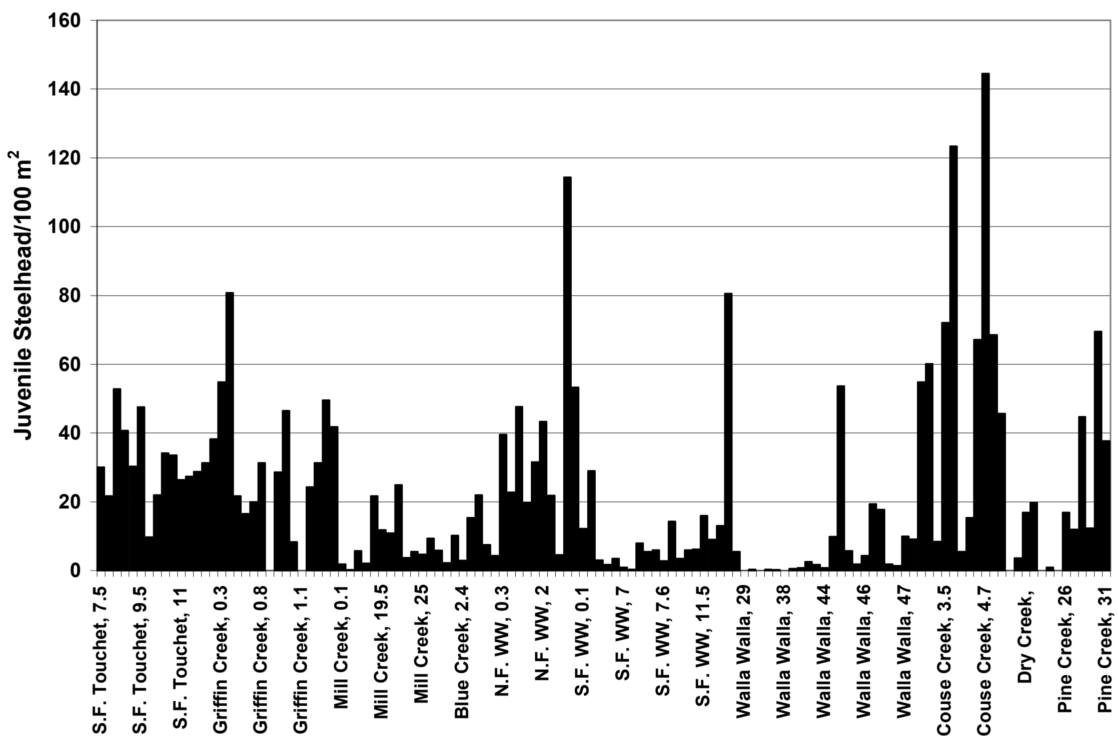

Figure 2-5 Observed densities of juvenile steelhead in the Walla Walla Basin using both electrofishing and snorkeling techniques (1999-2002).

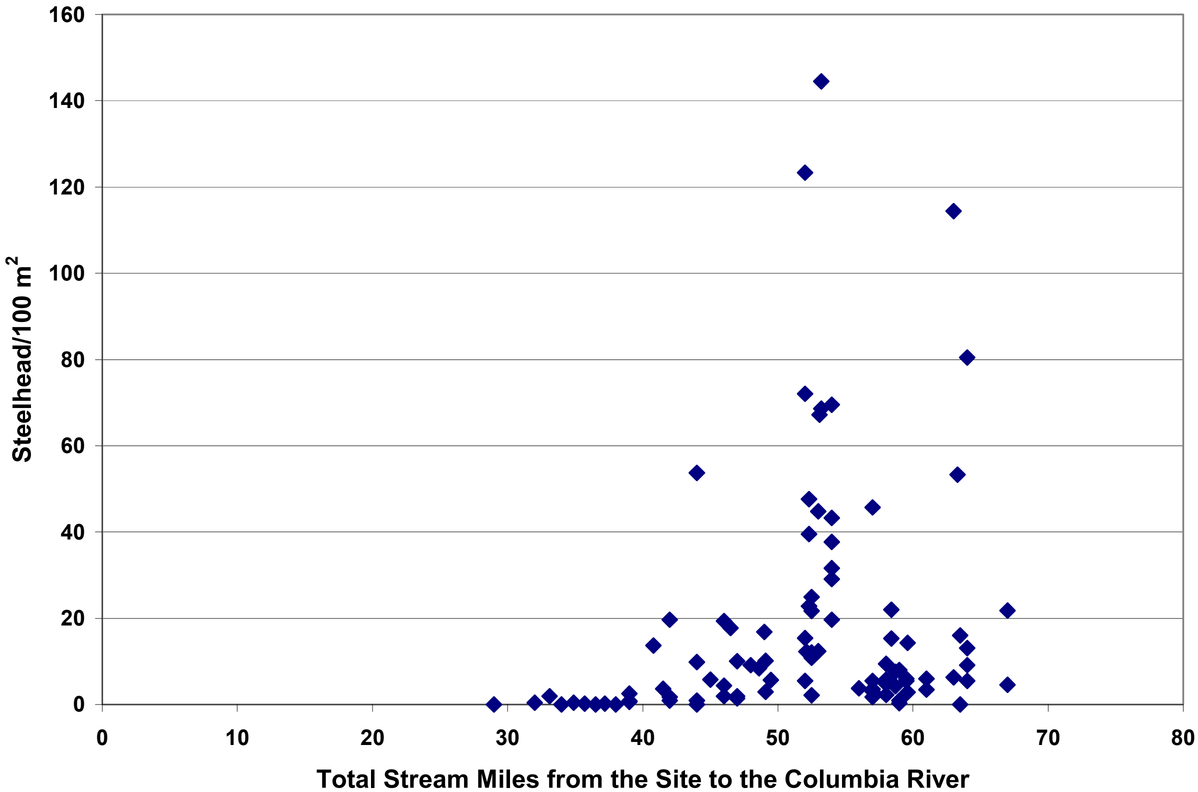

Figure 2-6 Densities of juvenile summer steelhead observed during fish surveys in the Walla Walla River and tributaries plotted by the approximate number of stream miles from the confluence of the Walla Walla and Columbia Rivers.

Table 2-2 Summary of electrofishing and snorkeling fish surveys in the Walla Walla River Basin 1993-2002 (next seven pages).

Walla Walla Fish Surveys

River or Stream	Location	RM	Date	Method	Survey Type	Habitat Surveyed	Site Length (m)	Water Temp (C)	Salmonids: Chinook	Steelhead	Bull Tout	MWF	Estimated Number of Non-Salmonids: Brook Lamprey	Dace	Shiners	Sculpin	Suckers	O. Pike Minnow	Bull head
Mill Creek	Swegle Rd.	0	5-Sep-02	Snorkel	Count	All	50												
Mill Creek	Near Mouth	0.1	29-May-01	Elect.	P/A	Margins	200			15				1500	750		100	50	3
Mill Creek	Wallula Road Bridge	2.7	29-May-01	Elect.	P/A	Margins	200	17.8		2				350	125	300		5	
Mill Creek	Wallula Road Bridge	2.7	5-Sep-02	Snorkel	Count	All	50		25										
Mill Creek	< Gose Street	4	5-Sep-02	Snorkel	Count	All	50												
Mill Creek	< Hussey Street	4	5-Sep-02	Snorkel	Count	All	50												
Mill Creek	9th St. - WW	6	6-Sep-02	Snorkel	Count	All	54			4									
Mill Creek	Wilbur St. - WW	8	6-Sep-02	Snorkel	Count	All	~50												
Mill Creek	< Yellowhawk Dam	10	6-Sep-02	Snorkel	Count	All	32												
Mill Creek	> Yellowhawk Dam	10	6-Sep-02	Snorkel	Count	All	40			1									
Mill Creek	Tausick Way - WW	10	6-Sep-02	Snorkel	Count	All	89												
Mill Creek	< Bennington Dam	11	6-Sep-02	Snorkel	Count	All	40		6	11									
Mill Creek	< Rooks Park Footbridge	11	6-Sep-02	Snorkel	Count	All	35			12									
Mill Creek	7 mile Bridge	17	12-Jul-01	Elect.	Deplete	All	100	21.4	6	40			4	175	100	75		5	
Mill Creek	Concrete Wall Bridge	20	29-May-01	Elect.	P/A	Margins	200	14.0	24	17	1			1		200	1		
Mill Creek	Concrete Wall Bridge 1	20	31-Jul-01	Elect.	Deplete	All	100	13.7	37	178	2		1	100		50			
Mill Creek	Concrete Wall Bridge 1	20	12-Aug-02	SN-P	Count	Pools			115	78	2			20	17		7		
Mill Creek	Concrete Wall Bridge 2	19.5	31-Jul-01	Elect.	Deplete	All	100	13.7	16	97	2			200		75			
Mill Creek	Concrete Wall Bridge 2	20	12-Aug-02	EF	Deplete	All	50		19	31	3			20	17	70	7		
Mill Creek	Concrete Wall Bridge 2	20	12-Aug-02	SN	Count	All	50		45	71	1			20	17	70	7		
Mill Creek	Concrete Wall Bridge 3	20	12-Aug-02	SN-P	Count	Pools			2	8				20	17		7		
Mill Creek	Kooskooskie Dam	23	6-Jun-01	Elect.	P/A	Margins	200	12.7	16	30	2	2		5		75	5		
Mill Creek	Straw Spring, (Henry Can)	24	6-Jun-01	Elect.	P/A	Margins	200	11.3	16	44	3			3		150			
Mill Creek	Tiger Can. Bridge	25	6-Jun-01	Elect.	P/A	Margins	200	9.1	43	38	2		4	2	225	p			
Mill Creek	Tiger Can. Bridge	25	24-Jul-01	Elect.	Deplete	All	100	11.1	33	83	4			20		300			
Mill Creek	Tiger Can. Bridge 1	25	12-Aug-02	SN-P	Count	Pools			29	13		2		20	17		7		
Mill Creek	Tiger Can. Bridge 2	25	12-Aug-02	EF	Deplete	All	80		17	41	6	1		20	17	70	7		
Mill Creek	Tiger Can. Bridge 2	25	12-Aug-02	SN	Count	All	80		5	16	2	2		20	17	70	7		
Mill Creek	Tiger Can. Bridge 3	25	12-Aug-02	SN-P	Count	Pools				7	1			20	17		7		

Walla Walla Fish Surveys (Continued)

River or Stream	Location	RM	Date	Method	Survey Type	Habitat Surveyed	Site Length (m)	Water Temp (C)	Salmonids: Chinook	Steelhead	Bull Tout	MWF	Estimated Number of Non-Salmonids: Brook Lamprey	Dace	Shiners	Sculpin	Suckers	Stickleback	Bull head
Tiger Creek	Below hair pin curve	1.1	21-Jun-00	Elect.	Deplete	All	100	11		23						p			
Tiger Creek	Below hair pin curve	1.1	17-Jul-01	Elect.	Deplete	All	100	10.7		33						p			
Tiger Creek	At hair pin curve	1.4	13-Jun-00	Elect.	Deplete	All	102			27						p			
Tiger Creek	At hair pin curve	1.4	17-Jul-01	Elect.	Deplete	All	100	10.8		15						p			
Tiger Creek	At hair pin curve	1.4	14-Aug-02	Elect.	Deplete	All	50			7						p			
Blue Creek	Habitat Project Site 1	2.4	20-Sep-99	Elect.	Deplete	All	138.8	14		39				200		150	5		
Blue Creek	Habitat Project Site 2	2.4	20-Sep-99	Elect.	Deplete	All	194.6	15		29				450		300	25		
S.F. Touchet	1	7.5	16-Aug-99	Elect.	Deplete	All	100	23.5		105				400		100			
S.F. Touchet	2	8.0	16-Aug-99	Elect.	Deplete	All	100	23.5		87				300		75			
S.F. Touchet	3	8.5	17-Aug-99	Elect.	Deplete	All	100	16.0		132				400	20	100			
S.F. Touchet	3, 2	8.5	15-Oct-02	Elect	Deplete	All	50			57									
S.F. Touchet	3, 2	8.5	15-Oct-02	SN-P	Count	Pools				65									
S.F. Touchet	4	9.0	17-Aug-99	Elect.	Deplete	All	100	17.0		106				275		100			
S.F. Touchet	5	9.5	17-Aug-99	Elect.	Deplete	All	100	17.5		119				275		75			
S.F. Touchet	6	10.0	17-Aug-99	Elect.	Deplete	All	100	17.5		63				350		100			
S.F. Touchet	7	10.5	17-Aug-99	Elect.	Deplete	All	100	20.0		121				400		125			
S.F. Touchet	7,1	11	15-Oct-02	SN-P	Count	Pools				45									
S.F. Touchet	7,2	11	15-Oct-02	Elect	CPUE	All	50			111									
S.F. Touchet	7,2	11	15-Oct-02	Snork.	Count	All	50			109									
S.F. Touchet	7,3	11	15-Oct-02	SN-P	Count	Pools				48									
S.F. Touchet	8	11.0	17-Aug-99	Elect.	Deplete	All	100	21.5		119				450	35	100			
S.F. Touchet	9	12.0	18-Aug-99	Elect.	Deplete	All	100	16.0		123				250		85			
S.F. Touchet	10	13.0	18-Aug-99	Elect.	Deplete	All	100	17.0		144				240		150			

Walla Walla Fish Surveys (Continued)

Salmonids

River or Stream	Location	Date	Method	Survey Type	Habitat Surveyed	Site Length (m)	Water Temp (C)	Chinook	Steelhead	Bull Tout	MWF
Griffin Creek	GD1-1	10-Aug-99	Elect.	Deplete	All	50	15		36		
Griffin Creek	GD1-2	10-Aug-99	Elect.	Deplete	All	50	15		44		
Griffin Creek	GD2-1	10-Aug-99	Elect.	Deplete	All	50	13		63	1	
Griffin Creek	GD2-2	10-Aug-99	Elect.	Deplete	All	42	16		78		
Griffin Creek	GD3-1	11-Aug-99	Elect.	Deplete	All	50	11		25		
Griffin Creek	GD3-2	11-Aug-99	Elect.	Deplete	All	50	11		19		
Griffin Creek	GD4-1	11-Aug-99	Elect.	Deplete	All	50	11		23		
Griffin Creek	GD5-1	11-Aug-99	Elect.	Deplete	All	50	10		36		
Griffin Creek	GD6-1	11-Aug-99	Elect.	P/A	All	50	17				
Griffin Creek	GD7-1	11-Aug-99	Elect.	Deplete	All	50	12		33		
Griffin Creek	GD8-1	12-Aug-99	Elect.	P/A	All	50	13				
Griffin Creek	GD9-1	12-Aug-99	Elect.	Deplete	All	50	11		28		
Griffin Creek	GD9-2	12-Aug-99	Elect.	Deplete	All	50	11		36		
Griffin Creek	GD10-1	12-Aug-99	Elect.	Deplete	All	50	12		57		
Griffin Creek	GD10-2	12-Aug-99	Elect.	Deplete	All	50	12		48		
Griffin Creek	RM 1.0	16-Oct-02	Elect.	Deplete	All	50			72		
Griffin Creek	RM 1.0	16-Oct-02	Snork.	Count	All	50			13		

Salmonids	Estimated Number of Non-Salmonids

Walla Walla Fish Surveys (Continued)

									Salmonids				Estimated Number of Non-Salmonids								
River or Stream	Location	RM	Date	Method	Survey Type	Habitat Surveyed	Site Length (m)	Water Temp (C)	Chinook	Steelhead	Bull Tout	MWF	Brook Lamprey	Dace	Shiners	Sculpin	Suckers	Stickleback	O. Pike Minnow	Carp	Chisel Mouth
Walla Walla	Lowden Rd.	27	5-Sep-02	Snorkel	Count	All	50														
Walla Walla	McDonald Rd.	29	15-May-01	Elect.	P/A	Margins	200	12.4						325	200		50	1	5	1	75
Walla Walla	McDonald Rd.	29	5-Sep-02	Snorkel	Count	All	50			2											
Walla Walla	Detour Rd Bridge	32	15-May-01	Elect.	P/A	Margins	200	12.6		3		2		400	275	45		1	5		35
Walla Walla	Swegle Road Bridge	34	15-May-01	Elect.	P/A	Margins	200							275	250	2	20		10		40
Walla Walla	Swegle Road Bridge	34	5-Sep-02	Snorkel	Count	All	60			15											
Walla Walla	Below Burlingame Dam	34.9	16-May-01	Elect.	P/A	Margins	200	10.8		3				250	225	5	15		15		35
Walla Walla	Below Burlingame Dam	34.9	5-Sep-02	Snorkel	Count	All	50														
Walla Walla	Last Chance Road	35	5-Sep-02	Snorkel	Count	All	50			16											
Walla Walla	Beet Road	35.5	5-Sep-02	Snorkel	Count	All	89			18											
Walla Walla	Old Mission Highway	37	16-May-01	Elect.	P/A	Margins	200	10.6		2				175	125	2	10		5		
Walla Walla	Old Mission Highway	37	5-Sep-02	Snorkel	Count	All	50			11											
Walla Walla	Hwy.11 Bridge	38	16-May-01	Elect.	P/A	Margins	200	10.8						150	100	5			3		
Walla Walla	Hwy.11 Bridge	38	5-Sep-02	Snorkel	Count	All	50		1												
Walla Walla	Peppers Bridge	39	5-Apr-01	Elect.	P/A	Margins	200	9.3	3	5				30	25	80	2		5		
Walla Walla	Peppers Bridge 1	39	8-Aug-02	SN-P	Count	Pools			9	9				500	100	500	25		50	20	
Walla Walla	Peppers Bridge 2	39	8-Aug-02	EF	CPUE	All	50		1	3				500		500	25				
Walla Walla	Peppers Bridge 2	39	8-Aug-02	SN	Count	All	50		11	9				500		500	25				
Walla Walla	Above Peppers Bridge	39.5	3-Aug-01	Elect.	Deplete	All	200	17.2	5	96		2	1	550	325				15		
Walla Walla	Tummalum Bridge	42	16-May-01	Elect.	P/A	Margins	200	11.7	14	14	3			200	75		3				
Walla Walla	Nursery Bridge	44	16-May-01	Elect.	P/A	Margins	200		1	7	2			75	50	10	3				
Walla Walla	Nursery Bridge 2	44	8-Aug-02	EF	CPUE	All	50		3	28				100		100					
Walla Walla	Nursery Bridge 2	44	8-Aug-02	SN	Count	All	50		36	153				100		100					
Walla Walla	Nursery Bridge 3	44	8-Aug-02	SN-P	Count	Pools			125	105											
Walla Walla	Cemetery Bridge	45	16-May-01	Elect.	P/A	Margins	200		17	46	1		3	225	50	15	5				
Walla Walla	Cemetery Bridge	46	16-Jul-01	Elect.	P/A	Margins	200	13.3		15				200		80					
Walla Walla	Cemetery Bridge 2	46	8-Aug-02	EF	CPUE	All	50		1	36				100		100					
Walla Walla	Cemetery Bridge 2	46	8-Aug-02	SN	Count	All	50		17	160				100		100					
Walla Walla	Grove School Bridge	46.5	17-May-01	Elect.	P/A	Margins	200	8.2	17	142	2			125	40	30					
Walla Walla	Lampson Index Site	47	23-Jul-99	Elect.	Mark	All	567.8	14.5		127	4	1				p					
Walla Walla	Lampson Index Site	47	26-Jul-99	Elect.	Recap.	All	567.8			94	2					p					
Walla Walla	Lampson Index Site	47	10-Jul-01	Elect.	P/A	Margins	200	17.8	5	80		1			100						
Walla Walla	Joe West Bridge	48	17-May-01	Elect.	P/A	Margins	200	8.5	18	73	1			125	35	20					

Walla Walla Fish Surveys (Continued)

									Salmonids				Estimated Number of Non-Salmonids									
River or Stream	Location	RM	Date	Method	Survey Type	Habitat Surveyed	Site Length (m)	Water Temp (C)	Chinook	Steelhead	Bull Tout	MWF	Brook Lamprey	Dace	Shiners	Sculpin	Suckers	Stickleback	S.M. Bass	Pumpkinseed	O. Pike Minnow	Carp
S.F. WW	Hwy. Bridge near mouth	0.1	24-May-01	Elect.	P/A	Margins	200	11.3	38	98	1			1	75	p						
S.F. WW	Steel Bridge	2	Nov, 1993	Elect.	P/A	All	33			92						p						
S.F. WW	Hatchery	5	24-May-01	Elect.	P/A	Margins	200	12.7	70	24						85						
S.F. WW	Hatchery, 2	5	7-Aug-02	EF	CPUE	All	49		4	9						p						
S.F. WW	Hatchery, 2	5	7-Aug-02	SN	Count	All	49		28	18	3	1				p						
S.F. WW	Hatchery, 3	5	7-Aug-02	SN-P	Count	Pools			3	10						p						
S.F. WW	Harris Park	7	19-Jul-99	Elect.	Mark	All	510.9	14	2	53	5					p						
S.F. WW	Harris Park	7	21-Jul-99	Elect.	Recap.	All	510.9	10	2	20	6					p						
S.F. WW	Harris Park	7	24-May-01	Elect.	P/A	L-margin	200	12.9	18	32				3		100						
S.F. WW	USGS Gage at Harris Park	7.5	9-Jul-01	Elect.	P/A	Margins	200		11	44	9					p						
S.F. WW	USGS Gage at Harris Park	7.5	Nov, 1993	Elect.	P/A	All	23			11						p						
S.F. WW	Harris Park TH, 1	7.6	6-Aug-02	SN-P	Count	Pools			252	115	3	5				p						
S.F. WW	Harris Park TH, 2	7.6	6-Aug-02	EF	CPUE	All	50		35	16	1					p						
S.F. WW	Harris Park TH, 2	7.6	6-Aug-02	SN	Count	All	50		150	81	2					p						
S.F. WW	Harris Park TH, 3	7.6	6-Aug-02	SN-P	Count	Pools			176	56		5				p						
S.F. WW	Cathedral Ledge, 2	9	6-Aug-02	EF	CPUE	All	50		33	21	3					p						
S.F. WW	Cathedral Ledge, 2	9	6-Aug-02	SN	Count	All	50		81	36	2					p						
S.F. WW	Cathedral Ledge, 3	9	6-Aug-02	SN-P	Count	Pools			93	33	2					p						
S.F. WW	Near Demeris Cabin	11.0	2-Aug-01	Elect.	P/A	Margins	200	12.2	22	50	4					p						
S.F. WW	Below Bear Cr.	11.5	2-Aug-01	Elect.	Deplete	All	100	9.3	15	72	9		1									
S.F. WW	Mouth of Bear Creek	12.0	14-Jun-01	Elect.	P/A	Margins	200	8.0	5	44	6					50						
S.F. WW	Above Bear Cr, 2	12	5-Aug-02	SN-P	Count	Pools			175	71	6					p						
S.F. WW	Above Bear Cr, 3	12	5-Aug-02	SN	Count	All	61.1		23	35						p						
S.F. WW	Above Bear Cr, 4	12	5-Aug-02	EF	CPUE	Braids	201.8		30	66	6					p						
S.F. WW	Above Bear Cr, 4	12	5-Aug-02	SN	Count	Braids	201.8		146	406	6					p						

Walla Walla Fish Surveys (Continued)

River or Stream	Location	RM	Date	Method	Survey Type	Habitat Surveyed	Site Length (m)	Water Temp (C)	Salmonids: Chinook	Steelhead	Bull Tout	MWF	Estimated Number of Non-Salmonids: Brook Lamprey	Dace	Shiners	Sculpin	Suckers	Stickleback	Chisel Mouth	Bull head
N.F. WW	Lance Bullock Property	0.3	9-Aug-01	Elect.	Deplete	All	100	13.8	14	83	3			60		180				
N.F. WW	Lance Bullock Property, 1	0.3	7-Aug-02	SN-P	Count	Pools			27	53										
N.F. WW	Lance Bullock Property, 2	0.3	7-Aug-02	EF	CPUE	All	90		4	43				50		50				
N.F. WW	Lance Bullock Property, 2	0.3	7-Aug-02	SN	Count	All	90		20	90				50		50				
N.F. WW	Lance Bullock Property, 3	0.3	7-Aug-02	SN-P	Count	Pools			15	83										
N.F. WW	Near Cup Gulch	2	11-Jul-01	Elect.	Deplete	All	100	12.6		59						15				
N.F. WW	Near Cup Gulch, 2	2	14-Aug-02	EF	Deplete	All	77			73			2	40	15	50				
N.F. WW	Near Cup Gulch, 2	2	14-Aug-02	SN	Count	All	77			100			2	40	15	50				
N.F. WW	Near Cup Gulch, 3	2	14-Aug-02	SN-P	Count	Pools			1	112					15					
N.F. WW	Headwaters, 2	15	13-Aug-02	EF	Deplete	All	50			24										
N.F. WW	Headwaters, 2	15	13-Aug-02	SN	Count	All	50			5										
Elbow Trib	9 Sites, 18% of Total Area	0.1	Oct, 1993	Elect.	Deplete	All	29.5			11						p				
Elbow Cr	65 Sites, 13% of Total Area	0-1.8	Oct, 1993	Elect.	Deplete	All	374	10.5		556	1			84		903				
Big Spring Cr.	300 m North of Stateline	1.2	23-Jan-02	Elect.	P/A	All	100	7.1		15				15	30	80	5			
Little WW West	Mouth	0.1	17-Jan-02	Elect.	P/A	All	150	4.8	1	4				2	2		2			
Little WW West	Public Access Area	1	10-Jan-02	Elect.	P/A	All	100	6.1		1				3						
Little WW West	Sunquist and Trolley Jnct.		17-Jan-02	Elect.	P/A	All	100	7.8						200		40				
Little WW West	Yancy Reser's Land		10-Jan-02	Elect.	P/A	All	100	6.4		2				7	5		1			
Little WW East	Sinden Property	0.3	23-Jan-02	Elect.	P/A	All	100	6		7				5	25	10	18		3	
Little WW East	Just above Big Spring Cr.	0.8	23-Jan-02	Elect.	P/A	All	100	6.4		4				20	100	100	25			

Walla Walla Fish Surveys (Continued) Salmonids Estimated Number of Non-Salmonids

River or Stream	Location	RM	Date	Method	Survey Type	Habitat Surveyed	Site Length (m)	Water Temp (C)	Chinook	Steelhead	Bull Tout	MWF	Brook Lamprey	Dace	Shiners	Sculpin	Suckers	Stickleback	Bull head
Birch Creek	BCWW		13-Jul-99	Elect.	P/A	All	75	20											
Couse Creek	Mouth	0.0	24-Jun-99	Elect.	P/A	All				7									
Couse Creek	Above mouth	0.1	24-Jun-99	Elect.	Deplete	All	88.8			12				15					
Couse Creek	Blue Mountain St. Rd.	3.5	23-Jun-99	Elect.	Deplete	All	95.3	17		151	1								
Couse Creek	Blue Mountain St. Rd.	3.5	26-Jul-01	Elect.	Deplete	All	100	16.3		185				30		55			
Couse Creek	Blue Mountain St. Rd.	3.5	7-Aug-02	EF	CPUE	All	24.8			3									
Couse Creek	Blue Mountain St. Rd.	3.5	7-Aug-02	SN	Count	All	24.8			8									
Couse Creek	Lower Shumway	4.3	15-Sep-99	Elect.	P/A	All		21		56				45		20	1		
Couse Creek	Shumway	4.6	23-Jun-99	Elect.	Deplete	All	92	18		105	1			75		150			
Couse Creek	Shumway	4.6	17-Sep-99	Elect.	P/A	All		20		94									
Couse Creek	Upper Shumway 1	4.7	21-Jun-99	Elect.	Deplete	All	68.2	15		138				50					
Couse Creek	Upper Shumway 2	4.7	21-Jun-99	Elect.	Deplete	All	63.5	12		74				20					
Couse Creek	Ubove Shumway	4.8	17-Sep-99	Elect.	P/A	All		20		10									
Couse Creek	Keseberg Can.	8.5	22-Jun-99	Elect.	Deplete	All	100	20		64				75		150			
Couse Creek	Hwy 204 & down 1/2 mile	15	28-Jun-99	Elect.	P/A	All	800	10											
Couse Creek	Vanderpool 1		21-Jun-99	Elect.	Deplete	All	47	14		49									
Couse Creek	Vanderpool 2		21-Jun-99	Elect.	Deplete	All	34.3	18		33				15		40			
Dry Creek	1/2 below Hwy 11 Bridge	8.5	12-Jul-99	Elect.	Deplete	All	63	22		6									
Dry Creek	Hwy 11 Bridge	9.0	12-Jul-99	Elect.	Deplete	All	75	22		31				450		20	150		
Dry Creek	D15-1		13-Jul-99	Elect.	Deplete	All	56.6	19		24									
Pine Creek	Off of Quary Rd.	13.5	9-Jul-99	Elect.	P/A	All	50	21						900					
Pine Creek	Lower Whitman C.	19.0	8-Jul-99	Elect.	P/A	All	86.3	24		2				6500		200	1500		
Pine Creek	Co. Br. at Charlie Betts	21.0	9-Jul-99	Elect.	P/A	All	83.6	17						400			3		
Pine Creek	Lieullen Switchback	29.5	7-Jul-99	Elect.	Deplete	All	74	21		16				10		500			
Pine Creek	Lieullen Lower		8-Jul-99	Elect.	Deplete	All	97.7	18		28				20		70			
Pine Creek	Lieullen Up. Boundary 1		7-Jul-99	Elect.	Deplete	All	63.5	15		54						500			
Pine Creek	Lieullen Up. Boundary 2		7-Jul-99	Elect.	Deplete	All	50	18		13						300			
Pine Creek	Rex Benzel Lower		6-Jul-99	Elect.	Deplete	All	50	17		73				10		300			
Pine Creek	Rex Benzel Upper		6-Jul-99	Elect.	Deplete	All	57.7	18		50				15		200			

Salvage Operations
The last two major salvage operations were conduced above and below Nursery Bridge Dam during the summers of 1999 and 2000. CTUIR, ODFW and local irrigation district personnel salvaged over 10,000 juvenile steelhead, and more than 100 bull trout (Table 2-3). Currently, irrigators provide enough water for fish in the mainstem Walla Walla River below Milton-Freewater. These large salvage operations are no longer necessary as fish are no longer stranded in isolated pools. Furthermore, the summer flows provide water to the fish ladder allowing fish to migrate upstream. In fact juvenile steelhead and Chinook were found rearing below Nursery Bridge Dam during August 2002 (Table 2-2).

Ongoing salvage operations are minor in comparison to the larger efforts of the past. Fish passage facilities and instream flows have eliminated most of the known, man induced, fish stranding problems in basin. However, fish can still get stranded in the fish bypass facilities at the end of irrigation season. Fish traveling in the Walla Walla River can enter canals through the head-gates. These fish are screened from the diversion and returned to the river via a pipe. The fish passage facilities prevent fish from moving down the canal and eventually being lost onto irrigated fields and pastures. CTUIR has worked cooperatively with irrigators to salvage salmonids that remained between the head-gates and bypass facilities after the head-gates were closed. To reduce the number of fish to be salvaged, irrigators reduce the flows significantly but allow some flow to encourage fish to leave the area on their own. The reduced flow also maintains the fish until we can collect them and haul them by bucket back to the mainstem. These types of salvage efforts usually involve from 10 to 100 fish. If time and conditions allowed, we PIT tagged juvenile Chinook and steelhead collected during the salvage operations to assist with the smolt monitoring objective. Occasionally, we salvaged fish at construction sites associated with fluvial systems. For example we moved 1,360 fish from areas affected by the construction of the new Nursery Bridge Fish Ladder during July 25 and 26, 2001 (Table 2-3).

Table 2-3 Summary of CTUIR fish salvage efforts conducted in coordination with ODFW and local irrigation districts in the Walla Walla River Basin (1999-2002).

Location	Date	Juvenile Steelhead	Chinook	Bull Trout	MWF	Brook Lamprey	Dace	Shiners	Sculpin	Suckers	Stickleback	S.M. Bass	Pumpkinseed	O. Pike Minnow	Carp	Chisel Mouth
Burlingame Dam	10-Jul-01	8				14		56	21	36	1			18	5	
Burlingame Dam	13-Jul-01	5				3		25	8	10						
Burlingame Dam	18-Dec-01	17	46	3			75	50	25	150	1	3	1	105		10
Burlingame Dam	15-Jan-02	2						50	20	50	15			15		
Nursery Bridge Area	29-Jun-99	1,531		5	4	7										
Nursery Bridge Area	30-Jun-99	1,993		61	6	9										
Nursery Bridge Area	1-Jul-99	3,001		42	19	16										
Nursery Bridge Area	30-Jun-00	2,263	1	8	11	9	31	4	94	2						
Nursery Bridge Area	6-Jul-00	1,251		2	3	8	95	73		27						
Nursery Bridge 25&26th	26-Jul-01	1,075	230	14	37	4										
East-Side Diversion	17-Oct-01	13	4													
Little WW: Below Screen	11-Dec-00	34														
Little WW: Below Screen	12-Dec-00	23		2												
Little WW: Above Screen	12-Dec-00	120		15												
Little WW: Above Screen	29-Dec-01	175	14	7												
Little WW: Above Screen	11-Jan-02	95	12	3			2		23		15					
Little WW: Above Screen	15-Jan-02	7				2	5		15	1						
Little WW: Below Screen	15-Jan-02	7			6											
Milton Diversion	19-Oct-00	150														
Milton Diversion	20-Oct-00	336														
Total		**12,106**	**307**	**162**	**86**	**72**	**208**	**258**	**206**	**276**	**32**	**3**	**1**	**138**	**5**	**10**

Smolt Monitoring

We trapped and PIT tagged juvenile spring Chinook salmon (CHS) and steelhead (STS) to evaluate their outmigration timing and survival from the Walla Walla Basin to the lower Columbia River. We used three different traps. The first was in the smolt by-pass channel at the Little Walla Walla Diversion in Milton-Freewater (RM 46.3, Figure 2-1). We also trapped in the fish ladder at Burlingame Diversion (RM 38.8) and with a rotary trap below Detour Road Bridge (RM 32.8). In this report we have provide initial results from the 2002 outmigration year. Further analysis will be made once we have collected several years of data. Work is continuing and we have provided a summary of our recent PIT tagging efforts from the current outmigration season though March 15, 2003 (Table 2-6).

<u>PIT Tagging and Detections:</u>

During the fall of 2001 and the spring of 2002, CTUIR PIT tagged 1190 Chinook and 135 steelhead. The PIT tag interrogation facilities at McNary, John Day and Bonneville Dams recorded a total of 207 of 1190 Chinook (17%) and 23 of 135 steelhead (also 17%). PIT tagging efforts extended from the fall through the spring, but most of the Chinook (94%) were tagged in the fall. Detections of PIT tagged spring Chinook parr tagged in the fall in the Walla Walla (17%) are similar to that observed during in the Umatilla River for fall tagged Chinook (16%, Ackerman et al. 2003). While sample sizes are modest, there was an apparent survival advantage for larger smolts for both steelhead and spring Chinook. Steelhead greater than 170 mm, were detected at a 32% rate (13 of 40 tagged) compared to 10% for steelhead less than 170 mm (10 of 95 tagged). Spring Chinook greater than 105 mm were detected at 24% (43 of 180) in contrast to 16% (164 of 1010) for those shorter than 105 mm.

Arrival Dates:

Most of the summer steelhead and spring Chinook tagged in the Walla Walla River passed through the lower Columbia from mid April to mid June. Both species had similar arrival dates at the lower Columbia River PIT tag interrogation sites (Figure 2-7). There was also a very significant difference ($P(t>= 7.577)<0.0001$) in arrival times between spring Chinook PIT tagged and released in the fall in comparison to those tagged and released in the spring (Figure 2-8). Fish tagged in the spring were up to 33 days behind the last arrival of fish tagged in the fall (May 21 compared to June 23).

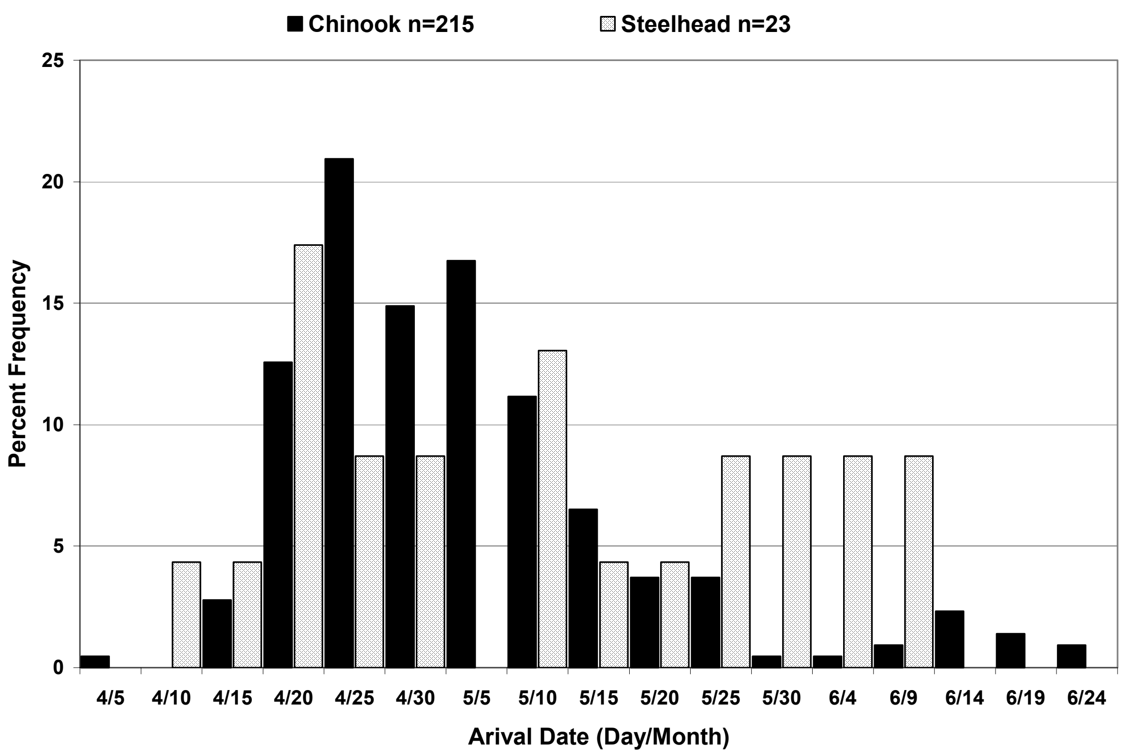

Figure 2-7 The percent frequency histogram of arrival dates to detection facilities in the lower Columbia River for both spring Chinook and summer steelhead that were PIT tagged and released in the Walla Walla River.

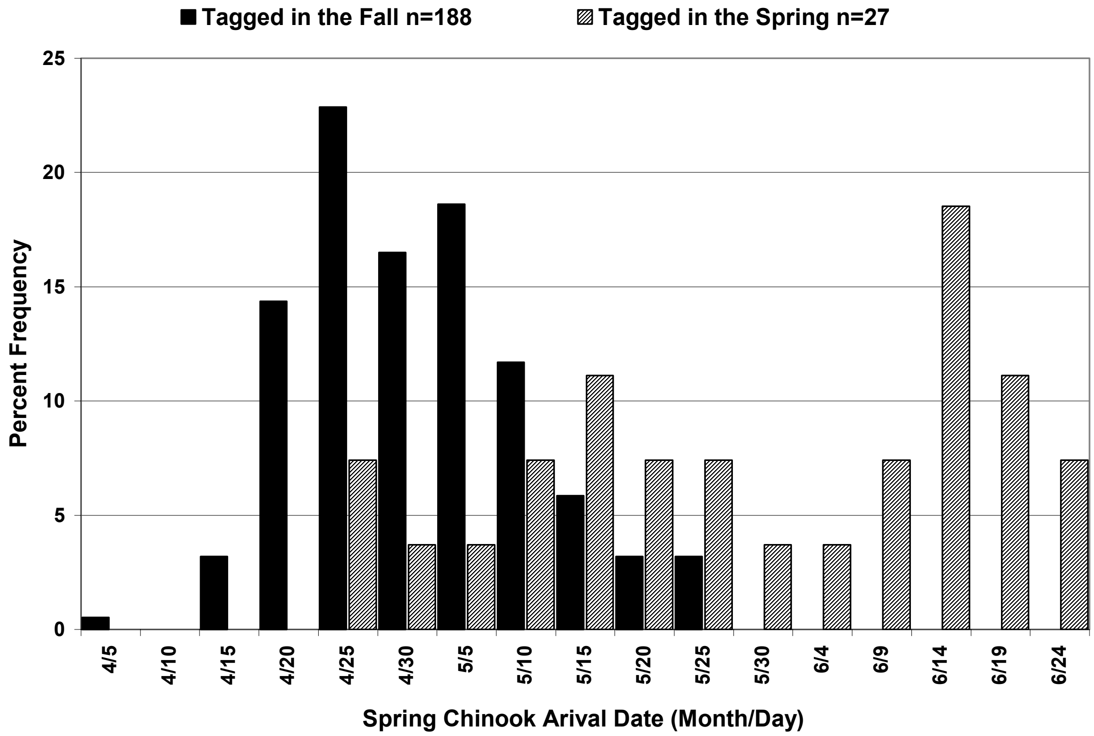

Figure 2-8 Percent frequency of spring Chinook arrival times at McNary, John Day and Bonneville Dams for migrants tagged and released both in the fall and spring.

Travel Time:

Travel times from release to detection were consistent with spring Chinook and summer steelhead life-history characteristics observed in the Umatilla River (Ackerman et al. 2003). A large number of juvenile salmon and steelhead move down from the headwaters in the fall when water temperatures in the mid and lower reaches become suitable for trout and salmon. Fish tagged in the fall leave the headwaters early, move at a slower pace, but arrive in the lower Columbia just before or at about the same time as fish the leave the headwaters in the spring. These different life-history characteristics provide for a wide range of travel times. Some steelhead tagged in the fall, were first detected after 194 days. First detection took as long as 245 days for some Chinook. On the other hand, steelhead tagged in the spring were detected as soon as four days. Chinook were detected as soon as seven days after tagging (Table 2-4 and Figures 2-9 and 2-10).

Table 2-4 Summary statistics for the travel times of spring Chinook salmon and summer steelhead PIT tagged in the Walla Walla River and detected in the Lower Columbia River.

Measure	Fall Tagged STS	Spring Tagged STS	Fall Tagged Chinook	Spring Tagged Chinook
Mean Days	150.1	14.5	171.8	23.0
Minimum Days	133	4	140	7
Maximum Days	194	32	245	50
n	8	15	188	27
Standard Error	6.677	2.280	1.882	2.395
Standard Deviation	18.886	8.831	25.806	12.444
Sample Variance	356.696	77.981	665.960	154.846

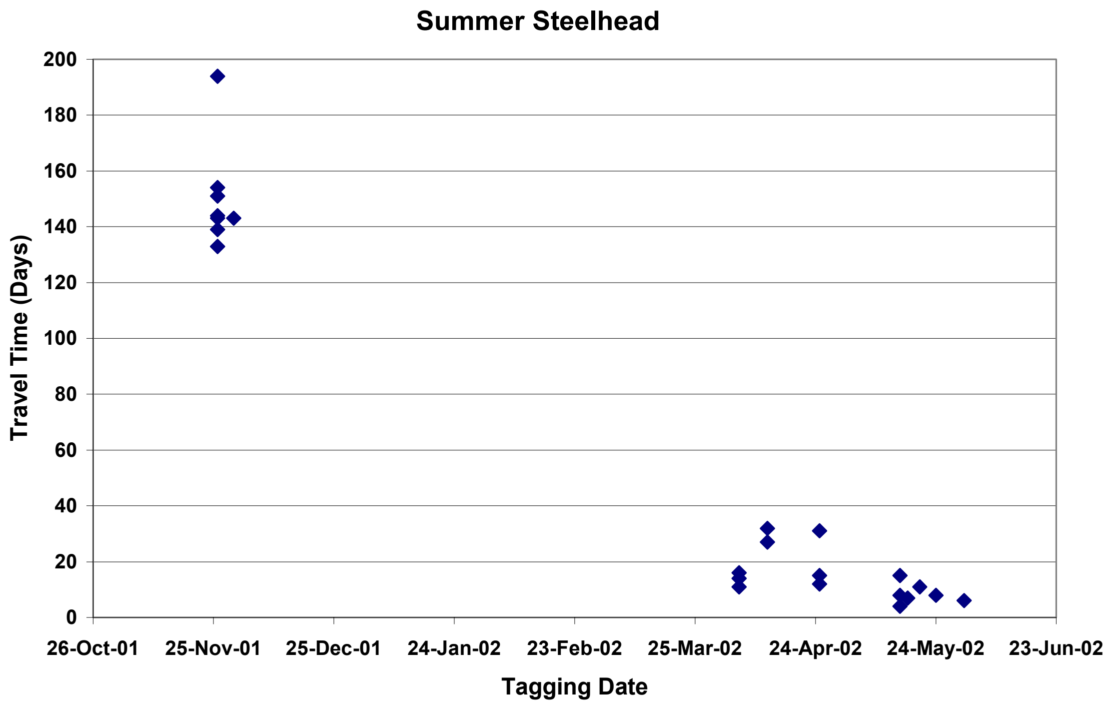

Figure 2-9 Travel time of PIT tagged steelhead out-migrants in relation to tagging date. Fish were PIT tagged and released into the Walla Walla River (RM 32.8, 38.2 and 46.3) and were detected at McNary, John Day and Bonneville Dams.

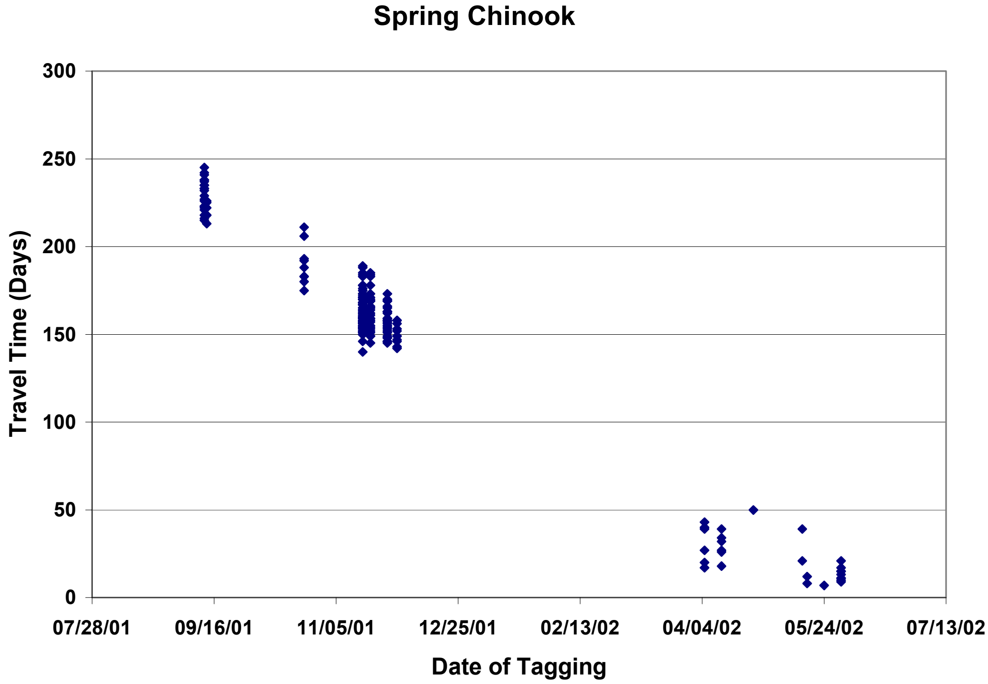

Figure 2-10 Travel time of PIT tagged spring Chinook out-migrants in relation to tagging date. Fish were PIT tagged in the Walla Walla River (RM 32.8, 38.2 and 46.3) and were detected at McNary, John Day and Bonneville Dams.

Length Data of PIT Tagged Salmonids:

The lengths at tagging for both spring Chinook and summer steelhead parr and smolts are listed in Table 2-5. Based on the deferential detection rates for larger fish discussed above (tagging and detections section), we hypothesized that there would be a significant difference between the lengths of all fish tagged in comparison to the lengths at tagging of those fish detected in the lower Columbia. At the 0.05 level there was not a significant difference for steelhead ($P(t \geq 1.857) \leq 0.0725$). For spring Chinook, we had a larger sample size and the difference was almost significant at the 0.05 level ($P(t \geq 1.936) \leq 0.0539$). Overall, it appears that for the 2002 migration year, there was a survival advantage for larger fish but the small sample sizes of larger fish (13 of 40 detected STS and 43 of 180 detected Chinook) masked the difference of the survival rates when using group length data as a diagnostic tool (Figures 2-11 and 2-12).

Continued growth from fall through spring would cause the fish tagged in the spring to be larger (at tagging) than fish tagged in the fall. In the Walla Walla River Basin, spring Chinook and summer steelhead were significantly longer than those tagged in the fall (Figure 2-13, Table 2-5, Chinook $P(t \geq 4.814) < 0.0001$, STS $P(t \geq 8.424) < 0.0001$, STS). These findings contrast with observations in the Umatilla River Basin where fork lengths of both Chinook and steelhead captured in rotary screw traps were significantly longer in the fall than in the spring (Contor et al. 1995, Table G-2). In the Umatilla, it appeared that the more of the larger fish left the headwaters in the fall while more of the smaller fish remained in the headwaters through winter. Preliminary findings from the 2002 migration year suggest salmonids may not demonstrate this behavior in the Walla Walla Basin.

Table 2-5 Summary of fork lengths at tagging for spring Chinook and summer steelhead parr and smolts PIT tagged in the Walla Walla River Basin during the fall of 2001 and spring of 2002.

Fork Length Measure	**Fall Tagged STS**	**Spring Tagged STS**	**Fall Tagged Chinook**	**Spring Tagged Chinook**
Maximum	195	215	125	130
Mean	130.6	160.7	90.7	97.5
Minimum	89	120	78	80
n	65	70	1122	68
Standard Error	1.855	3.054	0.231	1.402
Standard Deviation	14.953	25.553	7.721	11.560
Sample Variance	223.590	652.972	59.621	133.627

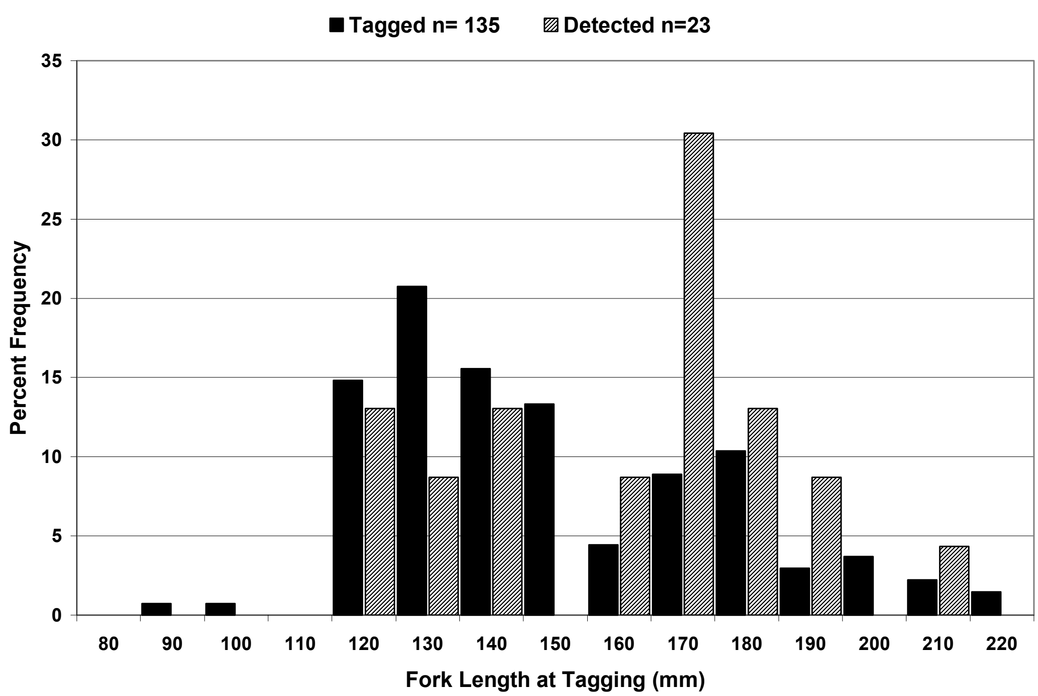

Figure 2-11 Length frequency of juvenile summer steelhead PIT tagged in the Walla Walla River, during the fall of 2001 and the spring of 2002, in contrast to the length at tagging of those detected in the Columbia River.

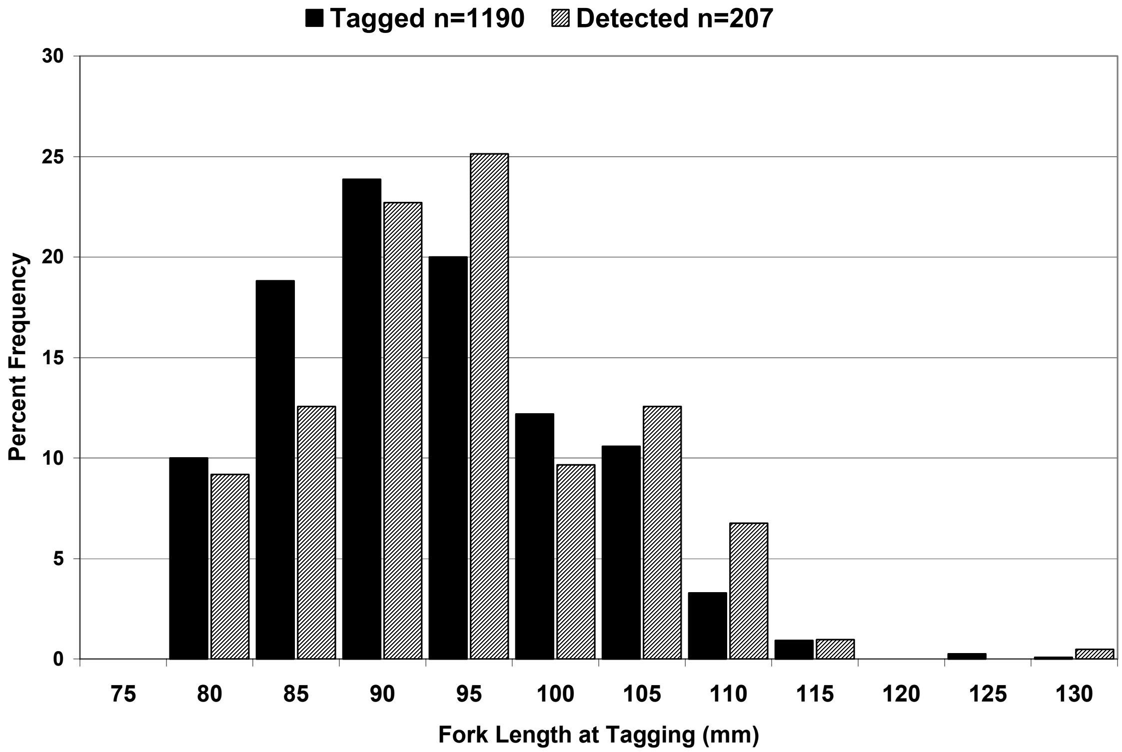

Figure 2-12 Length frequency of juvenile spring Chinook PIT tagged in the Walla Walla River, Fall 2001-Spring 2002, in contrast to the length at tagging of those detected at the Columbia River PIT tag interrogation sites.

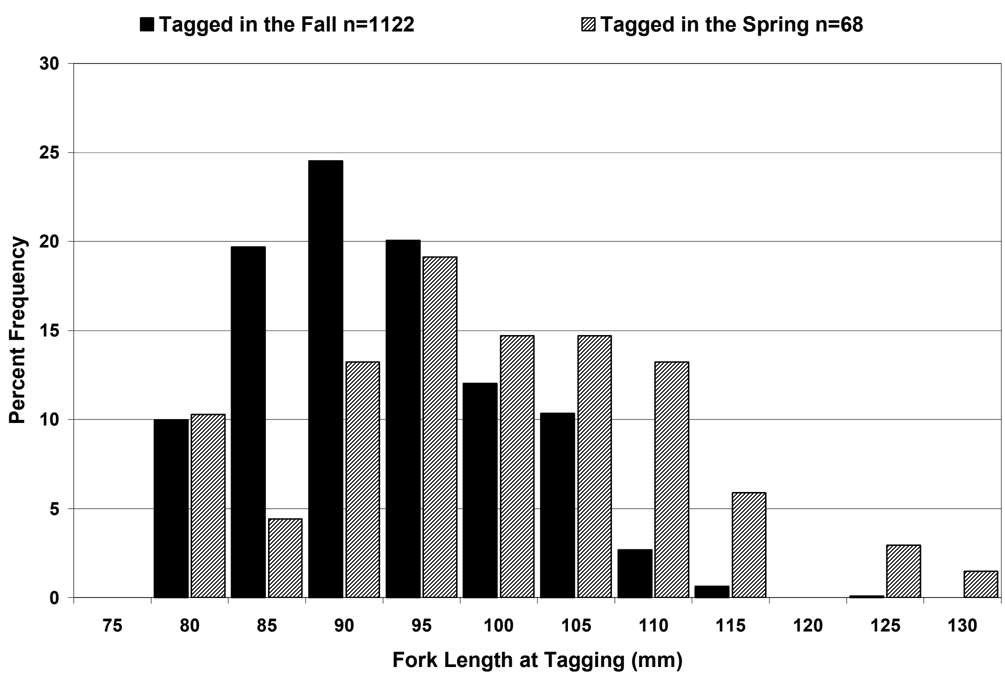

Figure 2-13 Length frequency of spring Chinook tagged in the fall of 2001 in contrast to fish tagged in the spring of 2002.

Table 2-6. Summary of PIT tagging efforts in the Walla Walla Basin through March 15, 2003 for migration year 2003.

Trap Location	Water Temp C	Date	Salmonids CHS Tag	CHS Other	CHS RCP	STS Tag	STS Other	STS RCP
Burlingame	4	1-Nov-02	3	0	0	1	2	0
Burlingame	3.5	6-Nov-02	16	0	0	7	2	0
Sub-Total			19	0	0	8	4	0
Little WW	5.8	29-Oct-02	400	58	0	0	20	0
Little WW	3.4	30-Oct-02	517	131	50	3	148	0
Little WW	3	1-Nov-02	181	40	23	2	20	0
Little WW	4.5	6-Nov-02	249	47	25	2	36	0
Little WW	8	8-Nov-02	250	15	22	0	38	0
Little WW	8.5	13-Nov-02	50	10	5	0	8	0
Little WW	3.8	6-Dec-02	194	20	24	2	10	0
Little WW	3.8	10-Dec-02	294	65	42	5	38	0
Little WW	6	12-Dec-02	297	53	54	2	40	0
Little WW	5	18-Dec-02	388	40	49	8	72	0
Little WW	4	19-Dec-02	297	28	62	3	21	0
Little WW	3	24-Dec-02	146	4	44	3	31	0
Little WW	5	30-Dec-02	146	6	45	2	28	0
Sub-Total			3409	517	445	32	510	0
Rotary Trap	6	14-Jan-03	10	5	0	1	1	0
Rotary Trap	5	21-Jan-03	7	1	1	0	2	0
Rotary Trap	7	26-Jan-03	10	2	1	0	3	0
Rotary Trap	6	14-Feb-03	69	2	3	23	4	0
Rotary Trap	6	21-Feb-03	63	8	7	8	3	0
Rotary Trap	5	25-Feb-03	111	3	5	11	5	0
Rotary Trap	7	4-Mar-03	86	6	13	14	4	0
Rotary Trap	7	7-Mar-03	28	6	2	1	3	0
Rotary Trap	9	14-Mar-03	11	2	0	4	2	0
Sub-Total			395	35	32	62	27	0
Total			3823	552	477	102	541	0

Age and Growth
Age was determined from scales collected from 55 bull trout ranging from 120 mm long at age 2+ to 655 mm at age 6+ (Table 2-7). Considerable overlap in lengths occurs between age classes Figure 2-14.

Table 2-7. Age and length data taken from bull trout observed in the Walla Walla River Basin.

Location	Date	Fork Length (mm)	Age	Sex	Comments
Griffin Creek- SF Touchet	10-Aug-99	120	2+		Electrofished
Nursery Bridge	30-Jun-00	140	2+		
Nursery Bridge	30-Jun-00	140	2+		
Nursery Bridge	30-Jun-00	145	2+		
Nursery Bridge	30-Jun-00	146	2+		
Little Walla Walla Diversion	16-Jul-99	158	2+		Salvage
Just below Nursery Bridge	1-Jul-97	180	2+		Salvage
Little Walla Walla Diversion	16-Jul-99	183	3+		Salvage
Nursery Bridge	30-Jun-00	190	2+		
Ready Mix-MF	1-Jul-97	200	3+		Salvage
Just below Nursery Bridge	2-Jul-98	200	3+		Salvage
Little Walla Walla Diversion	16-Jul-99	200	3+		Salvage
Little Walla Walla Diversion	16-Jul-99	210	3+		Salvage
Just below Nursery Bridge	2-Jul-98	217	3+		Salvage
Just below Nursery Bridge	2-Jul-98	222	3+		Salvage
Just below Nursery Bridge	1-Jul-97	224	2+		Salvage
Nursery Bridge	2-Jul-97	225	3+		Salvage
SF Walla Walla- RM 20	3-Nov-99	225	3+	M	Mortality-immature-otoliths read
Little Walla Walla Diversion	16-Jul-99	230	3+		Salvage
Little Walla Walla Diversion	16-Jul-99	232	3+		Salvage
Nursery Bridge to LWW Div	2-Jul-97	238	3+		Salvage
Just below Nursery Bridge	2-Jul-98	242	3+		Salvage
Nursery Bridge to LWW Div	2-Jul-97	260	3+		Salvage
Nursery Bridge to LWW Div	2-Jul-97	290	3+		Salvage
Salvage-Nursery Bridge	14-Jun-96	293	3+		Electrofished
SF Hatchery Facility-river	15-Jul-99	300	3+		Electrofished
SF Walla Walla River- RM23	29-Sep-93	325	5+	F	Scale margin eroded from spawning
Nursery Bridge Trap	7-Apr-98	330	4+	M	
Nursery Bridge Trap	18-Apr-96	330	4+	M	2 circuli of the year
Nursery Bridge Trap	1-May-94	330	4+		

Nursery Bridge Trap	18-May-98	340	3+		
Nursery Bridge Trap	16-May-96	340	4+		
Nursery Bridge Trap	7-May-94	345	4+		
Nursery Bridge Trap	16-May-96	350	3+		
Nursery Bridge Trap	19-May-98	350	4+		
Walla Walla Trap	16-Apr-94	350	4+		
Nursery Bridge Trap	19-Apr-98	360	4+	M	
Nursery Bridge Trap	29-May-95	360	4+	M	
Nursery Bridge	2-Jul-97	365	3+		Salvage
SF Walla Walla River	17-Oct-95	370	4+		Spawner-mort
Nursery Bridge Trap	23-Apr-98	380	R	M	Very poor scale
Walla Walla River	2-May-96	381	R	M	
SF Hatchery Facility-river	15-Jul-99	385	4+		Electrofished
Nursery Bridge Trap	7-Mar-95	387	5+		Mort-5 circuli of the year
Nursery Bridge Trap	20-Apr-98	390	4+		
Walla Walla River	17-Apr-94	406	4+		
Nursery Bridge Trap	17-Apr-94	406	4+		
Walla Walla River	11-Jul-95	419	R		Prespawn mort
Nursery Bridge Trap	16-May-96	425	R		
Little Walla Walla Screen	22-Apr-93	440	6+		Mort
Walla Walla River	26-Mar-94	440	R		Sport caught
SF Walla Walla River- RM22	20-Sep-93	445	R	F	
SF Hatchery Facility-river	15-Jul-99	495	5+		Electrofished
Little Walla Walla Screen	27-Oct-95	546	5+		Post spawn mort
SF Hatchery Facility	15-Jul-99	655	6+		Electrofished

Summer steelhead (*O mykiss*) had almost complete overlap in length by ages (Figure 2-15 and 2-16). In the Walla Walla Basin, the growth rates of rainbow are considerably slower than bull trout. Of 780 *O. mykiss* aged, only 10 were age 4+ (150 to 330 mm) and only one was age 5+ (240 mm). We purposely avoided young of the year for the most part but we did take scales on 23 age 0+ fish (49 to 87 mm). The mean length for age 3+ O. mykiss in the Walla Walla Basin is less than 180 mm. This is about half the length for age 3+ resident rainbow trout in productive systems of Western North America (Angradi and Contor et al. 1989). The apparent slower growth of *O. mykiss* may be an artifact (in part) created by the larger, faster growing *O mykiss* migrating to the ocean just after their second winter. The out-migrations would bias the sample by leaving the slower growing individuals for collection. Slow growth of *O mykiss* in the Walla Walla basin is significantly more pronounced in the headwater areas (age 2+ $P(t >= 7.484) < 0.0001$, age 1+ $P(t >= 9.085) < 0.0001$, Figures 2-17 and 2-18), where water temperatures are much colder and the oligotrophic nature of the streams limit energy pathways to fish (see Chapter 4 for water temperature information). Furthermore, channelization and the loss of complex habitat types compounded by the loss of adult spring Chinook salmon from the basin for the last 70-80 years may have also reduced the salmonid rearing capability of the basin. The reduced growth rates of *O mykiss* in the Walla Walla Basin probably has both natural and anthropogenic components and should favor anadromous behavior if mortality is not too severe in the migration corridors and the Ocean. Without sufficient passage, there may not be enough selective advantage to promote and maintain abundant anadromous forms of *O. mykiss* in the basin.

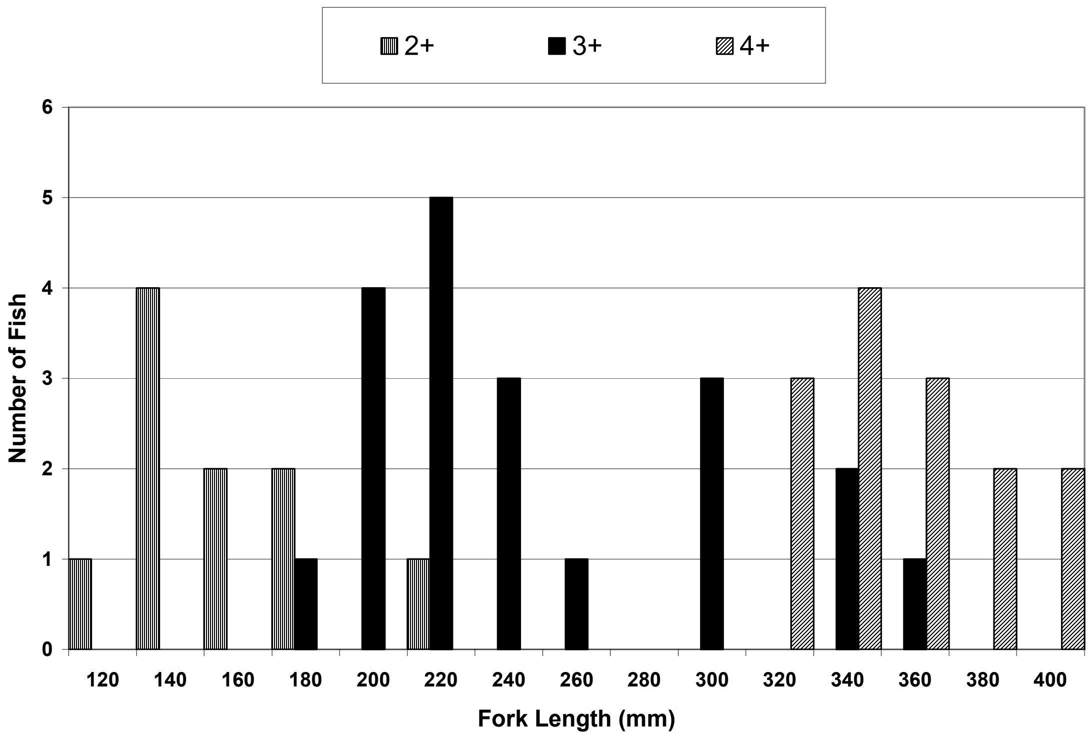

Figure 2-14 Bull trout age and length histogram for the Walla Walla River for ages 2+, 3+ and 4+ (n=44).

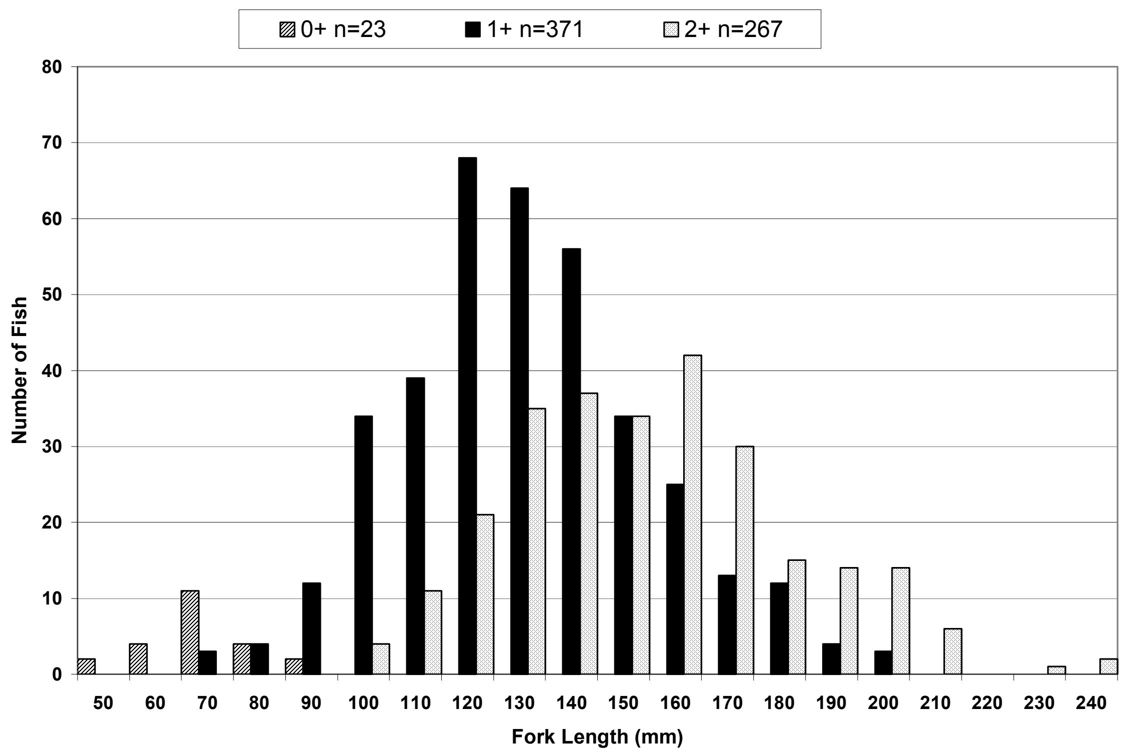

Figure 2-15 Age and length histogram for *O. mykiss* in the Walla Walla River Basin, ages 0+, 1+ and 2+.

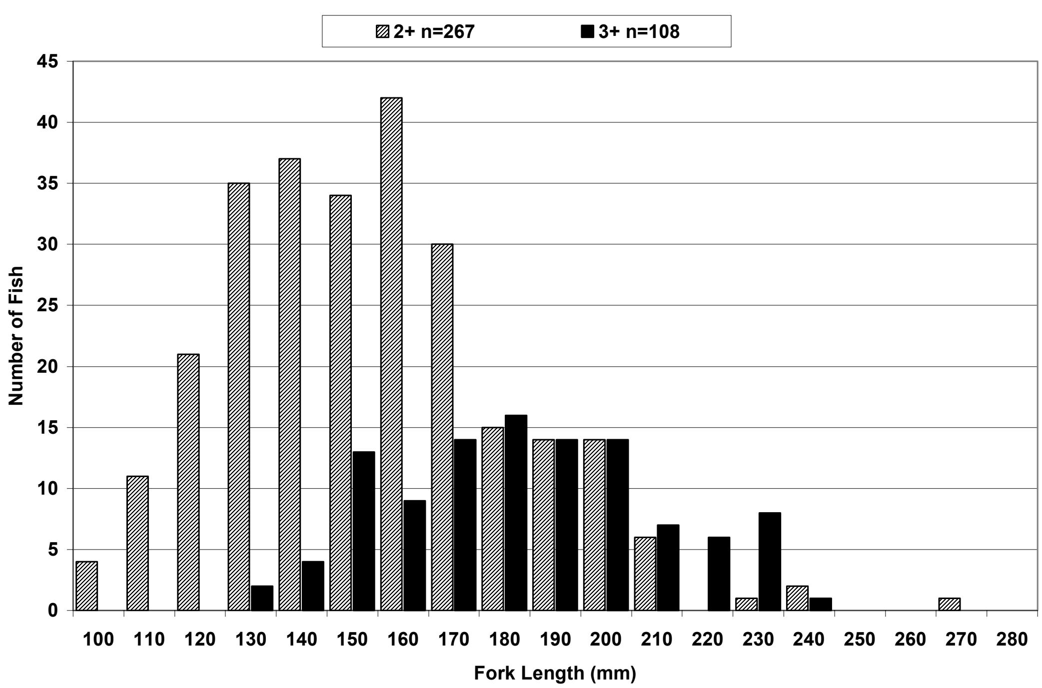

Figure 2-16 Age and length histogram for .*O mykiss* in the Walla Walla River Basin, age 3+; length frequencies of age 2+ fish are included for comparison.

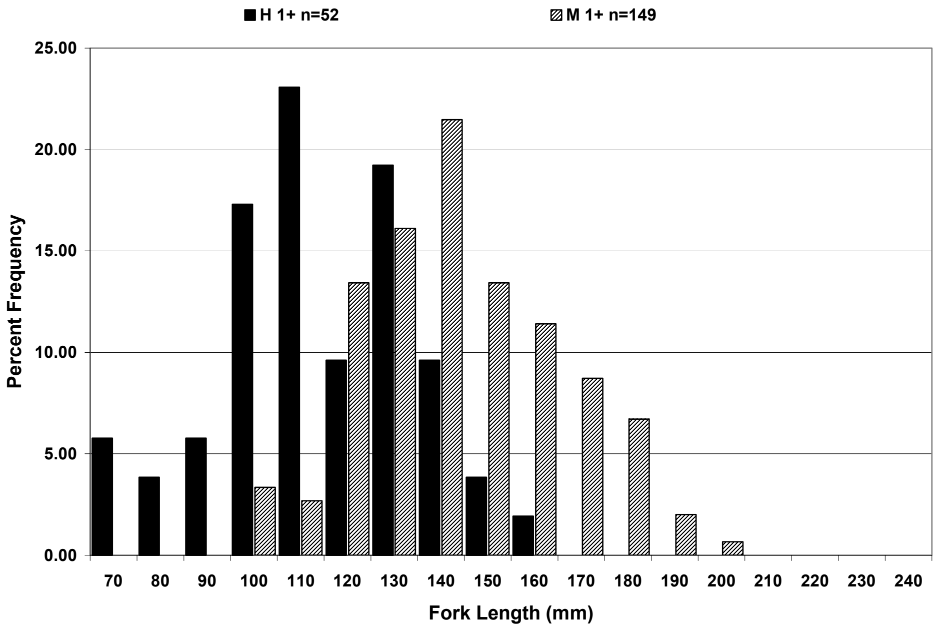

Figure 2-17 Length frequency histogram for age 1+ O. mykiss from two different areas of the Walla Walla River Basin. H 1+ fish are from four headwater reaches, N. F. Walla Walla, N. F. Touchet, Griffin Fork of the S.F. Touchet and West Pattit Creek. M 1+ fish are from mid-basin reaches of Mill Creek and the mainstem Walla Walla River near Milton-Freewater.

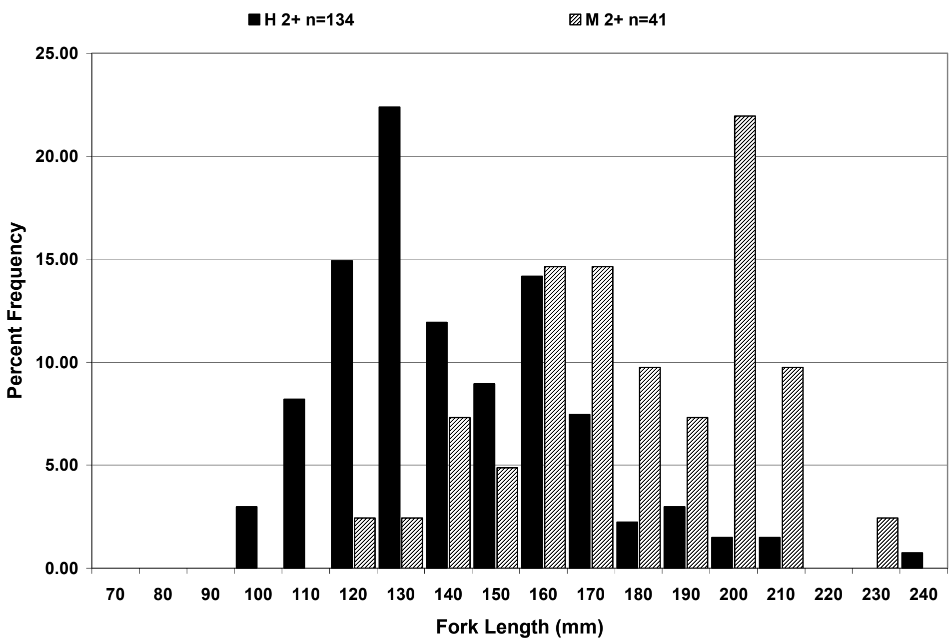

Figure 2-18 Length frequency histogram for age 2+ O. mykiss from two different areas of the Walla Walla River Basin. H 2+ fish are from four headwater reaches , N. F. Walla Walla, N. F. Touchet, Griffen Fork of the S.F. Touchet and West Pattit Creek. M 2+ fish are from mid-basin reaches of Mill Creek and the mainstem Walla Walla River near Milton-Freewater.

Salmonid Life-Histories

Spawning surveys, electrofishing, juvenile trapping, PIT tagging, and adult telemetry studies all provided information about salmonid life-histories in the Walla Walla Basin. Figures 2-19 and 2-20 represent how fish use the basin in their various life history stages. The different areas are generalized and the lower river section begins at the mouth and extends up to Whitman. Lower river tributaries include lower Touchet (mouth to Waitsburg), Pine Creek, both Dry Creeks and Mud Creek (near Milton-Freewater). The mid section stretches from Whitman to Nursery Bridge Dam in Milton-Freewater. The mid tributary reaches include the Touchet from Waitsburg to Dayton, Mill Creek from the mouth to Blue Creek and Yellowhawk Creek and the other foot hill stream such as Russell, Couse, Cottonwood etc. The headwater reaches and tributaries extend from the mid reaches to the foothills and Blue Mountains. Juvenile spring Chinook and steelhead utilized the headwaters and higher quality mid-basin reaches during the summers for rearing. At the onset of fall, some individuals begin to drop down into the mid and lower reaches. Almost all spring Chinook migrate to the Columbia River after their first winter (Figure 2-19). Steelhead have a more diverse life-history and may migrate at as age 1+ (as small as 80 mm) or wait until they are 3+. Based on current information, we estimate that about 80-90% of the steelhead smolts move into the Columbia after their second winter at age 2+.

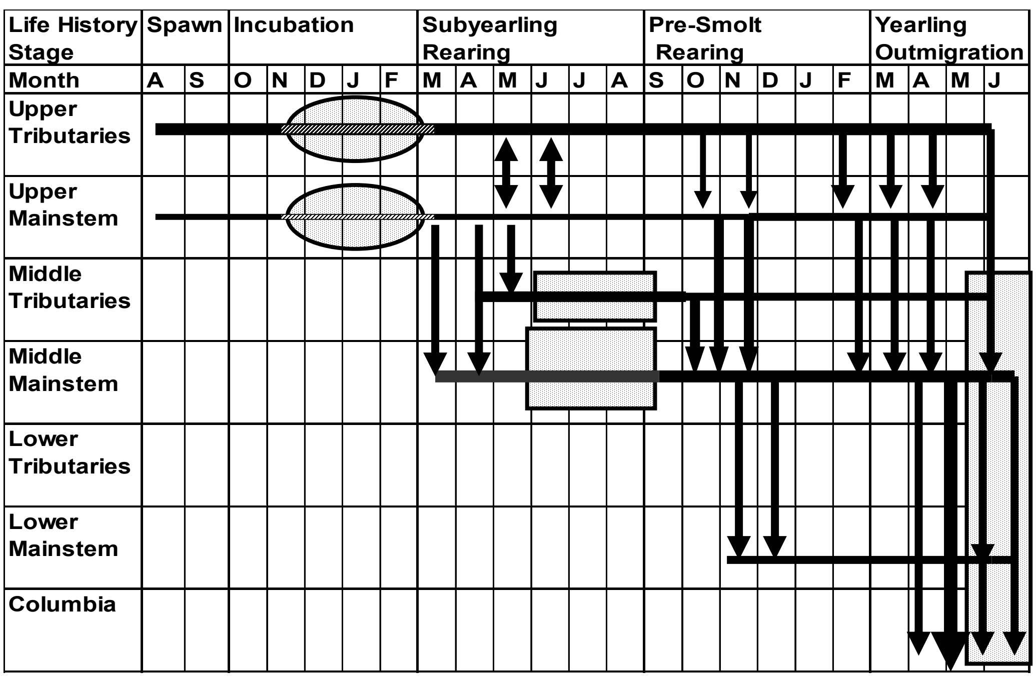

Figure 2-19 Preliminary spring Chinook life-history diagram for the Walla Walla River Basin. The shaded ovals represent potential impacts from high flows. The shaded squares represent impacts from high water temperatures and lack of instream flow.

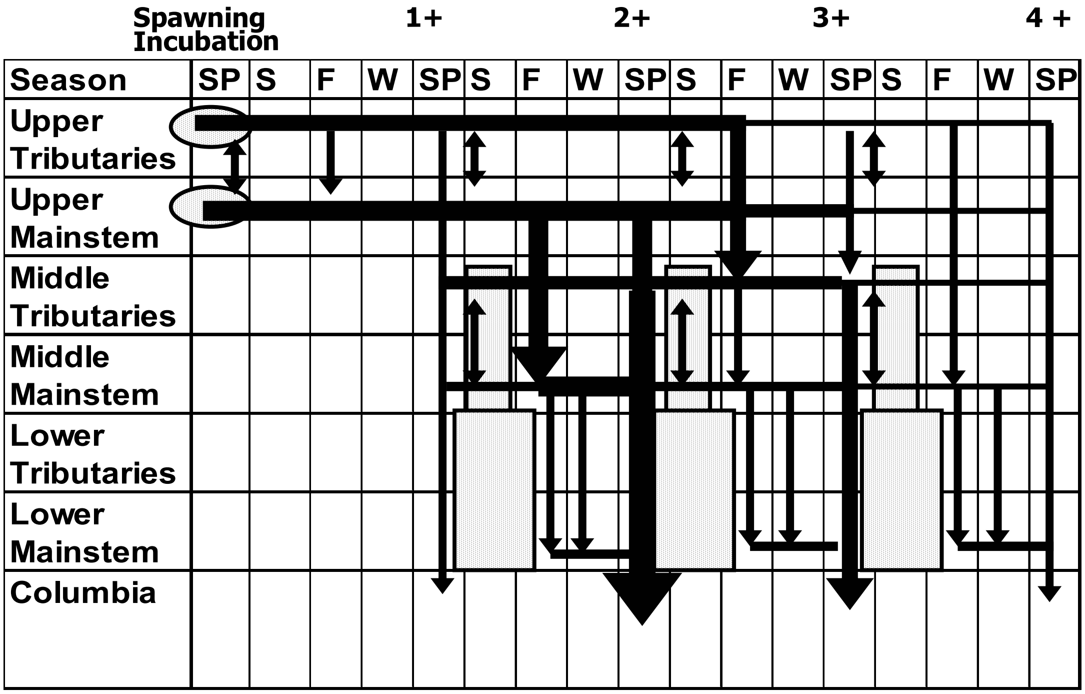

Figure 2-20 Preliminary summer steelhead life-history diagram for the Walla Walla River Basin. The shaded ovals represent potential impacts from high flows. The shaded squares represent impacts from high water temperatures and lack of instream flow.

RECOMMENDATIONS

Fish habitat in the mainstem of the Walla Walla River and lower portions of the South Fork, North Fork, and Mill Creek lack pools, cover, shade, and channel complexity. Critical habitat for summer rearing and winter holding is lacking in many of these reaches. Many of these problems are the direct result of federal flood channelization projects associated with protecting rural and urban areas built on the flood plain. In addition, land-use planning and zoning officers continue to allow new buildings and roads to be placed alongside and over streams in direct conflict with best management practices. Mitigation and enhancement should be considered for these reaches, including the restoration of pools, woody debris, shade, and off-channel rearing areas to provide important habitat for juvenile and adult salmon, steelhead and bull trout. The lack of sufficient in-stream-flow below Milton-Freewater throughout the summer and fall continues to be a problem in the Walla Walla River. The mandated addition of twenty-five cfs of base summer flow to the area below Nursery Bridge Dam and more gradual flow changes have greatly improved conditions for bull trout and other salmonids in this area. The current strategy prevents take. However for restoration, additional flows are needed to address salmonid habitat needs below Nursery Bridge. Additional flow needs are being examined through the ongoing CTUIR-USACE flow augmentation feasibility study.

ACKNOWLEDGEMENTS

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

The authors thank the following CTUIR employees for their contributions to the project: Gary James, fisheries program manager, for project management, assistance and manuscript review; Michelle Thompson for contract administration; Julie Burke, Celeste Reeves and Esther Huesties for managing the Fisheries Office.

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CHAPTER THREE: SPAWNING SURVEYS

SPRING CHINOOK SALMON AND SUMMER STEELHEAD SPAWNING SURVEYS:

THE WALLA WALLA BASIN NATURAL PRODUCTION MONITORING AND EVALUATION PROJECT

PROGRESS REPORT
1999-2002

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INTRODUCTION

The Walla Walla Basin Natural Production Monitoring and Evaluation Project (WWNPME) was funded by Bonneville Power Administration (BPA) as directed by section 4(h) of the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (P. L. 96-501). This project is in accordance with and pursuant to measures 4.2A, 4.3C.1, 7.1A.2, 7.1C.3, 7.1C.4 and 7.1D.2 of the Northwest Power Planning Council's (NPPC) Columbia River Basin Fish and Wildlife Program (NPPC 1994). Work was conducted by the Fisheries Program of the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) under the Walla Walla Basin Natural Production Monitoring and Evaluation Project (WWNPME). This chapter provides a summary of spawning survey findings from 1999 through 2002 with additional information from 1992, 1994 and 1995. Data and reports from this and previous efforts will be available at http://198.66.210.119/database (summer of 2003). In the future, all data and reports will be available through http://www.umatilla.nsn.us (CTUIR website).

Objective D: Objective 2 in the 2000 SOW and Objective 1 in the 2001 and 2002 SOW. Monitor spawning activities of hatchery and natural adult spring Chinook[3] salmon, and summer steelhead in the Walla Walla River Basin. Summarize spawning survey data collected to date and evaluate improved sampling design and protocol developed by ODFW and recommended by the ISRP.

Task D.1 Work with ODFW to evaluate and improve the spawning survey sample design to meet local and regional management needs, ISRP recommendations and BPA staff requirements.

Task D.2 Conduct spawning surveys for summer steelhead and spring Chinook to maintain trend data while the new spawning surveys methods and protocols are being developed and evaluated. Document the number and location of redds and examine carcasses in existing index sites as conditions allow.

Task D.3 Estimate adult escapement and survival to spawning and total egg deposition for spring Chinook salmon. Collect and record length, sex, pre and post-spawn mortality data, coded wire tags, marks, fin clips, kidney samples and scales from the appropriate carcasses examined on the spawning grounds.

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

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

METHODS

Escapement surveys were conducted in various reaches of the Walla Walla Subbasin to enumerate summer steelhead and spring Chinook salmon redds. Live adults were counted when conditions allowed and carcasses were examined when found. Individual reaches were surveyed before, during and/or after spawning. Surveyors wore baseball caps and polarized glasses to maximize fish observing capabilities. Redds were judged to be complete (and thus spawning successful) based on redd size and depth, location, and amount and size of rock moved. Redds were marked with flagging and the date, location and number of females and males on or near the redd and their spawning status were written with permanent marker on the flagging. For each observed redd, the surveyor recorded the location, date the redd was first observed, sex and number of fish observed on or near the redd, fish sampled, and spawning habitat type (riffle, tailout, glide).

Carcasses were measured from the middle of the eye to the hypural plate (MEHP) and tip of snout to fork of tail (fork length) if the fish was adipose clipped. Carcasses were cut open to determine the egg retention of females and spawning success of males. Tails of sampled fish were removed at the caudal peduncle to prevent subsequent sampling. Snouts of adipose clipped and adipose clipped plus left or right ventral fin clipped spring Chinook salmon were removed behind the orbit to recover coded wire tags. Snouts were placed in plastic bags and given individual snout numbers. The snout number linked the snout with other biological data collected from the individual fish.

The number of spring Chinook salmon eggs deposited in redds was estimated by multiplying the mean fecundity observed during spawning activities in the hatchery times the number of redds observed. We did not estimate the number of redds not observed by surveyors or the number of eggs represented by those redds.

RESULTS AND DISCUSSION

Spawning Survey Design

We developed a new steelhead spawning survey sample design and methodology late in 2001 and early in 2002 to complete Task 1. We worked with Bruce McIntosh of ODFW's Corvallis Research Station and developed a joint plan for both the Walla Walla and Umatlla Basins. We planned to utilize a stratified-random rotating-panel design described by Firman and Jacobs (2001). The strategy followed ongoing work conducted by ODFW on the Oregon coast as recommended by ISRP. However, this plan was rejected by BPA because of additional costs and continuing uncertainty about the effectiveness of the method in our region. They also had concerns about how WDFW spawning surveys would be meshed with the new design. They decided to evaluate the method through a pilot project in the John Day River Basin before committing considerable resources to other subbasins. Given that our initial plan was not adopted or funded, we continued with the same limited surveys that were conducted in 2001 (Figure 3-1). Both the summer steelhead spawning surveys and the spring Chinook salmon spawning surveys were limited in scope because of limitations in manpower as well as access to private lands. We will continue to work with ODFW, WDFW, BPA and others to develop a cost effective monitoring strategy and protocol to estimate adult returns and monitor spawning activities in the Walla Walla Basin.

Summer Steelhead

Steelhead spawning ground surveys have been conducted in various reaches of the Oregon portion of Walla Walla Basin intermittently since 1992 (Figure 3-1). Mendel (et al. 2002) conducted more extensive steelhead spawning surveys in the Washington portion of the Walla Walla basin including the Touchet River and Mill Creek. Tributaries surveyed by CTUIR and ODFW include:

1) The South Fork Walla Walla River from the hatchery (RM 5.3) to Burnt Cabin Creek (RM 14.1, 8.8 miles);
2) Couse Creek from the mouth to three miles above the end of Couse Creek Road (9.7 miles);
3) The North Fork Walla Walla River from Carol Sams' house (RM 1) upstream for seven miles (RM8, conducted by ODFW), and
4) Mill Creek from Kooskooski Highway Bridge (RM 20.8) to Paradise Creek (RM 28.9, 8.1 miles).

Survey conditions were often poor because of late snow melt in the headwaters. Results of surveys conducted to date are in Table 3-1. Because of the intermittent nature of surveys before 2001, additional years of intensive surveys will be necessary to determine the current status of summer steelhead in important spawning tributaries. Total egg deposition was not estimated because the total number of spawners or redds was not determined.

Reasonable numbers of steelhead redds have been observed in the South Fork Walla Walla and Couse Creek. However, few redds have been observed in Mill Creek since 1992. Brian Mahoney observed problems with the adult fish ladder at the Bennington Lake Diversion (2003, Chapter Six of this report). In fact, a steel plate with a small orifice had been inserted into the top of the ladder. This small orifice created a velocity barrier. We do not know how long the ladder had been blocked. We consider the installation of this plate to be a flagrant violation of NMFS criteria for the operation and maintenance of adult passage facilities. This action may have eliminated access to upper Mill Creek for salmonids for a number of years. The remnant Mill Creek steelhead stock may have been driven to very low number by these problems. In 1992, CTUIR observed 23 redds in Mill Creek but there were no redds observed in 1999. Bull trout that wintered in the lower section of Mill Creek may have also been blocked from the upper watershed. When water temperatures rise in the summer bull trout could die in the lower river if adequate passage is not provided. Since both steelhead and bull trout are listed under the Endangered Species Act, it is reasonable that efforts should be made to eliminate the passage problem in lower Mill and Yellowhawk Creeks.

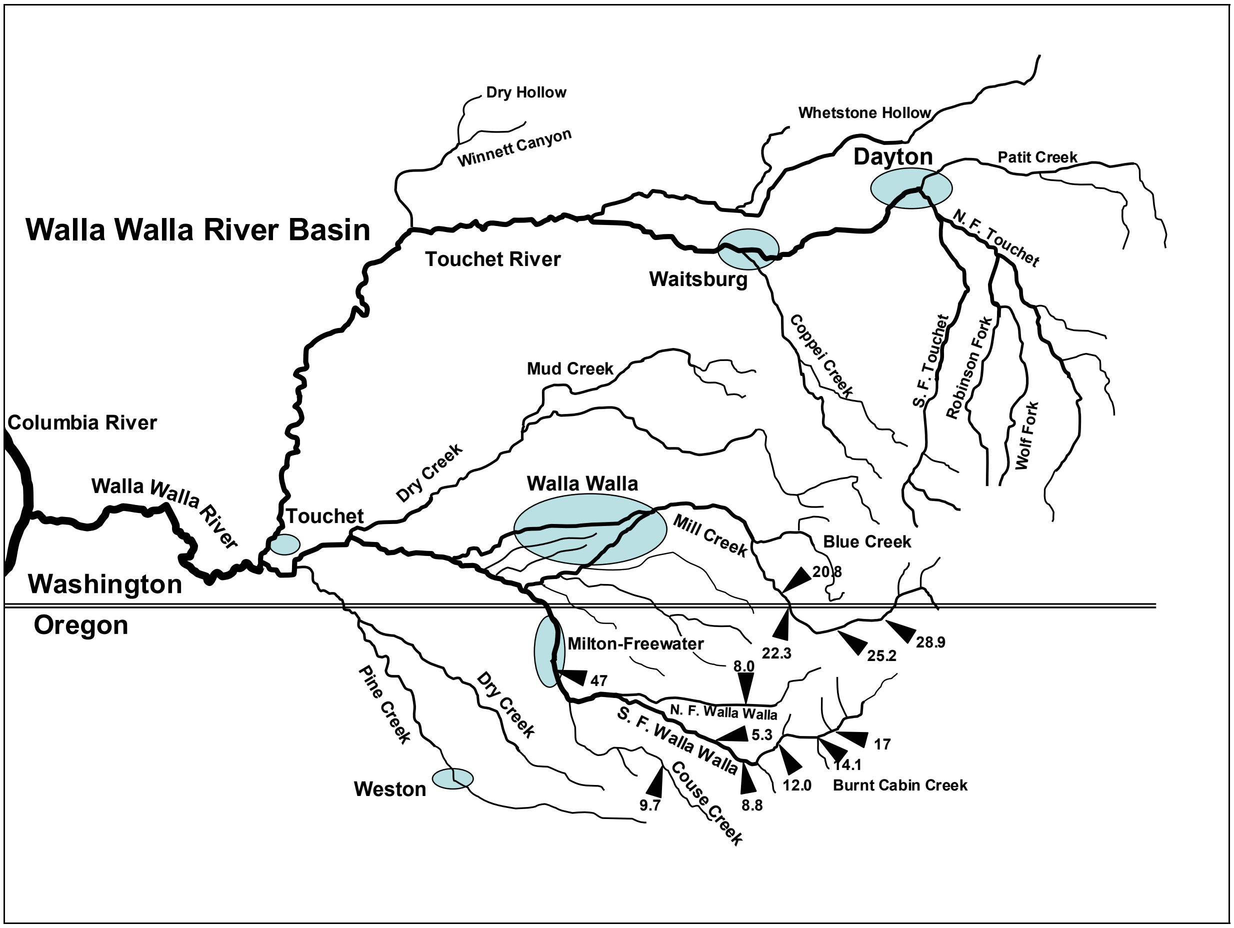

Figure 3-1 River miles denoting spawning survey reach boundaries in the Walla Walla River Basin (1992-2002).

Table 3-1 Summer steelhead redds / rainbow trout redds observed in the Walla Walla River Basin from 1992 through 2002. *ODFW conducted the surveys in 1994 and 1995.

Stream Reach	1992	1994*	1995*	1999	2000	2001	2002
South Fork Walla Walla, RM 5.3 to 14.1	35/	21/		3/16		38/25	28/9
North Fork Walla Walla, RM 1-8		36/					
Couse Creek, RM 0-9.7	2/		21/		0/1		49/0
Mill Creek, RM 20.8 to 28.9	23/			0/23		6/104	3/47

Spring Chinook Salmon

Spring Chinook salmon adults were released in the South Fork of the Walla Walla River at RM 5.3 and 7.0 and in the Oregon portion of Mill Creek at RM 22.3 (Tables 3-2 and 3-3). Adults Chinook were from Ringold Springs Hatchery north of Richland, Washington (2000-2002) and from the Umatilla River (2002 only). Fish were held in the South Fork Walla Walla adult holding facility and released approximately one week before the onset of spawning. Hatchery broodstock held at the South Fork Facility had average fecundities of 3,737, 4,168 and 3,824 for brood years 2000-2002 respectively. These numbers were used to estimate egg deposition in redds for both the South Fork and Mill Creek redds (Tables 3-2 and 3-3)

In the South Fork, adults were out-planted at the bridge just downstream from Harris Park and at the hatchery. Spring Chinook salmon were observed spawning from the Little Walla Walla Diversion to above Skiphorten Creek (RM 17.0), with the majority of spawning occurring within 4 miles above or below the release site. The number of redds observed during spawning ground surveys varied between 101 and 339 (Table 3-2). Fish per redd ranged from 2.3 to 3.2. The number of redds per mile varied between 4.5 and 27.3. Estimates of eggs deposited in redds in the South Fork ranged from 370,000 in 2000 to 1.4 million in 2001. Based on carcasses surveys, prespawning mortality during the past three years was between 2.1% and 8.0%. These low pre-spawning mortality estimates provide a significant contrast to observed mortalities in the Umatilla River. Kissner (2003) reports that pre-spawning mortality in the Umatilla River averaged over 60% during the last 12 years. Poor water quality is attributed to the significant mortalities. Pre-spawning mortalities averaged only 4.1% in the North Fork of the Umatilla River where water quality is nearly as good as in the South Fork of the Walla Walla River.

In Mill Creek, adults were out-planted approximately 100 yards above the Washington-Oregon border, just above Kiwanis Camp (RM 22.3). The annual number of redds enumerated varied between 23 and 53 from 2000-2002 (Table 3-3). The number of fish per redd varied between 2.2 and 2.8. The number of redds enumerated per mile varied between 4.9 and 6.5. Estimates of eggs deposited in redds in Mill Creek ranged from 88,000 in 2002 to 220,000 in 2001. Based on carcasses, prespawning mortality during the last three years varied between 0.0% and 21.9%. Spawning was observed from just above Kooskooski Highway Bridge upstream to just below Paradise Creek. Most fish spawned above the release site. The best spawning and rearing habitat was above the Mill Creek Diversion for the City of Walla Walla's water supply. For salmon to access and maximize the production potential of Mill Creek, adults should be out-planted above the diversion.

Mendel (et al. 2002) conducted spring Chinook redd surveys in 2001 along 29.2 miles in the Touchet River Basin and observed 32 redds (23 in the Wolf Fork). No spring Chinook were out-planted in the Touchet system and these fish were thought to be strays from the Tucannon program based on a limited number of CWT recoveries.

Table 3-2 South Fork Walla Walla River spring Chinook salmon redds (observed/percent) from adults released at Harris Park (RM 7), 2000-2002.

Stream Reach	2000	2001	2002
Above Skiphorton Creek-RM 17.0+	0/0	16/4.7	0/0
Skiphorton to Burnt Cabin Creek, RM 14.1-17.0	5/5.0	75/22.1	7/4.8
Burnt Cabin Creek to BLM/FS Boundary, RM 12.0-14.1	16/15.8	61/18.0	35/24.1
BLM/FS Boundary to USGS Gage, RM 8.8 to 12.0	35/34.7	101/29.8	58/40.0
USGS Gage to Hatchery, RM 5.3- 8.8	38/37.6	86/25.4	45/31.0
Hatchery to Little Walla, RM 47 to RM 5.3	7/6.9	0/0	0/0
Total Redds	**101**	**339**	**145**
Estimated Egg Deposition	**377,000**	**1,400,000.**	**554,000**
Spring Chinook Out-Planted			
Females	150	641	190
Adult Males	76	421	126
Jacks	33	30	13
Total Chinook Out-Planted	**259**	**1092**	**329**

Table 3-3 Mill Creek spring Chinook salmon redds (observed/percent for year) from adults planted 100 yards above Kiwanis Camp (RM 22.3), 2000-2002

Stream Reach	2000	2001	2002
Paradise Creek to Diversion Dam, RM 25.2-28.9	6/15.0	9/17.0	0/0
Diversion Dam to Kiwanis Camp, RM 22.3-25.2	34/85.0	39/73.6	15/65.2
Below Kiwanis Camp, RM 20.8.5-22.3	0/0	5/9.4	8/34.8
Total Redds	**40**	**53**	**23**
Estimated Egg Deposition	**150,000**	**220,000**	**88,000**
Spring Chinook Out-Planted			
Females	58	76	25
Adult Males	31	72	25
Jacks	16	2	0
Total Chinook Out-Planted	**105**	**150**	**50**

Future Monitoring Needs

Spawning survey design and protocol was proposed early in 2002 but not adopted. Additional coordination with local and regional managers will be required to develop, complete, and implement a new plan. There is a significant need for comprehensive spawning surveys because it is the only way to estimate the adult returns of both summer steelhead and spring Chinook salmon. Index values can be developed from the nursery bridge ladder, but variable conditions constantly affect the proportion of adults that use the ladder or jump the dam. Furthermore, only a portion of the basin is upstream from

Nursery Bridge. The current radio telemetry project will continue to track adult summer steelhead to better define the range of spawning habitat. Radio telemetry techniques efficiently provide spawning distribution information even when spring runoff prevents spawning surveys. CTUIR documented fish passage difficulties at the Bennington Lake Diversion (see Chapter Six). Managers must improve facility monitoring to ensure that passage facilities are in compliance with NMFS guidelines in both design and operation. Without adequate passage, salmon, steelhead and bull trout recovery will not be possible.

Habitat Needs

The access road along the S. F. Walla Walla River from the Bureau of Land Management Trailhead (RM 8.8) to the private cabins below Bear Creek (RM 12) should be closed. Currently the road is only open to full size vehicles from July 1 to August 15 and only for private landowners. However, the road is open to motorbikes all year. CTUIR biologists have observed riders driving their motorbikes across the river and up the side channels many times. Bikers frequently use the road when it is closed to other motor vehicles. It was closed to protect aquatic resources. Bikers probably cause more damage to the resource than the larger vehicles because they use the area all year. The existing road crosses the river ten times. These crossings are mostly in low gradient areas where fish spawn. In the past, CTUIR staff have observed the following:

1) Smashed juvenile fish in a side channel that was used as a road. Many juvenile steelhead/rainbow and spring Chinook salmon were present along with fresh tire tracks lengthwise through the side channel.
2) A truck driving through a spring Chinook salmon redd with two salmon present.
3) Four large trees in the riparian area were cut down to keep the road open.
4) Downed trees in the riparian area were taken for firewood. Fresh tire tracks indicated that a vehicle was used to collect the wood.
5) Silt flowing from a spring and into the river just after two vehicles passed through the wetland area near the cabins.

CTUIR recommends closure and obliteration of the road and subsequent restoration of the riparian habitat. Motor vehicles are disrupting spawning, damaging redds and destabilizing the riparian area. The road weakens the riparian areas ability to hold soils during high flow events. The road leaves a ribbon of vulnerability that could unravel large portions of the flood plane and cause severe erosion during high flows. Cutting timber and removing fallen timber will affect the long term recruitment of large woody debris that is critical for the creation of habitat complexity so important to salmonids.

ACKNOWLEDGEMENTS

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

The authors thank Tim Bailey of ODFW and Glen Mendel of WDFW for providing spawning survey data. We also thank the following CTUIR employees for their contributions to the project: Gary James for project management, development and assistance; Michelle Thompson for contract administration, and Julie Burke, Celeste Reeves and Esther Huesties for managing the Fisheries Office. We also appreciate the efforts of Darryl Thompson, David Wolf and David Thompson for assistance with spawning surveys.

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CHAPTER FOUR: WATER TEMPERATURE MONITORING

THE WALLA WALLA BASIN NATURAL PRODUCTION MONITORING AND EVALUATION PROJECT

PROGRESS REPORT
1999-2002

Prepared By:

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Fisheries Program
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Contor, Craig, R. and Carrie Crump. 2003. Chapter Four, Water Temperature Monitoring: In Contor, Craig R. and Amy D. Sexton editors, Walla Walla 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. 2000-039-00.

INTRODUCTION

The Walla Walla Basin Natural Production Monitoring and Evaluation Project (WWNPME) was funded by Bonneville Power Administration (BPA) as directed by section 4(h) of the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (P. L. 96-501). This project is in accordance with and pursuant to measures 4.2A, 4.3C.1, 7.1A.2, 7.1C.3, 7.1C.4 and 7.1D.2 of the Northwest Power Planning Council's (NPPC) Columbia River Basin Fish and Wildlife Program (NPPC 1994). Work was conducted by the Fisheries Program of the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) under the Walla Walla Basin Natural Production Monitoring and Evaluation Project, under Objective 5 in the 1999 project statement of work (SOW) and in Objective 3 in the 2000 and 2001. Water temperature monitoring was not an objective in 2002 because of extensive coverage by WDFW and the Oregon Walla Walla Watershed Council (Table 4-1). We did however continue to monitor water temperatures at RM 25.5 in Mill Creek and at the mouth S. F. Walla Walla River. We will not monitor water temperatures in 2003. There are several other CTUIR projects that still deploy thermographs in the basin. Data from this and previous annual reports are currently available at http://198.66.210.119/database (summer of 2003). In the future all data will be available through http://www.umatilla.nsn.us (CTUIR website).

Table 4-1. Summary of Walla Walla River Basin Thermographs in addition to 10 WWNPME thermographs that are no longer deployed (to avoid duplication of effort.)

Mainstem Touchet River	19
N.F. Touchet and Tributaries	9
Wolf Fork Touchet and Tributaries	5
Robinson Fork	2
S.F. Touchet and Tributaries	6
Whisky Creek	1
Coppei and Tributaries	7
Total in Touchet River Basin	**49**
Mainstem Walla Walla River	19
S.F. Walla Walla	3
N.F. Walla Walla	2
Mill Creek	22
Blue Creek	1
Yellowhawk/Garrison	10
Dry Creek and Tributaries.	5
Pine Creek	1
Couse Creek	2
Total Thermographs in the Walla Walla River (excluding Touchet)	**65**
Total Thermographs in the Basin (2002)	**114**

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

Objective E: Objective 5 in the 1999 SOW and Objective 3 in the 2000 and 2001 SOW. Monitor stream temperatures in coordination with other projects in the Walla Walla River Basin.

> *Task E.*1 Coordinate deployment protocols and thermograph locations with ODFW, WDFW, ODEQ, USFS, the Watershed Council and other CTUIR projects. Ensure optimum coverage in priority areas without duplication.
>
> *Task E.2* Deploy thermographs during April and May (June for some backcountry sites). Conceal cables and thermographs to minimize tampering by the public. Check the status, function and concealment of each thermograph monthly throughout the deployment period.
>
> *Task E.3* Retrieve thermographs in November.
>
> *Task E.4* Download, summarize and graph data. Examine trends, report findings and discuss management implications.

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

METHODS

We coordinated the deployment of thermographs in the Walla Walla River Basin with other projects and agencies to maximize consistency and coverage without duplicating effort from 1993 through 2002. Figure 4-1 shows the location of the WWNPME project thermographs. Table 4-2 is the key for Figure 4-1. The thermograph locations have been variable since 1993. Specifics regarding the location and deployment dates of thermographs are summarized in Table 4-3. Details of all project water temperature data are currently available at http://198.66.210.119/database (summer of 2003). In the future all data will be available through http://www.umatilla.nsn.us (CTUIR website). The website also lists some water temperature data from other projects with additional data being added regularly.

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

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

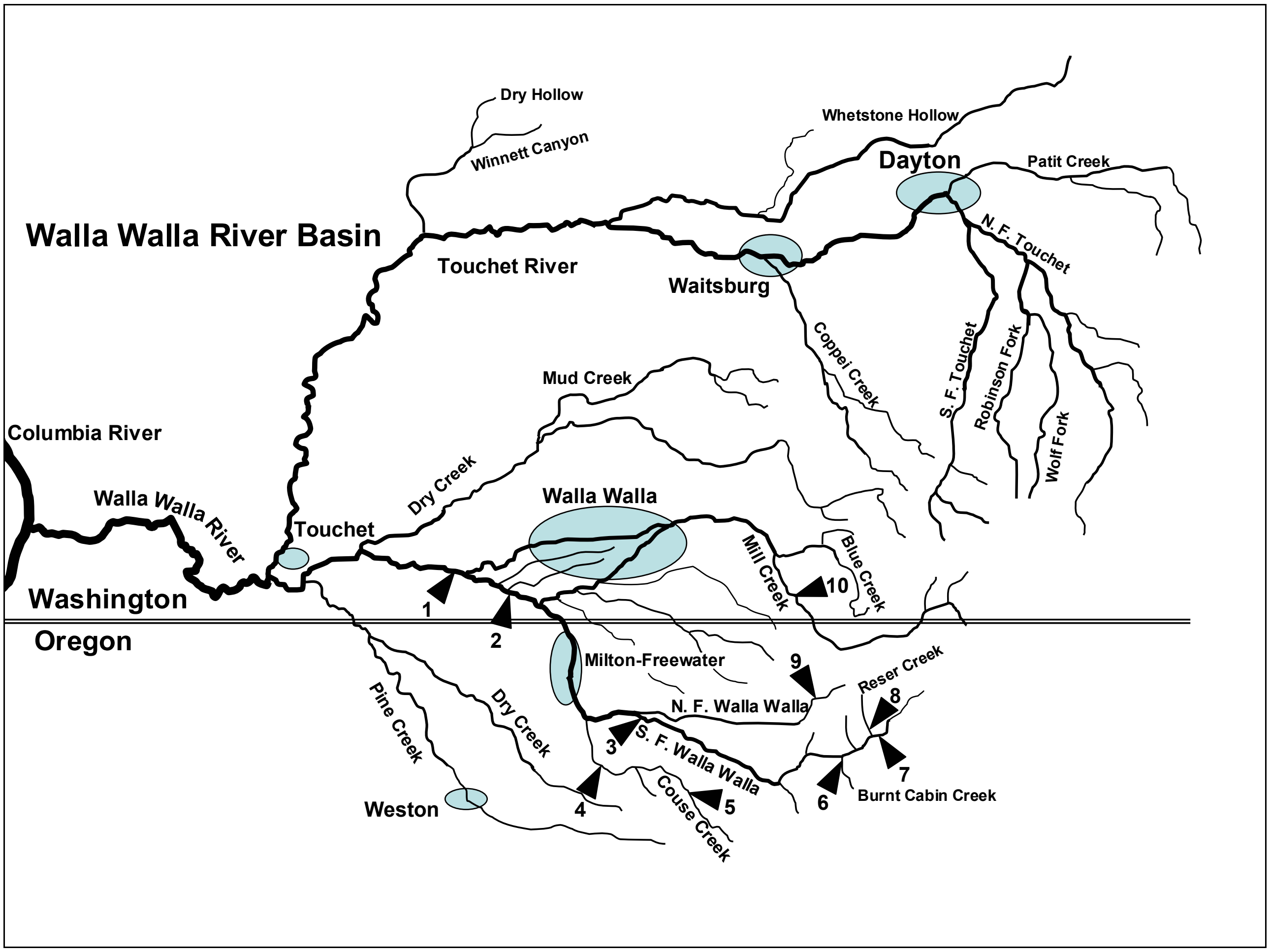

Figure 4-1. The Location of project thermographs in the Walla Walla River Basin

Table 4-2. The Location key for Figure 4-1

Stream	Location	River Mile	Site Number
Walla Walla	Below Whitman on Detour Road	32	1
Walla Walla	At Burling Game Dam	38	2
S. F. Walla Walla	Near the mouth	0.5	3
Couse Creek	Just above ODFW habitat project	4.7	4
Couse Creek	Off of Linction Mt. Road	10	5
Burt Cabin Creek	Tributary of the S.F. Walla Walla at RM 14.1	0.1	6
Reser Creek	Tributary of the S.F. Walla Walla at RM 20	0.1	7
S. F. Walla Walla	Just upstream from the mouth of Reser Creek	20	8
N. F. Walla Walla	Headwaters	15	9
Mill Creek	Bridge, 2 miles below Kooskooskie flow gage	18.5	10

Table 4-3. Summary of the water temperature data collected from 1993 to 2002 by the M&E project. RTM denotes a Ryan RTM 2000 thermograph, Mini denotes a Vemco Mini-Logger.

Stream	Location	River Mile	Start Date	End Date	Unit Type	Unit Number
Burt Cabin Creek	Tributary of the S.F. Walla Walla at RM 14.1	0.1	5/14/1993	7/23/1993	RTM	906050
Burt Cabin Creek	Tributary of the S.F. Walla Walla at RM 14.1	0.1	8/1/1993	11/10/1993	RTM	906050
Burt Cabin Creek	Tributary of the S.F. Walla Walla at RM 14.1	0.1	11/24/1993	6/19/1994	RTM	906050
Burt Cabin Creek	Tributary of the S.F. Walla Walla at RM 14.1	0.1	8/19/1994	9/1/1994	RTM	906050
Burt Cabin Creek	Tributary of the S.F. Walla Walla at RM 14.1	0.1	5/4/1995	8/17/1995	RTM	906050
Burt Cabin Creek	Tributary of the S.F. Walla Walla at RM 14.1	0.1	8/19/1995	8/5/1996	RTM	906050
Couse Creek	Just above ODFW Habitat Project	4.7	5/8/1998	12/17/1998	Minilog	4899
Couse Creek	Top end of ODFW Habitat Project	4.7	5/5/1999	11/15/1999	Minilog	7549
Couse Creek	Off of Lincton Mt. Road	10	5/13/1998	12/22/1998	Minilog	4901
Couse Creek	Off of Lincton Mt. Road	10	5/1/1999	11/18/1999	Minilog	7556
Mill Creek	Bridge, 2 miles below Kooskooskie flow gage	18.5	5/15/1998	12/22/1998	Minilog	4904
Mill Creek	Bridge, 2 miles below Kooskooskie flow gage	18.5	5/5/1999	11/17/1999	Minilog	7555
Mill Creek	Bridge, 2 miles below Kooskooskie flow gage	18.5	5/4/2000	11/1/2000	Minilog	7558
Mill Creek	Bridge, 2 miles below Kooskooskie flow gage	18.5	6/6/2001	11/28/2001	Minilog	4900
Mill Creek	Bridge, 2 miles below Kooskooskie flow gage	18.5	5/6/2002	11/4/2002	Minilog	4900
N. F. Walla Walla	Headwaters	15	5/18/2000	11/1/2000	RTM	906049
Reser Creek	Tributary of the S.F. Walla Walla at RM 20	0.1	7/31/1993	11/2/1993	RTM	906051
Reser Creek	Tributary of the S.F. Walla Walla at RM 20	0.1	11/20/1993	6/17/1994	RTM	906051
Reser Creek	Tributary of the S.F. Walla Walla at RM 20	0.1	8/4/1994	3/15/1995	RTM	906051
Reser Creek	Tributary of the S.F. Walla Walla at RM 20	0.1	8/5/1995	8/5/1996	RTM	906051
S. F. Walla Walla	Near the mouth	0.5	5/7/1993	7/20/1993	RTM	906043
S. F. Walla Walla	Near the mouth	0.5	8/2/1993	11/3/1993	RTM	906043
S. F. Walla Walla	Near the mouth	0.5	11/20/1993	8/1/1994	RTM	906043
S. F. Walla Walla	Near the mouth	0.5	8/3/1994	11/21/1994	RTM	906043
S. F. Walla Walla	Near the mouth	0.5	8/11/1995	1/2/1996	RTM	906043
S. F. Walla Walla	Near the mouth	0.5	5/8/1998	12/17/1998	Minilog	4902
S. F. Walla Walla	Near the mouth	0.5	5/1/1999	11/15/1999	Minilog	7557
S. F. Walla Walla	Near the mouth	0.5	5/4/2000	11/1/2000	Minilog	7556
S. F. Walla Walla	Near the mouth	0.5	6/7/2002	11/8/2001	Minilog	3855
S. F. Walla Walla	Near the mouth	0.5	5/7/2002	11/3/2001	Minilog	4901
S. F. Walla Walla	Just upstream from the mouth of Reser Creek	20	7/31/1993	11/2/1993	RTM	906049
S. F. Walla Walla	Just upstream from the mouth of Reser Creek	20	11/20/1993	6/17/1994	RTM	906049
S. F. Walla Walla	Just upstream from the mouth of Reser Creek	20	8/4/1994	3/16/1995	RTM	906049
S. F. Walla Walla	Just upstream from the mouth of Reser Creek	20	8/4/1995	8/4/1996	RTM	906049
S. F. Walla Walla	Just upstream from the mouth of Reser Creek	20	8/2/1996	11/4/1996	RTM	903640

Stream	Location	River Mile	Start Date	End Date	Unit Type	Unit Number
S. F. Walla Walla	Just upstream from the mouth of Reser Creek	20	6/19/1999	11/2/1999	Minilog	4896
S. F. Walla Walla	Just upstream from the mouth of Reser Creek	20	6/7/2000	11/1/2000	Minilog	7555
Walla Walla	Below Whitman on Detour Road	32	5/8/1998	12/22/1998	Minilog	4903
Walla Walla	Below Whitman on Detour Road	32	5/5/1999	11/15/1999	Minilog	7551
Walla Walla	At Burling Game Dam	38	5/1/1999	11/17/1999	Minilog	7553

Thermograph Deployment Protocol

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

<u>Pre-Season Calibration</u>

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.
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 thermographs sensor in flowing water.
3. Read the instrument several times to ensure readings have stabilized before recording temperatures.
4. Read the instrument perpendicular to its axis; reading at other angles will give erroneous readings.

Initialize Thermographs

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

Protocol for Setting Thermographs

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

Monthly Quality Control Checks

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

Protocol for Extracting Thermographs

1. Pull units after October 31st and prior to November 30 (to avoid loss during high-water events).
2. Record the date, time and temperature when the unit was pulled from the water.
3. Attach a new Tyvek tag to the unit with the site name, data, time and temperature.
4. Clean the mud and algae off the unit.
5. Download the data into the computer, check headers with Tyvek tag.
6. Check dates, times and temperatures of deployment and Q&E Record Sheets with recorded temperatures and times.
7. Save and archive original data file and create and American Standard Code for Information Interchange (ASCII file, or DOS Text file) with the Vemco software.

Post Season Calibration

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

Protocol for Summarizing Thermograph Data

The protocol used for thermograph data began in 1993 and includes a standard file naming format developed when file names were limited to eight characters. 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 can be over-written, we rename the files and store the original binary data, the converted ASCII file and the Excel file together in electronic folders specific to each monitoring site. The protocol outlined below is the process used to summarize all WWNPME thermograph data from 1993-2002.

Rename Data Files

Rename files to match the standard file name format. For example, thermograph number 3854 had been deployed in Reser Creek in April of 2002 and the binary file BIN3854.001 was generated by the Vemco proprietary software. In this case, we rename the binary file to MBRS0204.001. The Excel file would be named MXRS0204.xls. The file name denotes it is a file from a Vemco Mini-logger (M, in MXRS0204), in Excel format (X in MXRS204), from Reser Creek (RS in MXRS0204, deployed in 2002 (02 in

MXRS0204) in April (04 in MXRS0204). The BIN file for that same data set would be labeled MBRS0204 and the ASCII file would be named MARS0204. The BIN and ASCII files should only be renamed and filed without any other alterations. Only the Excel file will have the data summaries and deletions (if the thermograph was out-of-water or had other problems).

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

Import the ASCII file into Excel

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

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

Check File Headers

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

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

Rename the BIN, ASCII and Excel files for the proper stream code if needed. For example: file BIN3854.000 and its associated ASCII file ASC3854.000 have headers that say Reser Creek, RM 0.1. Check the thermograph pull sheet to ensure that unit 3854 was actually recovered from Reser Creek at RM 0.1. If the header is incorrect, make a note of the correction in the header of the Excel file.

Check Quality of Recorded Temperatures

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

Plot Temperatures

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

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

Expel Invalid Data

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

Develop the Hourly Data Sheets

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

Develop the Daily and Monthly Summary Sheets

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

1. Go to the daily and monthly pivot tables in the template file. Follow the steps below for each of the two summary sheets.
2. Highlight the entire pivot table on the daily or monthly sheet
3. Select Edit and Copy from the main menu.
4. Go to the appropriate daily or monthly sheet in the file you are working on
5. Place the curser where you want the upper left side of the pivot table to start (usually A-9), hit paste.
6. Click somewhere inside the pivot table to highlight the entire table.
7. Right click and select pivot table wizard, select back and click on the data range box icon.
8. Select the header and the data for the appropriate daily or monthly pivot table
9. Click again on the data range box icon, select next, and examine layout.
10. Correct any layout related problems such as missing data fields (these omissions sometimes occur in the "copy template" processes).
11. For the monthly summary select "layout" and drag "Date" and "Year" to far left column (labeled Rows) in the layout template.
12. Hit OK and select finish
13. For the monthly pivot table, click in the far left-hand column of the pivot table and right click
14. Select "Group and Show Detail"
15. Select "Group"
16. Select "month" and "year" for type. This will summarize the table by months and years.

Edit Tables

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

Save File and Make Backups

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

Post Data on the Website

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

Results and Discussion

CTUIR has summarized hourly data as well as daily and monthly summaries from each thermograph deployment from 1993-2002. These data are currently available at http://198.66.210.119/database. Data and summaries will be available through the CTUIR website (http://www.umatilla.nsn.us) in the future. The raw data from each thermograph was plotted in an Excel chart. Examples of several data sets are shown in Figures 4-2 though 4-5 and Tables 4-4 through 4-6.

Water temperatures in the Walla Walla River are suitable for salmonids during the summer above RM 47. All but the lower reaches of most tributaries in the basin are suitable for salmonids. The headwater reaches and tributaries are cold. The entire S. F. Walla Walla provides spawning and rearing habitat for steelhead, bull trout and salmon (Figures 4-2 and 4-4).

High water temperatures and related dewatering during the summer appear to be the primary factors limiting juvenile salmonid distribution and abundance in the Walla Walla River below Milton-Freewater. However, ocean conditions, survival in the Columbia River during migration, and spawner abundance are also important factors influencing juvenile salmonid abundance.

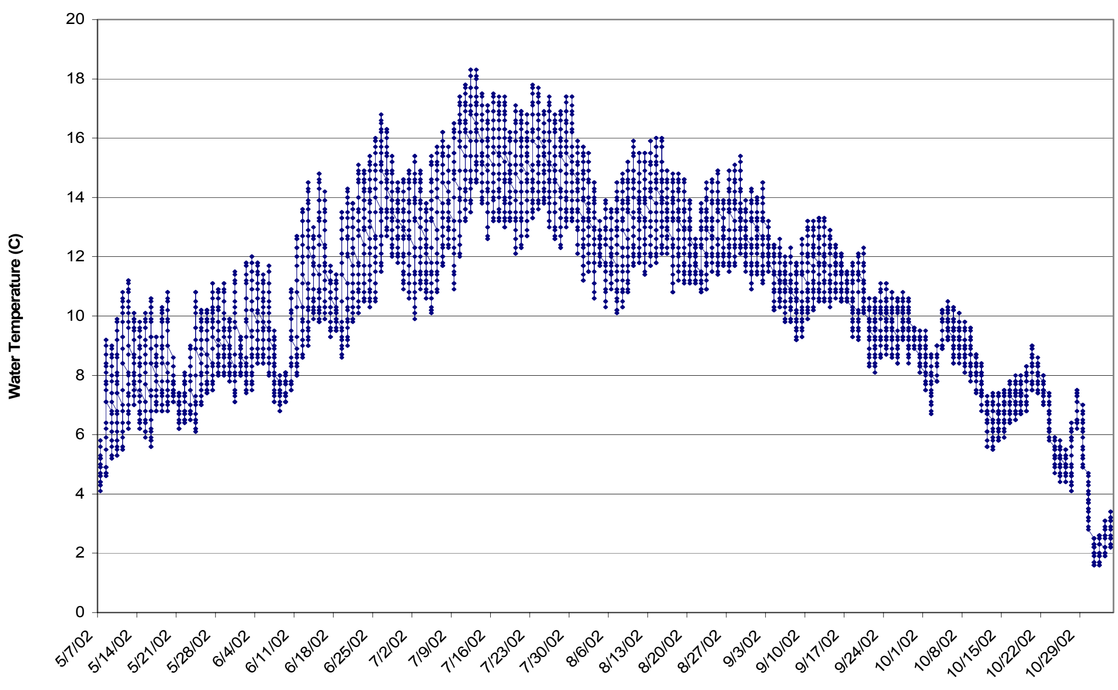

Figure 4-2. Hourly water temperature data from the S. F. Walla Walla River near the mouth (RM 0.5) from May 7through November 3, 2002.

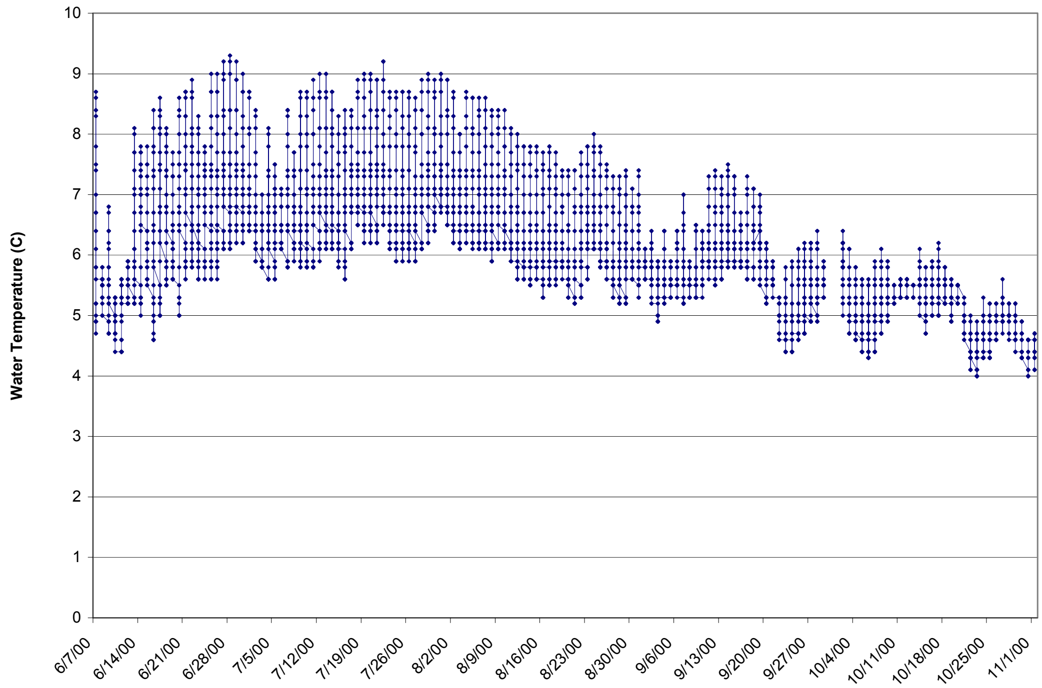

Figure 4-3. Hourly water temperature data from the South Fork Walla Walla River at RM 20, from June 7 through November 1, 2000. No water temperature data for September 30 and October 1, 2000.

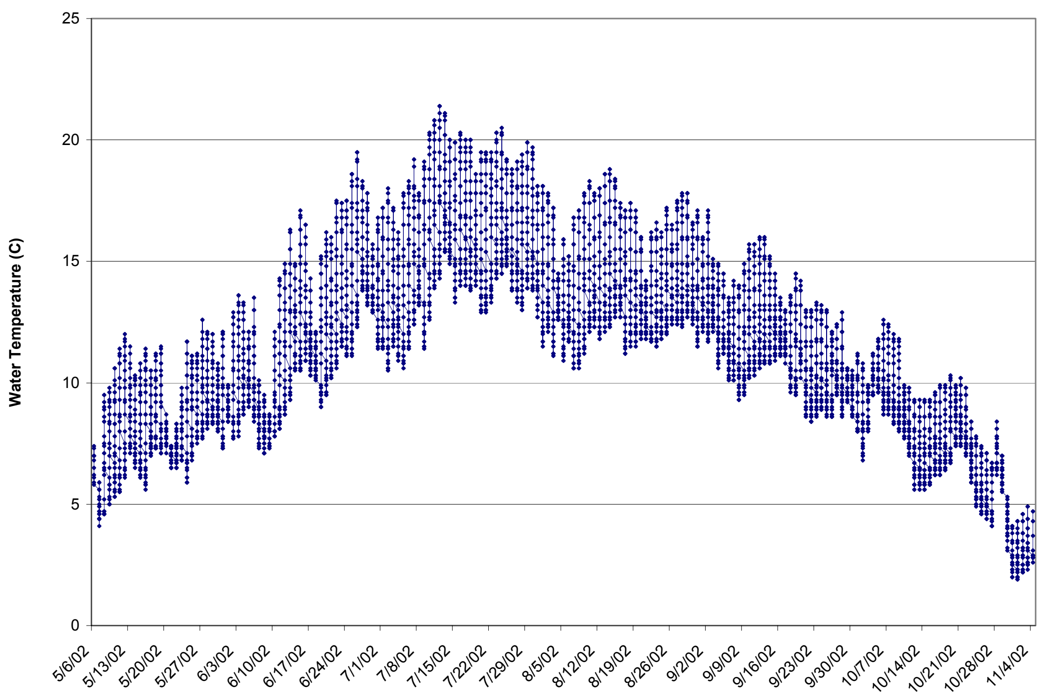

Figure 4-4 Hourly water temperature data from Mill Creek at RM 19 from May 6, through November 4, 2002.

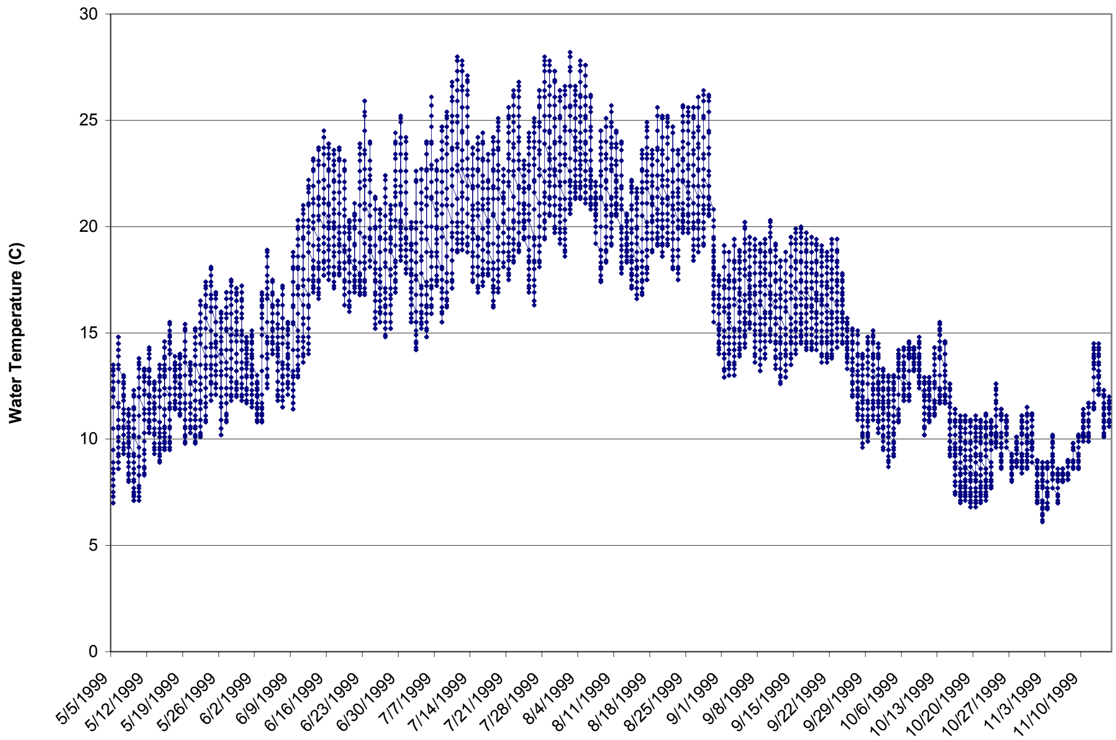

Figure 4-5. Hourly water temperature data from the Walla Walla River at RM 32, near Whitman Mission from May 5 through November 15, 1999.

Table 4-4. Monthly maximum, mean and minimum stream temperatures (°C) from three locations in the Walla Walla River Basin; the number of hours water temperatures met or exceeded listed criteria (values in column T>=25 denote the total hours when temperatures met or exceeded 25°C for the indicated time period). WWNPME Project water temperature data from all sites from 1993-2002 are available at http://198.66.210.119/database. In the future all data will be available at http://www.umatilla.nsn.us (CTUIR website).

S. F. Walla Walla River at RM 0.5								
2002	**Max**	**Mean**	**Min**	**T <=5**	**T >=12.78**	**T>=17.78**	**T>=20**	**T>=25**
May 7-31	11.5	8.0	4.1	24	0	0	0	0
June	16.8	11.1	6.8	0	183	0	0	0
July	18.3	14.5	9.9	0	618	10	0	0
August	16.0	13.0	10.1	0	389	0	0	0
September	14.5	10.8	8.1	0	49	0	0	0
October	10.5	7.1	1.6	98	0	0	0	0
November 1-3	3.4	2.5	1.6	72	0	0	0	0
May 7- Nov 3	18.3	10.7	3.5	58	1239	10	0	0

S. F. Walla Walla River at RM 20								
2000	**Max**	**Mean**	**Min**	**T <=5**	**T >=12.78**	**T>=17.78**	**T>=20**	**T>=25**
June 7-30	9.3	6.4	4.4	60	0	0	0	0
July	9.2	6.9	5.6	0	0	0	0	0
August	8.9	6.4	5.2	0	0	0	0	0
September	9.3	5.7	4.4	102	0	0	0	0
October	8.6	5.1	4	337	0	0	0	0
November 1	4.7	4.4	4.1	23	0	0	0	0
June 7- Nov 1	9.3	6.1	4	562	0	0	0	0

Mill Creek at RM 19								
2002	**Max**	**Mean**	**Min**	**T <=5**	**T >=12.78**	**T>=17.78**	**T>=20**	**T>=25**
May 6-31	12.6	8.3	4.1	28	0	0	0	0
June	19.5	11.9	7.1	0	263	16	0	0
July	21.4	15.8	10.5	0	662	183	35	4
August	18.8	14.1	10.6	0	498	28	0	0
September	17.1	11.6	8.4	0	183	0	0	0
October	12.6	7.7	2	82	0	0	0	0
November 1-4	4.9	3.0	1.9	86	0	0	0	0
May 6-Nov 4	21.4	11.5	1.9	196	1606	227	35	0

Walla Walla River, RM 32, near Detour Road downstream from Whitman Mission								
Date 1999	**Max**	**Mean**	**Min**	**T <=5**	**T >=12.78**	**T>3=17.78**	**T>=20**	**T>=25**
May 5-31	18.1	12.4	7.0	0	278	3	0	0
June	25.9	17.7	10.8	0	646	363	202	6
July	28	20.9	14.2	0	744	621	434	87
August	28.2	21.4	14	0	744	681	517	86
September	20.3	15.7	9.6	0	655	169	8	0
October	15.5	10.8	6.8	0	137	0	0	0
November 1-15	14.5	9.7	6.1	0	28	0	0	0
May 5-Nov 15	28.2	16.1	6.1	0	3232	1837	1161	179

Table 4-5. Example of hourly water temperatures and exceedence values of data collected from the Walla Walla River at RM 32 near Detour Road Bridge from May 5 to November 11 1999 (first 8 hours only). The complete record is available at http://198.66.210.119/database. In the future all data will be available at http://www.umatilla.nsn.us (CTUIR website).

Date	Time	Temp C	Temp F	<=5.0	>=12.78	>=17.78	>=20	>=25
5/5/1999	0:00:00	8.9	48.02	0	0	0	0	0
5/5/1999	1:00:00	8.4	47.12	0	0	0	0	0
5/5/1999	2:00:00	8.1	46.58	0	0	0	0	0
5/5/1999	3:00:00	7.8	46.04	0	0	0	0	0
5/5/1999	4:00:00	7.5	45.5	0	0	0	0	0
5/5/1999	5:00:00	7.3	45.14	0	0	0	0	0
5/5/1999	6:00:00	7	44.6	0	0	0	0	0
5/5/1999	7:00:00	7	44.6	0	0	0	0	0

Table 4-6. Example of daily water temperature summary of data collected from Walla Walla River at RM 32 near Detour Road Bridge from May 5-25, 1999. (first 15 days only). The complete record is available at http://198.66.210.119/database. In the future all data will be available at http://www.umatilla.nsn.us (CTUIR website).

	Temperature (C)			Temperature (F)		
Date	Max	Mean	Min	Max	Mean	Min
5-May-99	13.5	10.0	7.0	56.3	50.0	44.6
6-May-99	14.8	11.6	8.6	58.6	52.9	47.5
7-May-99	13.0	11.2	9.3	55.4	52.2	48.7
8-May-99	11.4	9.7	8.0	52.5	49.5	46.4
9-May-99	12.3	9.5	7.1	54.1	49.1	44.8
10-May-99	13.8	10.4	7.1	56.8	50.7	44.8
11-May-99	13.3	11.2	8.3	55.9	52.1	46.9
12-May-99	14.3	12.1	10.3	57.7	53.8	50.5
13-May-99	12.7	11.1	9.3	54.9	52.0	48.7
14-May-99	13.5	11.0	8.9	56.3	51.7	48.0
15-May-99	14.6	11.9	9.5	58.3	53.4	49.1
16-May-99	15.5	12.6	9.5	59.9	54.6	49.1
17-May-99	13.9	12.7	11.4	57.0	54.8	52.5
18-May-99	14.0	12.6	11.1	57.2	54.6	52.0
19-May-99	15.4	12.5	9.8	59.7	54.5	49.6
20-May-99	13.6	11.9	10.3	56.5	53.3	50.5
21-May-99	15.2	12.4	9.8	59.4	54.3	49.6
22-May-99	16.5	13.1	10.1	61.7	55.6	50.2
23-May-99	17.4	14.1	10.8	63.3	57.3	51.4
24-May-99	18.1	14.9	11.8	64.6	58.8	53.2
25-May-99	16.9	14.5	12.1	62.4	58.1	53.8

Recommendations

We recommend that the Walla Walla River and Mill Creek be protected and that degraded reaches be restored in ways designed specifically to reduce summer daily maximum water temperatures. We also recommend increased flows in the lower reaches of Mill Creek and in the Walla Walla and Touchet Rivers below diversions. We recommend that management of urban areas, flood control levees, forests, agricultural lands, and livestock allotments include basin-wide stream and riparian protection and rehabilitation actions. The need for healthy watersheds and riparian habitats for salmonid bearing streams has been well established (Waters 1995, Stouder et al. 1994, Stroud 1992, Meehan 1991). Quality uplands and stream habitat can produce natural salmonids in abundance. Land use practices and riparian vegetation have dramatic influences on water temperatures and water quality (Brown and Krygier 1970, Brown 1983, Wang et al. 1997, Abt et al. 1992). Many streams currently providing salmonid habitat should be protected. Other reaches could provide additional salmonid rearing habitat with moderate improvements.

Meanders and other features that optimize connectivity and interchange between instream and hyporheic flows could further improve instream water temperature profiles during the summer and winter in channelized reaches. Hyporheic and bank-storage water has been shown to be closely related to instream flows and can influence instream water temperatures (Mertes 1997, Fraser and Williams 1998, London et al. 2001, Hayashi and

Rosenberry 2002, Kasahara and Wondzell 2003 and Moore et al. 2003). For example, in McCoy Creek (of the Grande Ronde Basin) water temperatures were an average of 6 ^{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 as much as 10 ^{o}F colder in 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/m probably was probably not significant because historic overgrazing along both the original and channelized reaches left little vegetation other than short grasses. We expect further moderation in water temperatures through riparian restoration and recovery in time.

Much of the mainstem Walla Walla River and many of the tributaries have been channelized. Considerable improvement in salmonid habitat could be gained by naturalizing channels throughout the basin. These streams were channelized through state and federal programs and incentives during the last 100 years. We recommend that restoration should occur through similar programs during the next 50 years. Restoring natural flood-plane function could be obtained by re-establishing meanders, removing levees and setting back levees.

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CHAPTER FIVE: STEELHEAD GENETICS

GENETIC DIVERGENCE OF SYMPATRIC RESIDENT AND ANADROMOUS FORMS OF *Oncorhynchus mykiss* IN THE WALLA WALLA RIVER

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PREFACE

The Walla Walla Basin Natural Production Monitoring and Evaluation Project (WWNPME) was funded by Bonneville Power Administration (BPA) as directed by section 4(h) of the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (P. L. 96-501). This project is in accordance with and pursuant to measures 4.2A, 4.3C.1, 7.1A.2, 7.1C.3, 7.1C.4 and 7.1D.2 of the Northwest Power Planning Council's (NPPC) Columbia River Basin Fish and Wildlife Program (NPPC 1994). Project development, oversight and field sampling was conducted by the Fisheries Program of the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) under the Walla Walla Basin Natural Production Monitoring and Evaluation Project in cooperation with the Columbia River Intertribal Fisheries Commission (CRITFC) and University of Idaho. Oregon and Washington Departments of Fish and Wildlife (ODFW and WDFW) provided tissue samples from adult steelhead from the Snake River. Much of this chapter was submitted in manuscript form to the Journal of Fish Biology for publication. Data and reports from chapter will be available at http://198.66.210.119/database (summer of 2003). In the future, all data will be available through http://www.umatilla.nsn.us (CTUIR website).

Objective Schedule and Tasks

Objective F. Objective 7 in the 1999 project statement of work and in Objective 5 in the 2000 statement of work (SOW). Determine the genetic characteristics of steelhead and rainbow trout in the Walla Walla River and determine the geographic genetic structure and the level of gene flow between sub-populations and between anadromous and resident forms of *Oncorhynchus mykiss*.

Task F.1 Collect tissue samples for genetic analysis from adult and juvenile summer steelhead from a variety of locations in the Walla Walla and Umatilla River Basins. Place steelhead tissue samples in appropriately labeled and prepared vials. During the initial collaboration with the geneticists as well as ODFW and WDFW, it was recommended we change the sample design outlined in the 1999 SOW. We had originally planned to collect tissue samples from 1760 fish. Because of funding and personnel limitations and to improve the design, we reduced the sampling of parr to the Walla Walla Basin. Adult collections included the Walla Walla and Umatilla River steelhead and were expanded to the Snake River. This new design better matched the priority of fisheries program managers regarding information needs by narrowing the primary scope of the effort to the Walla Walla River Basin.

Task F.2. Process the samples using standard methods and protocols (discussed below). Delays in obtaining samples and filling personnel vacancies postponed the completion of the sample analysis. We also had difficulties in obtaining tissue samples from WDFW. These difficulties prompted us to re-sample some sites in 2000 to ensure adequate coverage in the Washington portion of the basin. Our samples were also behind many of the samples backlogged at the lab during the vacancies. Finally, some adult samples were not available until the fall of 2002.

Task F.3. Complete project report. The reporting task was originally scheduled to be completed by April of 2000. However, delays in obtaining samples and vacancies at the Hagerman Lab postponed the completion of sample collection, processing and analysis until late in 2002. Given these delays, the report was completed early in 2003.

ABSTRACT

The life history of *Oncorhynchus mykiss* is complex with the species containing both non-migrating resident and anadromous individuals existing in sympatry in numerous river systems. The extent of gene flow between the two life forms has been shown to be variable depending on the location. Sample collections of both anadromous steelhead and resident *O. mykiss* life forms were collected from the Walla Walla River and Columbia River basin with the intent of determining both the geographic genetic structure and the level of gene flow between the two life forms. Collections consisted of four types: adult steelhead, adult resident rainbow trout, non-indigenous resident rainbow trout stocked into the system, and mixed *O. mykiss* collections comprised of undetermined juvenile/adult resident rainbow and juvenile steelhead. Significant genetic population structure of resident rainbow trout was detected in decreasing intensity at three levels, out-of-basin stocks versus Walla Walla River stock (high divergence), Touchet River tributaries versus Walla Walla mainstem tributaries (intermediate divergence), and individual tributary pairwise tests (low divergence). However, populations of adult steelhead had overall low genetic divergence, particularly between Umatilla River and Snake River steelhead. While a genetic distance dendogram suggests geographic genetic structure between the two major segments of the Walla Walla River, low F_{ST} values indicate migration among resident populations may be occurring. Tests of Hardy Weinberg equilibrium indicate steelhead reference populations are in equilibrium, but many of the mixed populations are out of equilibrium. Populations out of equilibrium appear to be mixtures of progeny from assortatively mating steelhead and resident rainbow trout, but the W. Patit Creek collection is likely out of equilibrium due to the presence of stocked out-of-basin rainbow trout. F_{ST} tests reveal slight genetic divergence between sympatric reference populations of adult steelhead and resident rainbow trout. While F_{ST} was divergent between life forms, the greatest genetic divergence was observed in W. Patit Creek containing out-of-basin resident rainbow trout. This indicates that while statistically significant genetic divergence is observed between sympatric life forms, ancestry and gene flow between life forms is more recent than resident rainbow trout from an out-of-basin stock.

INTRODUCTION

Several species of salmonids exhibit variable life history strategies (henceforth referred to as "life forms") including rainbow trout (*Oncorhynchus mykiss*; Neave, 1944), cutthroat trout (*O. clarki;* Zimmerman et al., 1997), sockeye salmon (*O. nerka;* Wood, 1995), brown trout (*Salmo trutta*; Skaala and Naevdal, 1989), arctic charr (*Salvelinus alpinus*; Nordeng, 1983), and atlantic salmon (*Salmo salar*; Berg, 1948). Life forms range from individuals that remain in freshwater throughout their life (resident fish), those that make migrations from freshwater to estuaries and back (estuarine), and those that make migrations from freshwater to sea and back (anadromous). In many cases, fish displaying different life forms are sympatric in distribution, but the extent of gene flow between life forms ranges from high (Ehlinger and Wilson, 1988; Pettersson et al., 2001) to relatively low (Wilson et al., 1985; Foote et al., 1989; Verspoor and Cole, 1989; Zimmerman and Reeves, 2000). Reproductive isolation between life forms has been demonstrated via temporal separation (Leider et al., 1984), spatial separation (Kurenkov, 1978), or both (Zimmerman and Reeves, 2000). Assortative mating between life forms has also resulted in reduced gene flow or reproductive isolation between anadromous sockeye salmon and resident kokanee (*O. nerka*; Foote and Larkin, 1988). Reproductive isolation of sympatric life forms is not unique to salmonids, as evidenced by research of threespine stickleback (*Gasterosteus aculeatus*; Snyder and Dingle, 1990), rainbow smelt (*Osmerus mordax*; Taylor and Bentzen, 1993), whitefish (*Coregonus clupeaformis*; Bernatchez et al., 1996).

Oncorhynchus mykiss are native to western North America with both resident and anadromous life history forms found throughout the range (Behnke, 1992; 2002). Anadromous forms, referred to as steelhead, are found in rivers with ocean access and exhibit life history patterns similar to other Pacific salmon with juveniles rearing in freshwater, smolts migrating to sea, and adults returning to natal streams to spawn. Among Onchorhynchid fishes, and steelhead have the most variable anadromous life histories including duration of freshwater rearing (one to three years), and number of spawning migrations (salmon generally die after spawning – semelparity, while steelhead proceed with several spawning migrations - iteroparity). Resident *O. mykiss*, referred to as rainbow trout, spend their entire life in freshwater with potential migration to nearby freshwater lakes and streams (Riley et al., 1992). Originally, the two life forms of *O. mykiss* were classified as two distinct species based on morphology and behavior, but have recently been reclassified as a single species (Behnke, 1992). Moreover, *O. mykiss* populations are now further divided into subspecies based primarily upon morphological evidence (Behnke, 1992; 2002). Coastal rainbow trout (*O. mykiss irideus*) are distributed west of the Cascade Mountains in North America and range from California north to Alaska, whereas inland rainbow trout or redband trout (*O. mykiss gairdneri*) are distributed within the Columbia Basin and western inland waters. Diagnostic characters to definitively separate the subspecies have not been elucidated thus far (Behnke, 2002). Confounding this issue, both subspecies exhibit resident and anadromous life history patterns.

In the Walla Walla River in southeastern Washington, USA, sympatric anadromous and resident *O. mykiss gairdneri* life forms have been observed, but the level of genetic divergence and gene flow among these fishes remains unknown. Historically, the Walla Walla River sub-basin supported healthy stocks of anadromous steelhead and resident rainbow trout. The Walla Walla River and its main tributaries (Touchet River, Coppei Creek, Patit Creek, Mill Creek) have been highly impacted by anthropogenic factors in the past century (pers. comm., Confederated Tribes of the Umatilla Indian Reservation, 2002). River channels have been straightened to reduce flooding and erosion, water levels fluctuate dramatically due to irrigation, dams/diversions/weirs have been placed on several of the rivers in the sub-basin, and out-of-basin resident rainbow trout have been stocked into some waters by local residents (personal observation). Steelhead have been stocked in the Walla Walla River from 1983 to present (unpublished data, Oregon Department of Fish and Wildlife). Steelhead adult returns in recent years were approximately 400-800 steelhead annually to the Walla Walla River during the 1990s with larger runs in 2002 near 1200 individuals (unpublished data, Confederated Tribes of the Umatilla Indian Reservation).

In this study, genetic divergence between sympatric life forms in the Walla Walla River was evaluated in relation to adjacent Columbia River basin steelhead populations. Further, geographic genetic structure of Walla Walla populations was studied to determine gene flow between populations within the Walla Walla sub-basin. Using the level of genetic divergence between sample collections, we address whether these fish form one or more spawning aggregate. Further, comparing levels of genetic differentiation between life forms relative to geographic differentiation within a life form, we address questions regarding recent ancestry of life forms. If genetic divergence of a single life form between sites is greater than divergence between both life forms within a site, then evidence would indicate life forms share more recent ancestors than geographic populations.

METHODS

Sample Collections

Fin clip samples of *O. mykiss* were collected throughout various tributaries of the Walla Walla River sub-basin, Umatilla River, and Snake River in the Columbia River system from 1998 to 2002 (Table 5-1, Figure 5-1). Sample collections consisted of four types: adult steelhead, adult resident rainbow trout, non-indigenous resident rainbow trout stocked into the system, and mixed *O. mykiss* collections of undetermined life forms of juvenile/adult resident rainbow trout and juvenile anadromous steelhead (Table 5-1). Age (determined from scale samples) and total length were recorded for the majority of the sample collections. The reference population of resident rainbow trout was formed by grouping individuals from all the mixed *O. mykiss* collections with age ≥ 3 years and length ≤ 30 cm based on morphological traits of anadromous steelhead life history (age of steelhead smolt migration is less than 3 years, and average size of returning Walla Walla River steelhead is much larger than 30cm; personal observation). Temporal samples over two years were taken from N.F. Touchet River and Mill Creek to represent temporal genetic diversity from the two major segments of the Walla Walla River (Walla Walla mainstem and Touchet River). Samples from W. Patit Creek were taken to estimate genetic diversity of out-of-basin stocks since this tributary has been stocked with non-indigenous rainbow trout in recent years (personal observation). Fin clips were obtained from 895 fish and immediately placed in 95% ethanol until examined in the laboratory. For each general site, fish were collected individually from sub-sites spread over 1000s of meters, up to 19 km. We did not collect two fish from the same pool or riffle.

Table 5-1. Sample collection information: life form, year collected, adjustments to sample size, and Hardy Weinberg Equilibrium.

Sample Location	Life Form*	Year Collected	Original Sample Size	Full Siblings Removed	Moved to Resident Group **	Final Sample Size	# Loci Out of HWE
W. Patit Creek (WPC RES)	Resident Rainbow	2000	54	6	0	48	3
N.F. Touchet (NFT MIX)	Mixed	1999 & 2000	117	18	3	95	2
S.F. Touchet (SFT MIX)	Mixed	2000	86	9	19	58	2
N.F. Coppei Creek (NCP MIX)	Mixed	2000	38	1	6	31	0
S.F. Coppei Creek (SCP MIX)	Mixed	2000	34	5	3	26	1
Walla Walla mainstem (WW MIX)	Mixed	1999	32	1	0	31	1
Mill Creek (MC MIX)	Mixed	1999 & 2000	73	9	5	59	3
N.F. Walla Walla (NFWW MIX)	Mixed	2000	44	5	16	23	2
S.F. Walla Walla (SFWW MIX)	Mixed	1999	92	8	0	84	4
Walla Walla mainstem (WW STHD)	Adult Steelhead	1998 & 1999	118	0	NA	118	0
Touchet River (TOU STHD)	Adult Steelhead	1999 & 2000	59	0	NA	60	0
Umatilla River (UM STHD)	Adult Steelhead	2002	94	0	NA	94	0
Snake River (SN STHD)	Adult Steelhead	2000	54	0	NA	54	0
Touchet River resident (TOU RES)	Resident Rainbow	1999 & 2000	NA	0	NA	31	2
Walla Walla mainstem resident (WW RES)	Resident Rainbow	1999 & 2000	NA	0	NA	21	0
Total			895	62	-------	833	-------

* "Mixed" life form refers to collections of juvenile *O. mykiss* of uknown life form and are presumed to be a mixture of resident and anadromous individuals.
** Individuals of age three or greater with length less than 30cm were considered to be resident rainbow trout.

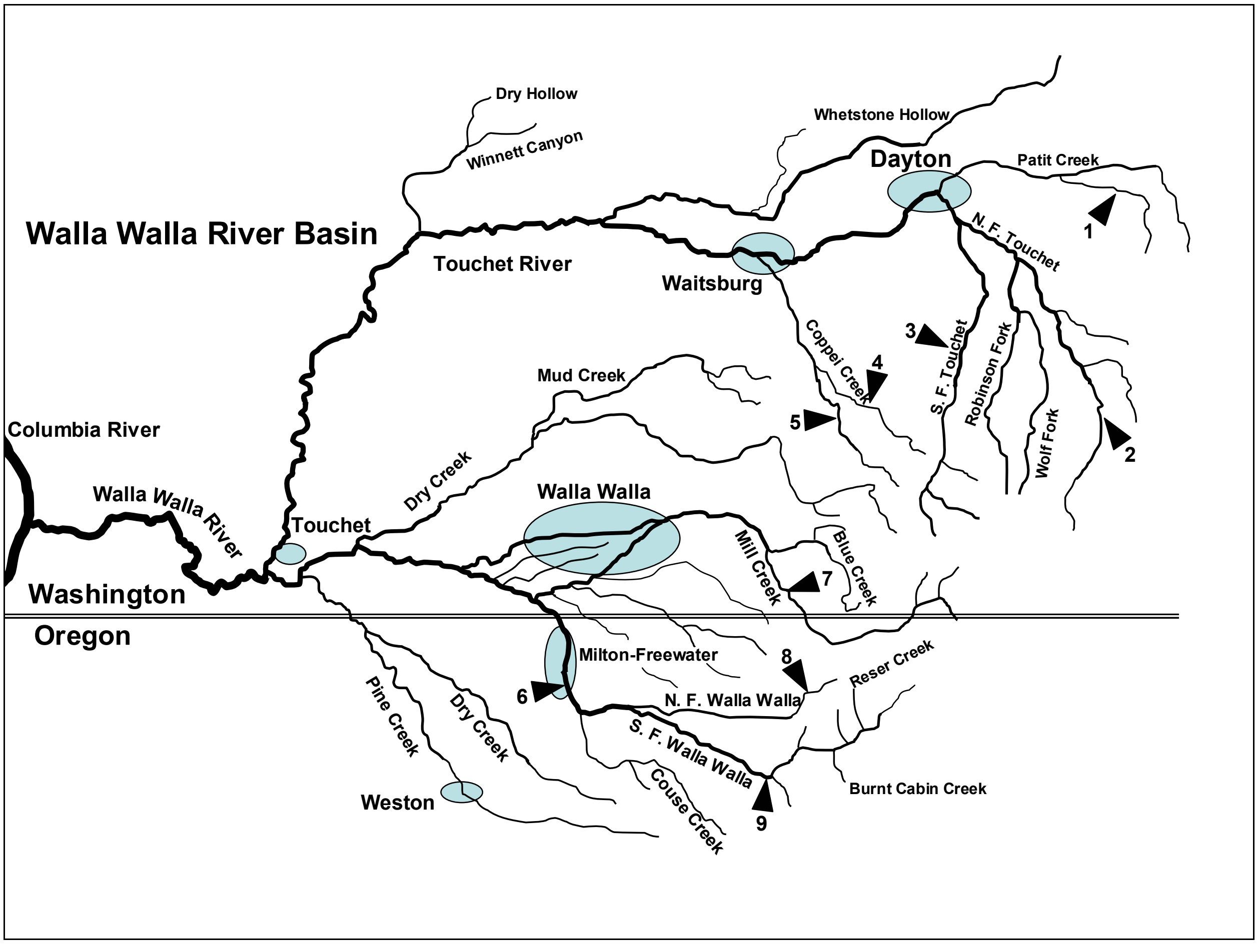

Figure 5-1. Map of the general study area of Pacific Northwest, USA (dashed box indicates detailed study area), and a detailed map of the sampling locations from the Walla Walla River, Umatilla River, and Snake River.

1) West Patit Creek
2) North Fork Touchet
3) South Fork Touchet
4) North Fork Coppei Creek
5) South Fork Coppei Creek
6) Mainstem Walla Walla
7) Mill Creek
8) North Fork Walla Walla
9) South Fork Walla Walla
10) Umatilla River (not shown)
11) Snake River (not shown)

Laboratory Analysis

Fin clips were digested and DNA extracted using standard manufacture's protocols from Qiagen® DNeasy™ in conjunction with a Qiagen® 3000 robot. Genomic DNA was quantified and arrayed into 96 well plates for high throughput genotyping.

The polymerase chain reaction (PCR) was used to amplify six microsatellite loci designed from *O. mykiss* (*OMM1007*, *OMM1019*, *OMM1020*, *OMM1036*, *OMM1046*, and *OMM1050*; GenBank Accession Numbers respectively AF346669, AF346678, AF346679, AF346686, AF346693, AF346694). Two loci were dinulceotide repeats (*OMM1019*, *OMM1020*), one was a trinucleotide repeat (*OMM1007*), and three were tetranucleotide repeats (*OMM1036*, *OMM1046*, *OMM1050*). PCR amplifications were performed using the AmpliTaq Reagent System (Applied Biosystems®) in an MJ Research® PTC-100 thermal cycler following manufacturer's protocols, with approximately 25 ng template genomic DNA in 15 µl total volume. Typical cycling conditions included an initial denaturation of 5 min at 96ºC, followed by 30 cycles of 30 sec at 94ºC, 30 sec at 50º-62ºC, and 30 sec at 72ºC. Final extension was carried out for 10 min at 72ºC. Annealing temperature was adjusted to optimize PCR conditions (*OMM1007* = 58ºC, *OMM1019* 58ºC, *OMM1020* = 58ºC, *OMM1036* = 60ºC, *OMM1046* = 60ºC, and *OMM1050* = 60ºC). Forward primers were fluorescently labeled (Applied Biosystems®), and PCR products were genotyped using manufacture's protocols with an Applied Biosystems® model 3100 genetic analyzer.

Since a major portion of the mixed collections were juvenile fish, tests for sibling relationships were performed with the program Kinship v.1.31 (Queller and Goodnight, 1989). Pairwise tests between individual fish determine the likelihood of full and half sibling relationships. To avoid over-representation of any single family, all but one individual (randomly chosen) in a family determined to be full siblings were removed from analysis.

To estimate the level of within-population genetic diversity, expected heterozygosity (H_E; eq 8.4 Nei, 1987), number of alleles per locus, and allele range were calculated for all microsatellite loci. Significant differences in heterozygosity among loci were evaluated between sample populations using the Wilcoxin signed ranks test, implemented in SyStat (SPSS Inc.).

Exact-significance testing methods were used to evaluate conformance to Hardy-Weinberg and linkage equilibria, and homogeneity of spatial distributions of genetic variance. Unbiased estimators of exact significance probabilities were obtained using the Markov-Chain algorithm described in Guo and Thompson (1993), as implemented in GENEPOP v. 3.3 (Raymond and Rousset, 1995), using 500,000 steps. Corrections were made against Type I error using the Bonferroni method (Rice, 1989). If collections are out of equilibrium, heterozygote deficiency may indicate there is non-random mating among individuals in the combined collection (Wahlund effect).

The proportion of genetic variance was calculated from allele frequencies (F_{ST}; Weir & Cockerham, 1984) using GENEPOP v. 3.3 (Raymond and Rousset, 1995) to estimate pairwise genetic divergence within and between populations. Corrections were made against Type I error using the Bonferroni method (Rice, 1989).

In order to infer the degree of relatedness between sample populations, pairwise genetic distances (Cavalli and Edwards, 1967) were calculated between all populations using GENDIST in PHYLIP v. 3.5 (Felsenstein, 1993). Genetic distances were then used to construct a neighbor joining tree of sample populations with NEIGHBOR (PHYLIP v. 3.5). Bootstrap replicates were attained using SEQBOOT and CONSENSE in PHYLIP v.3.5 with 1000 iterations.

Power analysis (STATISTICA v. 6.0; StatSoft Inc.) was used to examine reduced sample sizes among aggregate juvenile samples and determine whether an arbitrary difference of 5% in π (as H_E) could be detected given the genetic variance associated with each microsatellite locus used.

RESULTS

As a result of scale analysis and length measurements, 52 fish were determined to be resident rainbow trout of greater than 3 years of age and less than 30cm in length. The collections with the highest percentage of individuals greater than 3 years of age were N.F. Walla Walla River (41%) and S.F. Touchet River (25%). After sample populations were evaluated for kinship, all full siblings except one per family were removed from the study resulting in a reduction of total samples from 895 to 833 fish (Table 5-1). F_{ST} calculations indicated no significant differences between years within temporal samples from N.F. Walla Walla River and Mill Creek, and therefore temporal samples were pooled at each site.

The six microsatellite loci employed in the analysis ranged from 12-38 alleles observed, totaling 147 alleles (Table 5-2). The average number of alleles per locus was 23.5 for anadromous collections, 22.5 for the resident rainbow population, and 23.6 for the collections of mixed life forms (Table 5-2). Average heterozygosity (H_E) for the life forms was 0.75 for anadromous and 0.72 for resident rainbow trout, and 0.59 for mixed collections. The range in allele size (approximate base pairs) was 80 in anadromous collections, 74 in resident collections, and 88 in mixed collections. All of these indicators revealed higher genetic variation in steelhead than resident rainbow trout. Power analysis indicated a sufficient number of samples in the smallest collection (Walla Walla Mix, n = 31) to reliably detect a 5% difference in heterozygosity based upon variance associated with microsatellite loci combined ($p \geq 0.827$; $\propto = 0.05$).

Tests of Hardy-Weinberg equilibrium (HWE) indicated all loci in anadromous reference populations were in equilibrium as well as the resident rainbow trout collection from Walla Walla River, but two resident collections, Touchet River and W. Patit Creek were out of equilibrium at two and three loci respectively. Further, 7/9 of the mixed collections were out of equilibrium at one to four loci (Table 5-1) due to heterozygote deficiencies. Heterozygote deficiencies in the mixed *O. mykiss* collections suggest that at least seven collections are composed of more than one genetically distinct gene pool. The most common loci out of HWE for populations were *OMM1050* (out of HWE in 4 collections) and *OMM1036* (out of HWE in 3 collections), and these were also the most polymorphic with 38 alleles each. While heterozygote deficiencies in these highly polymorphic loci could have been the result of amplification problems (e.g. null alleles or allele drop out), the fact that these loci were in HWE in all steelhead populations indicates that the deficiencies were most likely due to effects of non-random mating in the mixed collections rather than amplification problems.

Table 5-2. Genetic Variation (Average Heterozygosity (H_E), alleles/locus, and allele range) for each of type of sample collection.

	Anadromous	Resident	W. Patit Creek	Mixed
Avg. H_E	0.75	0.72	0.75	0.59
Avg. Alleles/locus	23.5	22.5	17.5	23.6
Avg. Allele Range (bp)	80	74	53	88

Results of pairwise F_{ST} calculations between reference collections of steelhead and resident rainbow trout revealed only 5/20 tests were non-significant between collections analyzed even after Bonferroni correction, but still the largest F_{ST} values were relatively small with values near 0.04 (Table 5-3). The largest average F_{ST} detected was between W. Patit Creek (out-of-basin stock) and all the other populations (0.04; Table 5-3). In general, genetic divergence estimated by F_{ST} between anadromous collections and resident collections was significant (0.003 to 0.018), but at a similar level to the amount of genetic divergence between the two major segments of the Walla Walla River (resident = 0.001; anadromous = 0.01).

The neighbor-joining tree of the sample collections as shown in Figure 5-2 indicates geographic similarity within drainages of the Walla Walla sub-basin, and further that all anadromous steelhead collections except Touchet River steelhead cluster together. The Touchet River steelhead collection is more similar to other collections from Touchet River than other steelhead collections. Historical stocking of Snake River steelhead juveniles in Mill Creek (unpublished data, ODFW) would explain Mill Creek's position in the dendogram as most closely related to anadromous Snake/Umatilla River collections.

Table 5-3. Pairwise FST values overall loci (Fisher's method) for each sample population. abbreviations follow those in Table, 5-1

Population	WW STHD	TOU STHD	UM STHD	SN STHD	TOU RES	WW RES	WPC RES
WW STHD	**0.014**						
TOU STHD	0.010	**0.02**					
UM STHD	0.006	0.008	**0.02**				
SN STHD	0.013	0.009	0.004*	**0.02**			
TOU RES	0.003*	0.004*	0.006*	0.009	**0.02**		
WW RES	0.009	0.018	0.012	0.012	0.001*	**0.02**	
WPC RES	0.034	0.044	0.041	0.044	0.029	0.043	**0.04**

* Indicates values NOT statistically significant with Bonferroni correction p=0.05/21=0.0024

Bold values are average pairwise Fst between all populations

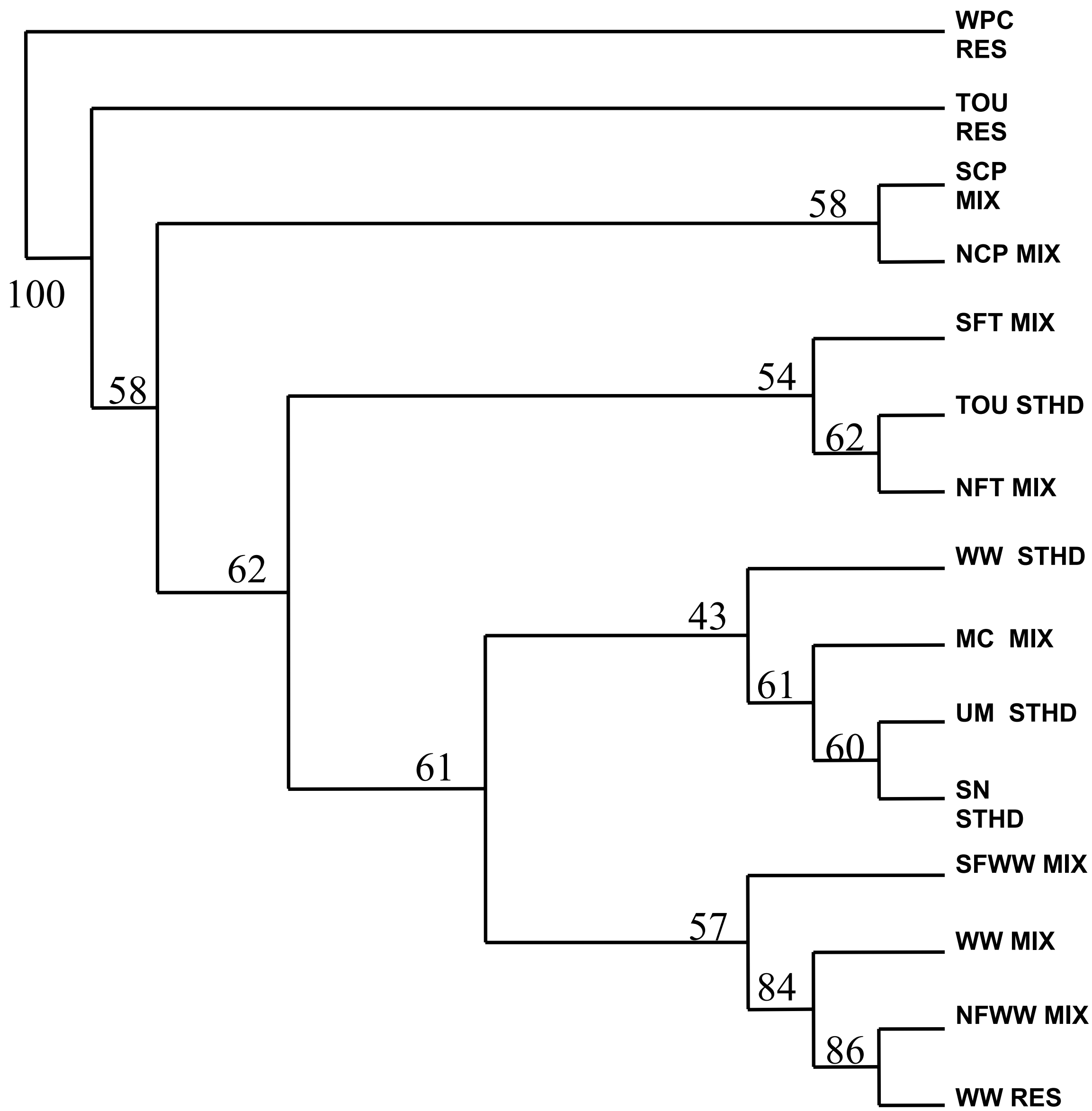

Figure 5-2. Neighbor-Joining dendogram displaying the relationship of sample collections. STHD = adult steelhead collection; RES = resident rainbow collection MIX = juvenile collection with unknown mixture of resident and anadromous forms of *O. mykiss*. Population abbreviations follow those in Table 5-1. Bootstrap values are present at each node as generated from 1000 iterations.

DISCUSSION

Reference populations of adult steelhead are in HWE, but mixed collections are out of equilibrium. An over abundance of observed homozygous individuals in the mixed collections indicates a complexity of spawning aggregates. Assuming a random sample, the presence of distinct gene pools in mixed collections may be due to several contributing factors including: inclusion of two assortatively mating life forms, immigration of resident fish from adjacent populations, and inclusion of various hatchery bred strains of resident rainbow trout.

Various hatchery strains (including Shasta, Cape Cod, McCloud, and possibly others) have been historically stocked (since 1945) into the Walla Walla River system (unpublished data, Washington Department of Fish and Wildlife, WDFW; Tim Bailey personal communication, Oregon Department of Fish and Wildlife, ODFW, 2003), with hatchery releases of resident rainbow trout ceased in 1993. Introgressive hybridization of resident hatchery strains with indigenous *O. mykiss* stocks has been documented (Currens et al., 1997). Thus, the opportunity for hatchery fish to have admixed with Walla Walla stocks has existed for some 50 years. It is unlikely under this scenario that sympatric, resident *O. mykiss* and introduced hatchery strains would have set up and maintained separate spawning aggregates. Therefore, the most obvious explanation for excess homozygous individuals is that non-randomly mating populations are a mix of life forms that generally mate assortatively or have variable reproductive success.
Resident fish are often considered to be confined to small geographic areas within a natal stream (Miller, 1957; Bachman, 1984; Hill and Grossman, 1987). However, recent studies show resident fish may disperse 0.4 to 33 km and occupy new territories (Clapp et al., 1990; Meyers et al., 1992; Riley et al., 1992; Young, 1994) or migrate into adjacent drainages (Fausch and Young, 1995). However, genetic differences among populations from adjacent drainages were detected in this study and have been previously demonstrated (Allendorf and Leary, 1988), indicating limited or reduced gene flow between populations in adjacent drainages. However, if immigrants are present in the sample set, they could account for at least a portion of observed disequilibrium in the mixed collections from the Walla Walla River sub-basin (especially if they are immature or have relatively reduced reproductive fitness and are not introgressing into the receiving population). Furthermore, genetic divergence between drainages (F_{ST} = 0.001 to 0.012) is close to that between life history forms (F_{ST} = 0.003 to 0.018; Table 5-3) such that non-equilibrium populations may contain both anadromous and/or immigrant individuals mixed with resident fish. If the number of immigrants is small relative to the size of the recipient population, the population may still be genetically divergent from the immigrant source population (Wright, 1969; Nelson and Soule, 1987; Fausch and Young, 1995). As discussed in Fausch and Young (1995), the extent of gene flow from immigrants necessary to alter the genetic composition of the recipient population is difficult to measure accurately. While traditional theory predicts gene flow at a rate of one migrant per generation is enough to effectively homogenize populations over evolutionary time (Nei, 1987), biologically significant estimates of migrants per generation to homogenize populations are probably much higher when monitoring on present day time scales (Whitlock and McCauley, 1999). These estimates are for reproductively successful immigrants, but some studies have shown that some immigrants may be less fit than fish within a receiving local population (Wiens, 1976; Tallman and Healey, 1994). Since genetic differences are still detected in populations between drainages in the Walla Walla basin, and the resident rainbow trout reference population consisting of individuals from several locations in the Touchet River was out of HWE, successfully reproductive immigrants are not occurring in large enough numbers per generation for us to detect homogenizing effects. Thus, observed heterozygote deficiencies in some mixed

populations are not likely to be unduly influenced by immigrants from adjacent drainages in the mixed sample collections, but in fact most likely the result of sampling two distinct gene pools in sympatry; anadromous steelhead and resident rainbow trout.

Detecting genetic divergence between resident and anadromous forms of *O. mykiss* is complicated by issues inherent to these sympatric life forms. Confirmed cases of anadromous salmonid progeny remaining as stream residents have been detected where no resident populations typically occur (Regan, 1938; Prouzet, 1981). Furthermore, migratory life histories are not necessarily genetically determined (Skaala and Naevdal, 1989; Hindar et al., 1991) as nonanadromous and anadromous forms can give rise to one another (Johnson, 1980; Nordeng, 1983; Osinov, 1984; Foote et al., 1989). This evidence suggests that gene flow should be sufficient to distribute genetic variation between life forms. However, selective pressure experienced by resident and anadromous forms is likely quite different in the ocean and freshwater environments (Ricker, 1940) possibly rendering hybrids less fit in either environment, therefore maintaining genetic divergence between life forms. For each of these life forms to be maintained over evolutionary time, there must be fitness advantages to each strategy.

In this study, genetic divergence was detected between life forms, yet evidence indicates the two life forms have more recent common ancestry than an unknown hatchery strain of resident rainbow trout released in W. Patit Creek. A detailed analysis of the genetic relationships of all collections in the dendogram (Figure 5-2), reveal concordance with known background information of the areas included in the study. Stocking history, “stray” rates (returns of non-natal adult steelhead), and management actions appear to have shaped the current genetic structure of *O. mykiss* in the Walla Walla River. Adult steelhead collections from Walla Walla River mainstem, Umatilla River, and Snake River, as well as the mixed collection from Mill Creek, cluster together as most genetically similar to each other than other collections. This relationship is likely explained by the strong influence of Snake River steelhead to the Walla Walla and Umatilla rivers revealed in hatchery steelhead releases and stray rates (unpublished data, Confederated Tribes of the Umatilla Indian Reservation; CTUIR). The Walla Walla River mainstem and Mill Creek have been heavily stocked (approximately 150,000 fish) with Snake River steelhead (Lyons Ferry Hatchery stock) from 1983 to present (unpublished data, WDFW), and over the last 13 years an average of 10% of steelhead returning to the Umatilla River were strays composed primarily of Snake River steelhead (unpublished data, CTUIR). The fact the Touchet River adult steelhead collection clusters more closely to other Touchet River mixed collections rather than the cluster of adult steelhead, may be the result of sampling anadromous juveniles in the North and South forks of the Touchet River, or evidence for high introgression among life forms in the Touchet River. Furthermore, all Walla Walla River collections cluster more closely to each other than to Touchet River collections (and vice-versa). This is likely related to separate management by governing state agencies between the Touchet River (located in Washington state) from the upper Walla Walla River (located in the state of Oregon). The respective state agencies have independently stocked the Touchet River with primarily McCloud hatchery strains of resident rainbow trout (unpublished data, WDFW), and Walla Walla River with Shasta and Cape Cod hatchery strains of resident rainbow trout (unpublished data, ODFW). Lastly, the W. Patit Creek collection is more genetically different than any other collections included in this study. Patit Creek has been purportedly historically stocked with private strains of resident rainbow trout of unknown origin by local landowners in the region. There is also evidence for one or more bottleneck events in W. Patit Creek due to uninhabitable water temperatures during the summer and dewatered stream beds, which is supported by reduced genetic diversity in the W. Patit Creek collection (Table 5-2). The current Patit Creek population may be a product of repeated population bottlenecks and small numbers of founders recolonizing the habitat after droughts, with little infusion of new genetic material from the rest of the basin.

If genetic divergence between life forms in the Walla Walla River is the effect of genetic drift (e.g. bottleneck) in steelhead collections, we would expect to see reduced genetic variation in steelhead populations. However, genetic diversity is greater for all steelhead collections than collections of resident rainbow trout or mixed *O. mykiss* (Table 5-2), providing no evidence for a recent bottleneck in the anadromous population. Other sympatric salmonid life forms have been shown to be genetically interrelated (Osinov, 1984; Ryman, 1983; Wilson et al., 1985) and more genetically similar within a location than between regions (Stahl, 1987; Foote et al., 1989) indicating life forms are not derived from separate genetic lineages or the result of multiple colonizations. Evidence for recent common ancestry between life forms may be partially related to observed matings involving precocious males hybridizing with alternate life form such as anadromous salmonid females and resident males through "sneaking" behavior (McCart, 1970). However, conflicting levels of heterozygosity between resident and anadromous forms have been detected (higher resident heterozygosity - Skaala and Naevdal, 1989; higher anadromous heterozygosity - Verspoor and Cole, 1989). One would expect higher heterozygosity in the anadromous form due to potential isolation in the resident population, as well as the belief that the anadromous form is the progenitor of the forms (Ricker, 1940). Under this scenario, resident genetic diversity should be a subset of the anadromous genetic diversity unless high levels of genetic drift occurred in the founding population (e.g. bottleneck). Genetic variation in life forms from the Walla Walla River follow this theory as H_E, number of alleles per locus, and allele range all indicate higher genetic diversity in anadromous steelhead than resident rainbow trout. This evidence corresponds well to previous research in salmonids as studies have indicated it is likely that anadromous sockeye originally colonized the present range of *O. nerka*, and gave rise to resident kokanee populations (Ricker, 1940; Nelson, 1968).

Management and protection of ESA-listed species is affected by whether each life history form can give rise to another form (Waples, 1995), and by movement of resident fish (Fausch and Young, 1995). Life history forms have been noted to give rise to one another in Arctic char (*S. alpinus*; Nordeng, 1983), brown trout (*S. trutta*; Osinov, 1984), brook trout (*S. fontinalis*; McGlade and MacCrimmon, 1979), atlantic salmon (*S. salar*; Stahl, 1987), sockeye salmon (*O. nerka*; Foote et al., 1989) and rainbow trout (*O. mykiss*; Zimmerman and Reeves, 2000). While it is clear from these studies that for many salmonids, one life history form can give rise to sympatric alternative forms, the fisheries management utility of this is unclear, particularly with regard to management options for

ESA-listed species. Too little is known at present about the time frame and ecological conditions needed to foster development of sympatric alternative life histories, for this evolutionary time-scale phenomena to be of utility on the ecological time-scales over which salmonid populations are managed.

Immigration of residents may also affect temporal and spatial genetic drift of ESU populations and should be considered in management decisions (Fausch and Young, 1995). Heterozygote deficiency detected in the Walla Walla River mixed populations provides evidence of more than one genetically distinct gene pool in the sympatric collections. However, this evidence is circumstantial and the degree of isolation needs to be corroborated and quantified by discrete techniques (e.g. parentage, tags, telemetry). Nonetheless, the evidence on hand along with previous studies (Verspoor and Cole, 1989) indicate mixed sample collections with a component of sympatric resident and anadromous life forms, as well as possible resident immigrants from nearby streams in the Walla Walla sub-basin. Since resident fish are genetically divergent from steelhead in the Walla Walla River at low levels, fish may be mating assortatively by size or spawning time (Zimmerman and Reeves, 2000), but gene flow is occurring between life forms, potentially due to residents fertilizing anadromous eggs, or residual anadromous progeny mating with residents. Further, higher levels of genetic divergence between life forms than between resident rainbow trout in adjacent streams within the Walla Walla River, indicate that gene flow is more common between adjacent resident populations than between life forms. However, the highest level of divergence was observed in a population of resident fish with presumed out-of-basin origin (W. Patit Creek), indicating life forms within the Walla Walla River are more closely related than resident rainbow trout from different basins.

Environmental conditions appear to influence juvenile development into life history types as well (Lee and Power, 1976), and juvenile development can vary temporally, based on conditions (Metcalf et al., 1989). The final determination of individual life history form is likely composed of complex interactions between environment and genetics. Furthermore, while reproductive isolation between life history types commonly involves discussion of only two life forms (resident and anadromous), several life forms (resident, estuarine, anadromous) exist in undisturbed environments such as the Kamchatka Peninsula of Russia (Savvaitova et al., 1997). Foote et al. (1989) describe how anadromous sockeye and resident kokanee in British Columbia could diverge in sympatry due to differential selection pressures and hybrids with reduced fitness in both fresh and salt water. Assortative mating in fishes by slight habitat segregation can result in speciation (Narum et al., in press) and possibly even species flocks (Greenwood, 1984; Bargelloni et al., 1994; Johns and Avise, 1994). Relatively undisturbed environments such as Kamchatka Peninsula may yield clues to the evolutionary process in species containing multiple life forms and are prime targets for future research regarding anadromous fish distribution and evolution. While this study detects genetic divergence between life forms, it does not consider differences in behavioral, ecological, and developmental elements between life forms of *O. mykiss*. This is an important area of future research as has been shown with *O. nerka* (Wood and Foote, 1990). The evolution of life forms is likely linked to these elements.

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CHAPTER SIX: RADIO TELEMETRY

SUMMER STEELHEAD AND BULL TROUT RADIO TELEMETRY STUDY: THE WALLA WALLA BASIN NATURAL PRODUCTION MONITORING AND EVALUATION PROJECT

PROGRESS REPORT
OCTOBER 2000 –JUNE 2002

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PROJECT OVERVIEW AND UPDATE

The radio telemetry field-season in the Walla Walla Basin runs from June to June. In this update section, we briefly outline the ongoing telemetry efforts from July 2002 through March 15, 2003. The main body of this report is in regard to telemetry project for contracts that began in October 2000 and include field activities and results through June of 2002. We cannot finalize the fall 2002-Spring 2003 data as tagged steelhead are in the middle of their spawning run and bull trout are in their winter holding habitat. A full and complete report for the June 2002-June 2003 telemetry project will be completed by January 2004. The report will be included in the project annual report in April of 2004. Telemetry annual reports will be cumulative and include data from previous years in subsequent analyses. This report and associated graphics, tables and appendixes are currently available at http://198.66.210.119/database (spring of 2003). In the future all data will be available through http://www.umatilla.nsn.us (CTUIR website).

In May 2001, the Walla Walla River Basin radio telemetry team implemented research to evaluate the effectiveness of three recently constructed adult fish passage facilities and document the spatial and temporal distribution of adult summer steelhead and adult bull trout in the subbasin. Project sponsors and cooperators include Bonneville Power Administration (BPA), Confederated Tribes of the Umatilla Indian Reservation (CTUIR), Hudson Bay District Improvement Company (HBDIC), Gardenia Farms Irrigation District (GFID), Oregon Department of Fish and Wildlife Service (ODFW), Washington Department of Fish and Wildlife Service (WDFW), Walla Walla Basin Watershed Council (WWBWC). University of Idaho (U of I), US. Army Corpse of Engineers (USACE). US Fish and Wildlife Service (USFWS) and US Forest Service (USFS). Fish were collected from a number of locations using a variety of techniques including hook and line, entanglement nets, fish ladder traps, weirs, and dip-nets. Selected adult steelhead (> 510 mm fork length) were implanted with gastric radio-tags. Adult bull trout (> 340 mm fork length) were surgically implanted with radio-tags. Radio-tagged fish were tracked by a series of up to 13 strategically placed fixed recording stations as well as by truck, foot, boat, and aircraft. In this brief, we update our provisional telemetry results for steelhead and bull trout through 15 March 2003.

Steelhead

In our inaugural field season, we radio-tagged and monitored 68 adult summer steelhead (38 hatchery and 30 native fish) between 26 September 2001 and June 30 2002. Tag loss from tag-regurgitation or death (n=10), and movement of tagged fish back to the Columbia River (n=2) reduced the number of study fish to 57 (33 hatchery and 24 native). Radio-tagged steelhead were located throughout the Walla Walla River and in nine tributary streams. Based on our tacking data, hatchery fish entered the Walla Walla River earlier, traveled shorter distances, and left the system earlier than native fish. Average delay (hours: minutes) of radio-tagged native steelhead at Burlingame Dam, Nursery Bridge Dam, and the Little Walla Walla Diversion (i.e., the three new adult fish passage facilities) was 15:55 (n=8, range 00:15-70:30), 23:05 (n=8, range 01:35-74:25), and 00:28 (n=8, range 00:17-00:58), respectively.

In our second field season, we have radio-tagged and monitored 60 steelhead (24 hatchery and 36 native fish) between 9 September 2002 and 15 March 2003. Of this total, 49 steelhead (28 hatchery and 21 native) were radio-tagged in the lower Walla Walla River near Touchet, Washington (between RM 8 and RM 26). Two native fish were tagged at Hofer Dam on the Touchet River (RM 05). One native fish was tagged at the Gose Street Dam on Mill Creek (RM 5) in College Place, Washington, and one native fish was tagged at the WDFW fish weir on Yellowhawk Creek (RM 7) in Walla Walla, Washington. Seven native steelhead were tagged in the west fish ladder trap at Nursery Bridge Dam in Milton-Freewater, Oregon (RM 44). Tag loss from tag-regurgitation or death (n=11), and missing tags (n=2) has reduced the number of study fish to forty-seven. Radio-tagged steelhead were located in the Walla Walla River, Touchet River, Coppei Creek, South Fork Touchet River, Dry Creek, Mill Creek, Yellowhawk Creek, Cottonwood Creek, Middle Fork Cottonwood Creek, Couse Creek, North and South Fork Walla Walla Rivers. As of 15 March, we are tracking 41 fish that have retained the transmitter and are alive. Of these, 13 (32%) have either left the basin or are moving downstream. Twenty-eight (67 %) radio-tagged fish are either actively moving upstream into the tributaries or holding in upstream areas. We will continue to radio-tag fish at Gose Street Dam, the Yellowhawk Weir, and the west fish ladder at Nursery Bridge Dam into April. Radio-tracking of steelhead is projected to continue into June (i.e., until fish either expire or leave the basin). Complete results for 2002-2003 will be reported in January 2004.

Bull trout

In 2001, 20 bull trout were tagged in the west fish ladder trap at Nursery Bridge Dam, between 10 May and 6 June. Tag loss from study effects was unacceptably high during the initial stages of the study. Tagging was immediately stopped until the problems could be identified and corrected. Fifty percent of radio-tagged fish either expired or lost the transmitter before spawning. Snorkel observation on tagged fish suggested that much of the tag loss was related to post-operative infection probably related to poor water quality and inadequate surgical technique. Radio-tagged bull trout that survived and retained the transmitter moved an average of 0.2 miles per day (n=10). Eight radio-tagged bull trout returned from the headwaters to over-winter in the Walla Walla River near Milton-Freewater (between RM 46 and RM 39). Two radio-tagged fish survived and retained the transmitters and remained in the upper South Fork Walla Walla to over-winter. After spawning, radio-tagged bull trout moved on average 0.1 miles per day (n=4) downstream. By June 2002, all but five of the 20 radio-tagged bull trout had either lost the transmitter or expired. In Late 2001, project cooperators convened and developed improved study protocols for bull trout in 2002.

In 2002-03, we implemented changes in study design to reduce tag loss in bull trout. Surgical procedures were improved and tagging relocated upstream. Tagging bull trout above the Milton-Freewater reach of the Walla Walla River provided fish with cleaner water and refugial habitat to recover from surgery before continuing to migrate upstream. Surgical improvements included practicing techniques on hatchery rainbow trout, using buffered anesthetic (MS-222) to reduce pH shock, maintaining good sterilization techniques, using smaller radio tags (< 1% of fish body weight), relocating the antenna exit wound anterior of the pelvic girdle, application of a topical anti-biotic, closing with non-absorbable sutures to prevent “wicking” of stream water into the wound, and sealing the stitches with a “vet-bond” adhesive.

In 2002-2003, 19 adult bull trout (> 340 mm total length) were implanted with radio transmitters in the upper South Fork Walla Walla River between 6 June and 24 July. Eighteen (95 %) of the 19 radio-tagged fish were found to have survived and retained their transmitters and were located upstream in South Fork Walla Walla River. Five (25%) of the 20 fish tracked from 2001 were also found to have survived and retained their transmitters and located upstream in the South Fork. Of the 23 fish confirmed alive (as of October 2002), 13 (56%) returned to near their initial tagging location or over-wintering area, suggesting site fidelity. Four (17%) returned to areas below their original location, suggesting that these fish were tagged while migrating upstream from their over-winter sites. Four (17%) returned to an area above their tagging location or over-wintering location. These fish may have expired, shed the tag, or are over-wintering within the upper watershed. One tagged fish returned downstream in the October and then moved up stream into the North Fork Walla Walla River to over-winter. One fish did not move downstream from the spawning reach and is presumed to have expired or expelled the transmitter.

An additional seven adult bull trout were radio-tagged in the upper Walla Walla River between 10 January and 24 January 2003. Two of these fish have moved a short distance downstream and four remain near their original tagging area in 2003. As of 15 March, we are tracking 29 radio-tagged bull trout. We will continue to track these fish until the transmitter batteries fail, or the fish either expire, lose their tag, or leave the basin. Complete results for 2002-2003 will be reported in January 2004.

EXECUTIVE SUMMARY (FOR OCT 2000 – JUNE 2002)

This is the first progress report of a multi-year project that monitors the movement of adult summer steelhead (*Oncorhynchus mykiss*) and bull trout (*Salvelinus confluentus*) in the Walla Walla River Basin (BPA Project Number 20127). This project uses mobile and fixed site radio telemetry to answer several critical life-history questions about steelhead and bull trout. Specifically, what is their spatial and temporal habitat distribution, and do they move throughout the basin effectively? The project began in May of 2001 and will continue through 2003. This report and associated graphics, tables and appendixes are currently available at http://198.66.210.119/database (spring of 2003). In the future all data will be available through http://www.umatilla.nsn.us (CTUIR website).

This project is a collaborative effort among CTUIR's Fisheries Program, Oregon Department of Fish and Wildlife (ODFW), Washington Department of Fish and Wildlife (WDFW), Walla Walla Basin Watershed Council (WWBWC), the Hudson Bay District Improvement Company (HBDIC), the Walla Walla River Irrigation District (WWRID), Gardena Farms Irrigation District 13 (GFID-13), and the University of Idaho (U of I). In addition, project support, review, and technical assistance is derived from the US Army Corps of Engineers (USACE), Oregon Watershed Enhancement Board (OWEB), US Fish and Wildlife Service (USFWS), the National Marine Fisheries Service (NMFS), US Forest Service (USFS), local landowners, sports fishing groups, and volunteers.

This study will provide critical information to managers regarding the movement of steelhead and bull trout and the effectiveness of fish passage in the Walla Walla Basin. This information helps managers to develop effective strategies for fisheries and flow enhancement within the basin.

Objectives for 2001 - 2002
Objective G was listed formally as Objective 7 in the 2001 statement of work (SOW) and Objective 5 in the 2002 SOW. The objective of the study was to monitor adult steelhead and bull trout movement in the Walla Walla Basin with radio telemetry techniques in cooperation with ODFW, WDFW, WWBWC, and the irrigation districts (WWBNPME Statement of Work). Projects tasks for the 2001 – 2002 SOW included:

1. Coordinate quarterly with ODFW, WDFW, the irrigation districts, and the Walla Walla Basin Watershed Council.
2. Establish and maintain fixed-site telemetry receivers throughout the basin.
3. Capture adult summer steelhead and tag with one-year radio tags.
4. Assist ODFW with bull trout radio-tagging efforts as needed.
5. Track tagged steelhead and bull trout with fixed and mobile telemetry methods to document movement, habitat use, spawning areas, and passage efficiency.
6. Compile, summarize, and incorporate findings and management implications in reports and on the WWBWC web site.

Accomplishments and findings in 2001 - 2002
We achieved our objective in 2001 - 2002 of monitoring adult steelhead and bull trout movement throughout the Walla Walla Basin with radio telemetry in cooperation with ODFW, WDFW, the

irrigation districts and the Walla Walla Basin Watershed Council. This report summarizes results from May 2001 through June 2002, the first fourteen months of work on the project, which includes one spawning season for bull trout (September to November) and steelhead (January to June) in the Walla Walla Basin. In this report, we have compiled telemetry data (our fish tracking database) from May 2001 through December 2002 in Appendix E for reference (appendix E is 35 pages long and is available online at . As of December 2002, we are continuing with our project tasks as stated above. In 2003, we will continue to monitor radio-tagged bull trout and steelhead in the Walla Walla River Basin (WWBNPME 2003 Statement of Work, BPA Project Number 20127). We will report results from our second field season (June 2002 thru May 2003) in December 2003. A final project report will be distributed in April 2004.

Steelhead

CTUIR tagged sixty-eight adult summer steelhead (38-hatchery origin and 30 wild fish) in the Walla Walla Basin between 26 September 2001, and 8 April 2002. Of this total, fifty-seven fish (36 hatchery and 21 wild) were radio-tagged in the Walla Walla River, eight fish (all wild) were tagged in Yellowhawk Creek at the WDFW fish weir, and three fish (2 hatchery and 1 wild) were tagged at the Gose Street Dam on Mill Creek.

We tracked thirty-seven of the fifty-seven steelhead radio-tagged in the Walla Walla River upstream and in nine tributary streams. Initial tag loss from harvest (n=9, 16%), tag-regurgitation or death (n=9, 16%), and movement of tagged fish back to the Columbia River (n=2, 4%) reduced the number of radio-tagged fish for study to thirty-seven (21 hatchery and 16 wild). We documented movement, habitat use, and passage efficiency with fixed-site and mobile radio telemetry techniques.

Based on our observations, catch, and tracking data, hatchery fish entered the Walla Walla River earlier, traveled shorter distances, and departed sooner than wild fish. Radio-tagged hatchery fish were tracked from September through April; wild fish were tracked between November and June. Hatchery fish moved an average of thirty miles upstream and wild fish an average of fifty-three miles before returning downstream.

CTUIR maintained telemetry stations to evaluate fish passage facilities at Burlingame Dam (BGD) in College Place, Washington, Nursery Bridge Dam (NBD) in Milton-Freewater, Oregon, and Little Walla Walla River (LWWR) in Milton-Freewater.

Eleven radio-tagged steelhead reached BGD (3 hatchery and 8 wild). The remaining twenty-six radio-tagged fish (18 hatchery and 8 wild) were tracked and either remained in the lower Walla Walla River below BGD or migrated into a tributary stream (e.g. Touchet R., the Wolf Fork of the Touchet R., Pine Creek, Dry Creek-WA., Mill Creek, or Yellowhawk Creek). No radio-tagged hatchery fish entered the fish ladder or moved past BGD. Six of the eight radio-tagged wild fish at BGD breached the dam through the spillway adjacent to the fish ladder. The remaining two fish used the fish ladder. Average delay (hours: minutes) below BGD for fish that eventually moved upstream was 15:55 (range 00:15 - 70:30).

These same eight radio-tagged steelhead reached NBD. All eight used the fish ladder to pass the dam. One fish fell back over the dam and used the ladder a second time to ascend. Average delay below NBD was 23:05 (range 1:35 – 74:25). On average, fish spent 16:34 in the Nursery

Bridge fish ladder; therefore, on average, fish required 6:31 to find and enter the NBD ladder from the tailrace area below the dam.

All eight radio-tagged fish reached the LWWR site. The Little Walla Walla River site differs from BGD and NBD in that an inflatable Bridgestone dam diverts water to the Little Walla Walla River for irrigation. This diversion dam was not inflated from December to early March. Three radio-tagged fish passed the site before the dam was inflated for irrigation diversion. The remaining five fish either passed the dam through the fish step pass (ladder) or simply breached the spillway adjacent to the step pass. Average passage time at LWWR was 0:28 (range 00:17 - 0:58).

As of June 2002, all fifty-seven steelhead radio-tagged in the Walla Walla River were accounted for. Twenty-three (40%) escaped to the Columbia River, twenty-four (42%) had lost the transmitter or died, and anglers harvested ten (18%). The final disposition of the "escaped" fish is unknown. However, it is probable that most died a short time later in the Columbia River due either to natural causes, study effects (the radio tag remained in their stomach), or harvest. Because the condition of fish as they moved past the telemetry station near the mouth of the river was unknown (e.g. if the fish was alive), our escapement figure of 40% may overestimate the portion of kelts attempting to recondition in the Columbia River from the Walla Walla Basin.

In addition to the fifty-seven steelhead tagged in the Walla Walla River, eight wild steelhead were tagged at the WDFW fish weir on Yellowhawk Creek between 23 February and 12 March to ensure fish for study in the Mill Creek and Yellowhawk Complex in Walla Walla, Washington.

In Yellowhawk Creek, one fish expelled the tag immediately after release, four of the remaining seven fish held in Yellowhawk Creek for an average of twenty days before moving back downstream to the Walla Walla River not to return, and three fish moved upstream into Mill Creek. These three fish required fourteen days to move approximately two miles upstream from the fish weir into Mill Creek.

Once in Mill Creek, two fish (tags 35 and 39) continued upstream for a mile in Mill Creek until reaching Bennington Lake Diversion Dam (BLDD). The third fish (tag 36) moved downstream over the Yellowhawk Diversion Dam (YHD) in Mill Creek and did not return. Fish 35 and 39 remained within a mile of BLDD for the next two weeks. During this time, both fish repeatedly entered the BLDD fish ladder but did not move past the entrance. When not directly below the dam, both fish moved back and forth between YHD and BLDD, presumably trying to find an upstream passage. After thirteen and fourteen days respectively, both fish moved downstream over the YHD in Mill Creek and did not return.

None of the seven fish tracked in Yellowhawk Creek moved directly upstream, and all tended to "mill about" near the trap site. One fish re-entered the trap from downstream three weeks after release. The others remained near the trap holding in an adjacent channel or circling back downstream below the weir. This pattern of movement suggests study effects and a recovery period related to tag insertion as a stressor and that fish were unable to negotiate the braided channels and passage barriers near the trap site.

Three additional fish (2 hatchery and 1 wild) were collected and tagged directly below the Gose Street Dam on Mill Creek in College Place between 5 and 8 April 2002. These three fish were released directly above the dam to provide fish for study in the Mill Creek Flood Control Canal. Initially, at least one fish (75A) did appear to try to go upstream. Tag 75A was recorded two miles upstream at the 9th Street Bridge on Mill Creek in Walla Walla, but within a week of release, all three of the tagged fish had fell back over Gose Street Dam and had moved downstream not to return. This suggests study effects related to tag insertion, that we simply tagged these three fish during their downstream migration, or that fish have a problem successfully navigating through the lower section of the Mill Creek Flood Control Canal.

Bull Trout

ODFW radio-tagged twenty adult bull trout captured in the trap at the old Nursery Bridge fish ladder between 10 May and 6 June 2001. Radio-tagged fish were allowed to recover from the surgical tagging procedure and then released into a backwater area directly above the dam. CTUIR monitored the movements of these fish with radio telemetry techniques. On average, bull trout required six days to move the first mile from the release site at NBD upstream past LWWR, 47 days to travel the 14 miles to Harris Park, and 111 days to move the entire 20 miles from NBD and enter the upper headwaters above Burnt Cabin Creek. On average, bull trout moved 0.2 miles per day during their migration upstream.

Of the twenty fish radio-tagged at NBD, twelve (60%) provided data upstream past Harris Park. Ten of these fish were then tracked upstream to an area between Skiphorton Creek (mile 67) and Reser Creek (mile 70). We did not observe spawning in bull trout. However, based on movement, these ten fish probably spawned between mid-September and early October. By the end of October, eight of the ten radio-tagged bull trout had returned from the headwaters to over-winter in the Walla Walla River near Milton-Freewater.

By June 2002, fifteen (75%) of the bull trout tagged during the previous season had either lost the transmitter or died. There were substantial indications that much of the tag loss was due to study effects (infection, poor water quality, and stress). During the winter of 2002, project cooperators convened to review study design and address the problem of tag loss in bull trout. New protocols were developed and tested on hatchery rainbow trout. In spring 2002, new methods were implemented to tag an additional nineteen bull trout. As of December 2002, we have confirmed tag retention in eighteen of nineteen fish tagged with the new protocols.

We were able to document seasonal distribution and critical habitat (rearing, spawning, and migratory corridors) for bull trout in the Walla Walla River. However, we did not document any movement of bull trout between the three known populations of bull trout in the basin: the Touchet River, Mill Creek, and upper Walla Walla River populations. This suggests that our sample size and study design may have been insufficient to detect migration or that physical and/or thermal barriers may be preventing exchange of genetic material between these three populations.

Additional work is needed to evaluate bull trout passage efficiency at the Burlingame, Nursery Bridge, and Little Walla Walla River facilities. As of December 2002, we have documented only two bull trout moving upstream at NBD and LWWR and none at BGD. Average delay below

NBD was 67:34 (range 19:34 -115:34). Average delay below LWWR was 00:25 (range 00:23 – 00:25). As of December 2002, it remains uncertain if the fish tagged in the spring will move into the passage facilities and provide data for evaluation.

In 2003, better tag retention and a larger study group should yield results on bull trout movement that will help guide ongoing watershed restoration efforts by the coalition of public and private groups working towards ecosystem recovery in the Walla Walla Basin.

2002 – 2004 Study Design

This project is a cooperative effort between CTUIR, ODFW, WDFW, WWBWC, HBDIC, WWRID, GFID-13, U of I, USCOE, USFWS, USFS, and NMFS. These cooperators are actively involved in the management, use, or monitoring of salmon and their habitat in the Walla Walla Basin.

General telemetry methods will follow CTUIR's adult passage evaluations in the Umatilla Basin (Contor et al. 1996 and 1997). Monitoring will include a detailed examination of how fish negotiate each of the new passage structures at Burlingame Diversion, Nursery Bridge Dam, and Little Walla Walla River Diversion. In we addition intend to conduct a detailed examination of how radio-tagged steelhead use Yellowhawk Creek and Mill Creek. This monitoring effort will focus on possible passage barriers and travel time within Mill Creek Flood Control Canal and Documenting steelhead spawning in Yellowhawk Creek.

Between 2001 and 2004, up to ninety bull trout and 180 wild and hatchery steelhead will be radio-tagged and monitored in the Walla Walla Basin. The Uof I will maintain a telemetry station near the mouth of the Walla Walla River, WDFW will maintain three stations in the upper Touchet system, and CTUIR will maintain up to twelve telemetry stations throughout the basin. Individually digitally encoded transmitters (radio-tags) combined with the strategic deployment of telemetry stations, each with multiple air and submerged antennas, will allow for tracking of individual fish. Multiple antennas at each station will show if the fish use the ladder or jump over a structure. Telemetry receivers will also record how long fish hold below a structure before moving past it. Mobile tracking from the air and on the ground will locate fish away from the stations and follow individuals throughout the basin. Mobile tracking should allow for the detection of fish passage routes and any unknown passage barriers.

INTRODUCTION

The Confederated Tribes of the Umatilla Indian Reservation (CTUIR) is funded by Bonneville Power Administration (BPA) to conduct a three-year telemetry study (BPA Project number 20127) to monitor movement and habitat use by adult steelhead and bull trout in the Walla Walla Basin and to evaluate the effectiveness of three recently constructed fish passage facilities on the Walla Walla River at Burlingame Dam (BGD), Nursery Bridge Dam (NBD), and Little Walla Walla River Diversion (LWWR). This project is in accordance with the Northwest Power Planning Council's Columbia River Basin Fish and Wildlife Program and one of several under the Walla Walla River Basin Natural Production Monitoring and Evaluation Project. This three-year study will provide critical information to fisheries managers on the effectiveness of new fish passage facilities, potential barriers to migration, and the movements of summer steelhead and bull trout in the Walla Walla Basin.

This project is a cooperative effort among CTUIR's Fisheries Program ODFW, WDFW, WWBWC, HBDIC, WWRID, GFID, and U of I. In addition, project support, review, and technical assistance is derived from the USACE, OWEB, USFWS, NMFS, USFS, local landowners, sports fishing groups, and volunteers.

This study is designed to collaborate with three other projects: The WDFW Touchet River Bull Trout Telemetry Study, the ODFW/WWBWC Bull Trout Telemetry Study, and the U of I Columbia River Steelhead Study. The local co-managers (CTUIR, ODFW and WDFW), USFWS, and NMFS agree that collaboration and expansion among these studies is warranted.

The objective of this study is to monitor adult steelhead and bull trout movement in the Walla Walla Basin with radio telemetry techniques in cooperation with ODFW, WDFW, WWBWC, and the irrigation districts (WWBNPME Statement of Work). We hope to answer several critical life-history questions about steelhead and bull trout in the Walla Walla Basin. Specifically, what are their spatial and temporal habitat distributions, and do they move throughout the basin effectively?

Projects tasks for the 2001 – 2002 project period were:

1. Coordinate quarterly with ODFW, WDFW, the irrigation districts, and the Walla Walla Basin Watershed Council.
2. Establish and maintain fixed-site telemetry receivers throughout the basin.
3. Capture adult summer steelhead and tag with one-year radio tags.
4. Assist ODFW with bull trout radio-tagging efforts as needed.
5. Track tagged steelhead and bull trout with fixed and mobile telemetry methods to document movement, habitat use, spawning areas, and passage efficiency.
6. Compile, summarize, and incorporate findings and management implications in reports and on the WWBWC web site.

This report summarizes results from May 2001 through June 2002, the first fourteen months of work on the project, which includes one spawning season for bull trout (September to November) and steelhead (January to June) in the Walla Walla Basin. In this report, we have compiled telemetry data (our fish tracking database) from May 2001 through December 2002 in Appendix E for reference. As of December 2002, we are continuing with our project tasks as stated above. In 2003, we will continue to monitor radio-tagged bull trout and steelhead in the Walla Walla River Basin (WWBNPME 2003 Statement of Work, BPA Project Number 20127). We will report results from our second field season (June 2002 thru May 2003) in December 2003. A final project report will be distributed in April 2004.

Study Area

The Walla Walla River and its major tributaries (the Touchet River, Mill Creek, Yellowhawk Creek, and the North and South Forks of the Walla Walla River) drain an area of 1,758 square miles (Mendel et al. 2001). The Walla Walla River originates in the Blue Mountains of eastern Oregon near an elevation of 6,000 feet and runs north into Washington and northeastern Oregon, with most of the basin (73%) in Washington State (Figure 6-1). The river flows in a northwesterly direction through steep volcanic canyons, rolling dry-range foothills, and broad valley croplands to its confluence with the Columbia River about twenty-one miles upstream of McNary Dam.

Throughout the 20th century, most of the summer flows in the Walla Wall River were diverted for agricultural use. In April 1998, the Walla Walla River was listed as “one of American’s most Endangered Rivers” due to being “flow impaired” because of irrigated agriculture having diverted the entire river’s flow. This traditional use of all the water in the river became a political concern once bull trout and steelhead were listed as threatened species in the Walla Walla River under the Endangered Species Act in 1998 and 1999 respectively. In 2001, an agreement was reached between local irrigation districts, federal, state, tribal, and local entities that resulted in a continuously flowing river during the summer irrigation season for the first time in more than 100 years.

Additional concern for the Walla Walla River has centered on degradation of fish habitat in areas that once provided productive spawning and rearing habitat for Columbia River salmon, steelhead, and bull trout (Nielson 1950). In addition to irrigation, habitat loss, poor water quality (e.g. low flows, sedimentation, and high temperatures), flood control measures, passage impediments, urbanization, agricultural practices, and illegal harvest continue to threaten fish in the basin. Other out-of-basin impacts include uncertain ocean conditions, habitat loss in the Columbia River and estuaries, predation, and pollution (Mendel et al. 2001).

MATERIALS AND METHODS

This project is a cooperative effort between CTUIR, ODFW, WDFW, WWBWC, HBDIC, WWRID, GFID, U of I, USCOE, USFWS, USFS, and NMFS. These cooperators are actively involved in the management, use, or monitoring of salmon and their habitat in the Walla Walla Basin.

General telemetry methods will follow CTUIR's adult passage evaluations in the Umatilla Basin (Contor et al. 1996 and 1997). Monitoring will include a detailed examination of how fish negotiate each of the new passage structures at Burlingame Diversion, Nursery Bridge Dam, and Little Walla Walla River Diversion. In addition, we intend to conduct a detailed examination of how radio-tagged steelhead use Yellowhawk Creek and Mill Creek. This monitoring effort will focus on possible passage barriers and travel time within Mill Creek Flood Control Canal and on documenting steelhead spawning in Yellowhawk Creek.

Between 2001 and 2004, up to ninety bull trout and 180 wild and hatchery steelhead will be radio-tagged and monitored in the Walla Walla Basin. The Uof I will maintain a telemetry station near the mouth of the Walla Walla River, WDFW will maintain three stations in the upper Touchet system, and CTUIR will maintain up to twelve telemetry stations throughout the basin (Table 6-1). Individually digitally encoded transmitters (radio-tags) combined with the strategic deployment of telemetry stations, each with multiple air and submerged antennas, will allow for tracking of individual fish. Multiple antennas at each station will show if the fish use the ladder or jump over a structure. Telemetry receivers will also record how long fish hold below a structure before moving past it. Mobile tracking from the air and on the ground will locate fish away from the stations and follow individuals throughout the basin. Mobile tracking should allow for the detection of fish passage routes and any unknown passage barriers.

The above listed cooperators have combined efforts to enhance information while avoiding project overlap or interference. This cooperative effort will improve efficiency and yield higher quality results. Cooperator oversight should enhance the project's scope and probability of success. Our initial study plan is for three years. After the end of the second year, we will evaluate our findings and determine if a third field season is needed to expand results. In 2005, we plan to conduct similar telemetry research on adult spring Chinook[4] returning to the Walla Walla Basin.

Fixed Sites

Project cooperators selected strategic sites to monitor the movement of fish throughout the Walla Walla River Basin (Figure 6-1). Emphasis was placed on major irrigation diversion dams, migration routes, and tributary streams. Station components varied by location and objective.

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

However, the basic telemetry station included receiver, antennas, and power source with the general purpose of recording time and direction of fish passage. A typical station had at least one 5-element yagi antenna and a number of underwater coaxial antennas (RG-58) linked to a Lotek Engineering (Newmarket, Ontario, Canada) Model SRX_400 telemetry receiver programmed to record the presence of radio-tagged fish. Either 120-volts AC or a 12-volt, deep-cycle, gel-cell battery supplied power.

The placement of multiple yaggis on the dam facing up and downstream along with underwater coaxial antennas within the fish ladder and at the entrance and exits of the ladders were designed to allow for determination of migration route (fish ladder or over the dam crest), passage time, and travel direction for individual fish. Station reception was regularly tuned to maximize quality and minimize signal overlap between individual antennas. Regular tuning was necessary because signal reception varied due to certain conditions (e.g. water depth, velocity and temperature, background noise, line of site interference, etc.). Project personnel typically exported telemetry data from the stations to a laptop computer or hand-held field PC once a week.

Mobile Tracking

Movement of radio-tagged fish was monitored with mobile tracking techniques at least once per week or more often during the peak of migration or when monitoring fish at potential migration barriers. The frequency and focus of mobile tracking depended on fish activity past the fixed-site receivers and fish locations as determined by the previous mobile tracking effort.

We tracked fish from the air, on the water, and over the ground. On the ground, we mobile tracked on foot, in a drift boat with a hand held H-antenna, and in a truck equipped with a 5-element yagi antenna mounted in the bed of the vehicle. In the air, we used a Cessna 182 with two wing-mounted 4-element yaggi antennas, one facing fore and one aft. The pilot and aircraft were contracted through Sky Runners (Walla Walla, Washington), a company that specializes in fish and wildlife telemetry. Aerial telemetry was used to locate radio-tagged fish at least once per month between March and June, and once per week through April 2001.

We recorded fish movement at the reach scale. Fish position was plotted using United States Geological Survey topographic maps (scale 1:24000) to the nearest mile. A set of known landmarks were used to plot fish position (Appendix A). We also recorded fish position using a hand-held Global Positioning System receiver during some ground and aerial surveys. Project personnel typically exported mobile tracking data to a laptop computer or hand-held field PC once a week.

Steelhead

In 2001, project coordinators planned to tag sixty steelhead (30 hatchery and 30 wild fish) from below Mill Creek on the Walla Walla River. Sixty was considered the minimal number of tagged fish needed to assure basin-wide coverage. Because no permanent fish trapping facilities exist on the lower Walla Walla River, study fish had to be obtained by hook and line, seines, weirs, and dip-nets (Figure 6-2). All fish were examined and measured, and those selected had radio-transmitters inserted into their gullets. Since each transmitter produced a distinct digital code, individual fish could be tracked and monitored.

We captured most steelhead with hook and line techniques (bait and lures) while drifting or back trolling downstream in the lower Walla Walla River. Most drift trips were contracted through a local guide (Paul Cilvik, Milton-Freewater, Oregon, Chairman ODFW Salmon and Trout Enhancement Commission and a former WWBWC Board member). The date, location, and duration of each drift depended on fish activity and local knowledge and recommendations.

We also collected steelhead with hook and line techniques from the bank, by beach seining in the lower Walla Walla River, from the WDFW fish weir on Yellowhawk Creek in Walla Walla, and by dip netting at the Gose Street Dam in College Place.

A steelhead suitable for tagging was over 51 cm in fork length and in good condition. All other fish were released alive at the capture site. Once a suitable fish was caught, the radio tag was gently inserted into the fish's stomach (tags were lubricated with olive oil to aid insertion). Once inserted, the tag's transmitting antenna ran back up the gullet and out the mouth, laying back flush along the body of the fish (Appendix B).

We used Lotek MCFT-3A radio transmitters configured with the year 2000 code set for tagging fish. Each transmitter (16.1g in air) was encapsulated in a bio-safe resin and equipped with an external, transmitting, whip antenna. Each tag transmitted a unique code on a frequency of 150.210 MHz and had a guaranteed transmitting life of 365 days for steelhead and 720 days for bull trout (the different "ping intervals" for steelhead and bull trout tags determines their lifespan). Each tag had a return address and contact phone number. Informational signs were posted offering a $25 reward for returned transmitters (Appendix B). Returned and recovered tags were reused to tag additional hatchery steelhead**.**

Most transmitters were fitted with a section of surgical tubing to help anchor them within the fish's stomach and thereby minimize tag regurgitation. We confirmed tag function with the telemetry receiver just prior to and after insertion.

We were able to insert transmitters quickly, with little apparent stress, and without anesthetizing fish. Steelhead were placed in fiberglass trough (76 cm long, 15 cm wide, and 15 cm deep) then gently inverted. With a firm hold on the lower jaw, the transmitter was inserted into the throat and carefully pushed into the stomach. A small wooden dowel was helpful for pushing the tag into the stomach. Tag insertion with this technique required seconds, whereas dosing a fish with MS-222, clove oil, or CO_2 would have prolonged handling time and stress. Moreover, we were prohibited from using MS-222 and clove oil due to human health concerns regarding exposure during handling and the possible consumption of treated fish by anglers. Each tagged fish was held for about 15 minutes, tag retention was confirmed visually, and the fish was released at the capture site. We did not hold fish for an extended period time in order to minimize handling stress. Project personnel recorded date, tag number, capture location and method, fish condition, sex, fork length, water temperature, and comments.

Bull Trout

ODFW radio-tagged adult bull trout (> 38 cm fork length) captured in the trap at the old Nursery Bridge fish ladder between May and June 2001. Radio-tagged fish were allowed to recover from the surgical tagging procedure and then released into a backwater area directly above the dam. CTUIR assisted ODFW with radio-tagging on one occasion. CTUIR tracked radio-tagged bull trout and forwarded results to project cooperators. Methods for surgically implanting radio tags in bull trout generally followed previous work on adult bull trout evaluations in the Umatilla River Basin by the ODFW Umatilla Fish District (Tim Bailey, ODFW, personal communication). Only bull trout heavier than 600g were retained for radio-tagging, thus ensuring that tag weight did not exceed 3% of the host fish weight. A digitally encoded radio transmitter was surgically implanted in the abdominal cavity of the fish using the following techniques (adapted from Shappart 2001, ODFW unpublished technical report).

A surgeon and assistant performed the procedure in the morning in the shade at the NBD ladder. Pre-surgery setup consisted of disinfecting surgical instruments, the tag, and hands in a solution of Argentyne brand germicide and then rinsing in fresh river water. Transmitter function was checked prior to arriving on site.

Bull trout were netted from the trap and anesthetized in an 80mg/l bath of MS-222 (Finquel, Argent Labs). Anesthetized fish were measured for total length, weighed, and then placed in a plywood cradle. An assistant delivered anesthetic and fresh water over the gills, keeping the anesthetic solution out of the incision, and monitored fish respiration during the surgery. Fresh water was used to bring the fish out of anesthesia toward the end of surgery, generally during the first suture.

The surgeon placed the fish in the cradle ventral side up. The tagging cradle was cushioned with paper towels to pool the anesthetic solution near the gills. A small incision was made anterior to the pelvic girdle and slightly lateral to the mid-ventral line. Forceps held the proximal end of the incision open while the scalpel worked gently ventral and distal. The surgeon then checked for sex, maturity, and damage to internal organs.

A rigid plastic tube was inserted into the incision and carefully pushed back until it made contact with the body wall posterior to the pelvic girdle. The surgeon then inserted a cannula (large gauge needle) into the tube until it emerged through the body wall outside the fish. The whip antenna was then threaded through the cannula, beginning proximal to the incision, and exiting outside the body wall. The surgeon then inserted the tag by pulling on the exposed antenna while gently pushing on the tag until it was in the body cavity. The tube and cannula were then removed by pulling distally through the body wall. Three or four absorbable sutures were used to close the incision. The surgeon then applied tissue adhesive to seal the sutures and antenna exit wound.

Surgery time averaged ten minutes. Each fish was allowed to recover in a bin of fresh river water until it regained equilibrium (usually 10 to 15 minutes). Fish were then released directly above the fish ladder in a lateral pool with woody cover.

RESULTS AND DISCUSSION

In 2001-2002, we achieved our objective of monitoring adult steelhead and bull trout movement throughout the Walla Walla Basin with radio telemetry in cooperation with ODFW, WDFW, the irrigation districts, and the Walla Walla Basin Watershed Council.

CTUIR established and maintained 12 fixed-site telemetry stations in the Walla Walla Basin. Sixty-eight steelhead and twenty bull trout were radio-tagged. Both fixed-site and mobile tracking efforts were used to monitor the movements of tagged fish to document habitat utilization, spawning areas, and passage impediments.

In 2003, we hope to document movement of bull trout into the lower Walla Walla River and Columbia River. We will also monitor the movements of steelhead in the Yellowhawk and Mill Creek Complex, continue to evaluate efficiency at the new passage facilities, and attempt to observe steelhead spawning in Yellowhawk Creek, Mill Creek and the Upper Walla Walla system.

Steelhead

CTUIR captured and tagged sixty-eight adult summer steelhead (38 hatchery origin and 30 wild fish) in the Walla Walla Basin between 26 September 2001, and 8 April 2002 (Figure 6-2). Fifty-seven fish (36 hatchery origin and 21 wild fish) were radio-tagged in the lower Walla Walla River between September and March (Figure 6-3). In addition, eight fish (all wild) were tagged in Yellowhawk Creek at the WDFW fish weir between March and April, and three fish (2 hatchery and 1 wild) were tagged at the Gose Street Dam on Mill Creek in April. We captured fifty-four steelhead (80%) with hook and line techniques; the remaining fourteen radio-tagged steelhead (20%) were collected by seining, trapping, and dip-netting (Figure 6-4).

We tracked thirty-seven radio-tagged steelhead (21 hatchery and 16 wild) upstream in the Walla Walla River and in nine tributary streams (Table 6-2). Initial tag loss from harvest (n=9, 16%), tag-regurgitation or death (n=9, 16%), and movement of tagged fish back to the Columbia River (n=2, 4%) reduced the number of radio-tagged fish for study from fifty-seven to thirty-seven.

From this study group of thirty-seven fish we compared run timing, movement, and escapement back downstream to the Columbia River between hatchery and wild radio-tagged steelhead (Figure 6-5 & 6-6). Based on our observations, catch, and tracking data, hatchery fish entered the Walla Walla River earlier, traveled shorter distances, and left the system earlier than wild fish. Radio-tagged hatchery fish were tracked from September through April; wild fish were tracked between November and June. Hatchery fish moved an average of thirty miles upstream and wild fish an average of fifty-three miles before returning downstream. (Figure 6-5 and 6-6). In general, hatchery fish seemed to be more numerous and easier to catch for radio tagging than wild fish. Additional study is needed to further document run timing, movement, and spawning in hatchery and wild steelhead in the Walla Walla River Basin.

Tag Loss

In 2001, the first twelve radio tags implanted into steelhead were not fitted with surgical tubing to help anchor the tag within the fish's stomach. Three of these first twelve fish (25%) probably expelled the tag soon after release. We observed one fish (tag 7) break the surface of the water and expel the tag. Our initial inexperience with the tagging process contributed to this high rate of tag loss. However, we quickly became adept at tagging, which, along with the addition of surgical tubing, seemed to reduce tag loss. We estimate that only four of the remaining fifty-six (7%) steelhead expelled the tag.

Location of initial tag loss varied. Six transmitters were located at the release site, and three were found upstream. It is probable that the six expelled the tag soon after release due to improper insertion. Once upstream, fish may have expelled the tag, died if hooked by an angler, had their tags removed by anglers (e.g. from prohibited wild fish), or died from study effects.

The tag loss due to harvest probably varied due to fishing regulations. Based on returned radio-tags, the harvest rate on hatchery fish was 28% (Table 6-3). The catch rate or illegal harvest on wild fish was uncertain. Anglers did not return any radio-tags from wild fish as fishing regulations require the release of all wild fish (those fish with a complete adipose fin). We did receive anecdotal reports of anglers catching and releasing wild fish with radio-tags. It is probable that some anglers kept wild fish and discarded the radio-tag; or that angler-landed fish died after release due to handling stress; or that fish expelled the transmitter upon being hooked. This may explain some of the apparent tag loss in both hatchery and wild fish where fish moved upstream before apparently losing their radio-tags the lower Walla Walla River (e.g. tags 2, 51 and 55).

Ladder Passage

We evaluated fish passage at Burlingame Dam (BGD, mile 36) in College Place, and at Nursery Bridge Dam (NBD, mile 44) and Little Walla Walla Diversion (LWWR, mile 45), both in Milton-Freewater (Table 6-4). Average upstream travel time from below BGD to above LWWR was roughly 21 days through this 10-mile stream reach (n=8, range 9 - 43 days, Table 6-5). On average, steelhead traveled 0.5 miles per day through this reach.

Eleven radio-tagged steelhead reached BGD (3 hatchery and 8 wild fish). None of the hatchery fish entered the fish ladder or moved past BGD. These three hatchery fish below BGD probably strayed from their lower river cohort (hatchery out-plants by WDFW) or from another system. Recent counts above BGD (at the NBD ladder) show that only a few hatchery fish (range 0 to 17) ascend the ladder each year (Tim Bailey, ODFW personal communication). The number of hatchery fish ascending NBD was not available for 2002 (Brian Zimmerman, CTUIR, personal communication).

At BGD, six of the eight wild fish passed the dam over the spillway adjacent to the fish ladder. The remaining two fish used the fish ladder. Average delay (hours: minutes) below BGD was 15:55 (range 00:15: - 70:30, Table 6-4). Of the two fish that used the Burlingame ladder, one remained in the ladder for over twenty-three hours while the second was in the ladder for only eleven minutes. Judging from its short time in the ladder, this second fish may have entered from the exit after breaching the dam through the spillway.

At BGD during the steelhead migration (December through May), most of the attraction water flowed from the spill gate adjacent to the ladder. Fish were predictably attracted to this flow bypassing the ladder entrances to breach the low head dam directly over the spill gate. Based on observation and some limited telemetry data (i.e. two fish in the ladder), it is believed that steelhead probably use the ladder as a refuge from high flow or as a route over the dam when the flashboards are installed and the spillway closed. Further work is needed to correlate facility operations, fish passage, ladder use, and flow at BGD.

The eight wild fish that passed BGD all reached NBD. All eight used the fish ladder to pass the dam. Average delay below NBD was 23:05 (range 1:35 – 74:25, Table 6-4.). On average, fish spent 16:34 in the Nursery Bridge fish ladder. Therefore, on average, fish required 6:31 to find and enter the NBD ladder from the tailrace area below the dam.

Passage time within the ladder varied between fish that ascended directly and those that lingered. Four fish stayed in or near the exit of the Nursery Bridge ladder an average of 37 hours, and four steelhead ascended and exited the ladder in just over two hours. One fish fell back over the dam and used the ladder a second time. Tag 53 fell back over the dam on 13 March during a high flow event, returned, and re-ascended the ladder on 25 March. Both times, tag 53 moved directly through the ladder. Fallback and repeat passage through the ladder, as well as residency in the ladder, could result in an overestimation in enumeration of fish passing NBD. Future counts may need to be adjusted accordingly. In addition, fallback and residency within the ladder suggests that passage efficiency is lower under certain flow and operating conditions. We were not able to quantify ladder passage to stream flow or facility operations. Additional work is needed to document which ladder entrance fish are using. However, there are technical limitations associated with this task. Specifically, there are reception and signal overlap problems with placing adjacent underwater antennas, as would be the case at the multiple-entrances to the NBD ladder. We shall endeavor to circumvent these technical difficulties and provide results in 2003.

Within two days of passing NBD, all eight radio-tagged fish reached the LWWR site. The Little Walla Walla River site differs from BGD and NBD in that there is no permanent in-channel diversion. At LWWR, an inflatable Bridgestone dam diverts water to the Little Walla Walla River for irrigation. An Obermeyer spill gate controls flow over the dam and to the fish screen. A short (3-meter) fish step-pass (ladder) adjacent to the spill gate provides passage over the Bridgestone dam during the irrigation season when much of the stream is diverted to the screened canal. The dam was deflated from late December to early March. Three radio-tagged fish passed LWWR in February and March, before the dam was inflated for irrigation diversion. After the dam was inflated, three fish moved through the Obermeyer spill gate and two fish probably passed the dam through the step-pass. The LWWR site did not seem to present a significant delay to steelhead due to spill through the Obermeyer gate between January and April. Average passage time at LWWR was 0:28 (range 00:17 - 0:58, Table 6-4).

We did not directly evaluate the LWWR step-pass due to its short length, mid-channel location, and problems with signal overlap. In 2002, we placed an underwater antenna below the spill gate to monitor passage. In 2003, we will place an underwater antenna in the LWWR step pass to evaluate its use by fish.

This past season, no radio-tagged fish were diverted into the screened canal at the LWWR site. However, it is believed that bull trout and steelhead use the canal during their upstream and downstream migrations, possibly as a refuge site or feeding area. In 2003, we will continue to monitor the canal with underwater antennas. Additional work is needed to quantify information on facility operations, fish passage, ladder use, temperature, and flow at BGD, NBD, and LWWR.

Fish Movement

We tracked radio-tagged steelhead in Washington in the lower Walla Walla River, the Touchet River, the Wolf Fork of the Touchet River, Pine Creek, Dry Creek, Mill Creek, and Yellowhawk Creek. In Oregon, we tracked fish in the Walla Walla River, Couse Creek, and the North and South Forks of the Walla Walla River (Figures 6-5 through 6-22).

Thirty-seven radio-tagged steelhead (21 hatchery and 16 wild) used the Walla Walla River or tributary stream. Three hatchery fish ascended the Touchet River (Figure 6-9); one strayed into lower Pine Creek; seven veered into lower Mill Creek (Figure 6-8), nine remained in the lower Walla Walla River near Collage Place (Figure 6-5) and one used lower Yellowhawk Creek (Figure 6-10). Half of the wild fish tracked (n = 8) used tributary streams in Washington or remained in the Lower Walla Walla River. Four wild radio-tagged fish were located in the Touchet River (Figure 6-11), three used Dry Creek between Lowden and Dixie (Figure 6-12), and one remained near the mouth of Mill Creek near College Place with its hatchery cousins (Figure 6-14). The remaining eight radio-tagged wild fish moved to the headwaters of the Walla Walla River above Milton-Freewater (Figure 6-6). Two wild fish were found in Couse Creek (Figure 6-15); one fish remained near the confluence of the North and South Fork Walla Walla River (Figure 6-13), two fish veered into the lower North Fork (Figure 6-16), and three used the South Fork Walla Walla River between the confluence of the forks and Harris Park (Figure 6-17).

As of June 2002, all fifty-seven steelhead radio-tagged in the Walla Walla River were accounted for (Table 6-3.). Twenty-three (40%, 15 hatchery and 8 wild) returned to the Columbia River, Twenty-four (42%, 9 hatchery and 13 wild) had lost the transmitter or died, and anglers returned transmitters from ten (18%, all hatchery). Escapement back to the Columbia River was similar among hatchery (N=36, n=15, 41%) and wild fish (N=21, n=8, 38%). Most, if not all, of the "escaped" fish probably died a short time later downstream in the Columbia River due either to natural causes, study effects (the radio tag remained in their stomach), or harvest. Their final disposition is unknown. Another option is that they may have already been dead and then floated out past our telemetry station to the Columbia River. Thus, our escapement figure of 40% may overestimate the number of kelts that recondition in the Columbia River from the Walla Walla Basin.

As stated above, the fate of radio-tagged steelhead after leaving the Walla Walla River is uncertain. However, tag 21 was removed as a steelhead kelt at the McNary Dam juvenile bypass facility on 3 April 2002. The fish was a slim, post-spawned female of bright coloration and in poor condition with severe "head burn" (Robert Wertheimer, USACE, Personal communication). After the radio tag was removed, the fish was PIT-tagged (3D9.1BF14BE146) and released as a conscript in the USACE kelt reconditioning study. We recovered one other tag from the

Columbia River: One ripe hatchery female in good condition was harvested near the Irrigon hatchery on 6 April. This fish was described as bright and in good condition, the fish was retained by the angler and the radio tag returned.

In addition to those fish that either expire or leave the basin in the spring, some adult steelhead hold the headwaters through the summer. Snorkelers from the USGS observed one adult steelhead in the South Fork Walla Walla River near Burnt Cabin Creek (mile 62) while conducting bull trout population surveys in early August, 2002 (Robert Al-chokhachy, USGS, personal communication). This may suggest a vestigial winter steelhead run or kelts holding in the headwaters. Further study is needed to document movement, spawning, and reconditioning of steelhead in the Walla Walla Basin.

Yellowhawk and Mill Creek

Only two of fifty-seven fish tagged in the lower Walla Walla River entered Mill and Yellowhawk Creeks (Figure 6-10 and 6-14). To ensure fish for study, we radio-tagged an additional eleven steelhead within the Mill Creek and Yellowhawk Complex. We tagged eight fish (all wild fish) at the WDFW weir on Yellowhawk Creek in Walla Walla (between 23 February and 12 March) and three fish (2 hatchery and 1 wild) at the Gose Street Dam on Mill Creek in College Place (between 5 and 8 April 2002).

In Yellowhawk Creek, one fish expelled the tag immediately after release, four remained in Yellowhawk Creek for an average of twenty days before moving back downstream to the Walla Walla River (Figure 6-18), and three fish moved upstream into Mill Creek (Figure 6-19).

On average, these three fish required fourteen days to move approximately two miles upstream from the fish weir into Mill Creek. Once in Mill Creek, two fish (tags 35 and 39) continued upstream for a mile in Mill Creek until reaching Bennington Lake Diversion Dam (BLDD). The third fish (tag 36) moved downstream over the Yellowhawk Diversion Dam (YHD) in Mill Creek and did not return. Fish 35 and 39 remained within a mile of BLDD for the next two weeks. During this time, both fish repeatedly entered the BLDD fish ladder but did not move past the entrance. When not directly below the dam, both fish moved back and forth between YHD and BLDD, presumably trying to find an upstream passage. After thirteen and fourteen days respectively, both fish moved downstream over the Yellowhawk Dam in Mill Creek and did not return.

None of the seven fish tracked in Yellowhawk Creek moved directly upstream and all tended to “mill about” near the trap site. One fish re-entered the trap from downstream three weeks after release while the others remained near the trap holding in an adjacent channel or circling back downstream below the weir (Appendix E). This pattern of movement suggests study effects and a recovery period related to tag insertion as a stressor and that fish were unable to negotiate the braided channels and passage barriers near the trap site.

Although we tagged these fish towards the end of their migration (February to April), it is uncertain if they spawned. We did receive anecdotal reports of steelhead spawning in Yellowhawk Creek during March and April. However, most of the known spawning reaches in the Yellowhawk and Mill Creek Complex are above Bennington Lake Diversion Dam in upper

Mill Creek. The five radio-tagged fish that did not move upstream in Mill Creek may have spawned in Yellowhawk Creek. The remaining two fish may have spawned below the BLDD in Mill Creek or not at all.

In 2002, annual counts of steelhead redds in Mill Creek above Bennington Lake found only one redd and one dead steelhead in Washington (Glen Mendel, WDFW, personal communication). In addition, one steelhead redd was recorded above BLDD in Oregon (CTUIR, unpublished data).

As of June 2002, all eight of the fish radio-tagged in Yellowhawk Creek were accounted for. One fish expelled the transmitter at the weir, one stopped moving in Yellowhawk Creek, two stopped moving in Mill Creek, two in the lower Walla Walla River, and two fish escaped to the Columbia River.

Three additional fish (2 hatchery and 1 wild) were collected and tagged directly below the Gose Street Dam on Mill Creek in College Place between 5 and 8 April 2002. These three fish were released directly above the dam to provide fish for study in the Mill Creek Flood Control Canal. Initially, at least one fish (75A) did appear to try to go upstream. Tag 75A was recorded two miles upstream at the 9th Street Bridge on Mill Creek in Walla Walla, but within a week of release, all three of the tagged fish had fell back over Gose Street Dam and had moved downstream not to return (Figure 6-20). This suggests study effects related to tag insertion, that we simply tagged these three fish during their downstream migration, or that fish have a problem successfully navigating through the lower section of the Mill Creek Flood Control Canal.

After dropping below Gose Street, one of the Mill Creek fish moved to below Burlingame Dam for approximately eight hours on 9 April and then moved downstream past the telemetry station at 9-Mile Ranch on 11 April and escaped to the Columbia River. The other two fish tagged at Gose Street stopped moving and presumably died in the lower Walla Walla River near Touchet, Washington in mid-April.

In 2002, results from redd counts and telemetry data suggest passage impediments exist in upper Yellowhawk Creek and that BLDD was a significant barrier to fish passage during March and April. In 2003, we plan to tag up to twenty wild steelhead in the lower Mill Creek and Yellowhawk Complex early in the migration (Between January and March, Appendix C), locate passage barriers, monitor fish in the Mill Creek Flood Control Canal and observe steelhead spawning.

2003 Study Design

In 2003, we will implement changes to our study design to address additional information needs for steelhead as identified by this season's results and field observations.

We will radio-tag steelhead lower in system and at strategic locations in order to get more information per tag and to monitor fish in specific stream reaches (Appendix C). We intend to radio-tag up to seventy-five adult steelhead. We will tag more wild fish, and although it is generally more difficult to collect wild fish, we intend to tag at a 60% wild to 40% hatchery ratio. The total number of wild fish we can handle is set by our NMFS scientific take permit at forty-five listed, wild, mid-Columbia steelhead per annum. We expect to meet this goal with improved capture techniques (e.g. experimental gillnets, hook and line, trapping, and seining), better local knowledge of run timing and the fishing grounds, volunteer anglers, and by trapping and netting at strategic sites including the lower Walla Walla River, lower Mill Creek, lower Yellowhawk Creek, the Gose Street Dam, the WDFW weir, below Burlingame Dam, and in the new fish ladder trap at Nursery Bridge Dam.

Our continuing investigation will monitor fish throughout the Walla Walla River Basin with renewed focus on movement through the Mill Creek and Yellowhawk Creek Complex and evaluating ladder passage at the Burlingame, Nursery Bridge, and Little Walla Walla facilities. We hope to document steelhead spawning and identify unknown passage barriers with additional tagging effort and on-the-ground surveys. We will continue to evaluate the apparent passage problem at the Bennington Lake Diversion Dam and work with USACE and others to effect a solution. We may install additional telemetry stations: one at Hofer Dam to evaluate steelhead passage on the Touchet River , one at the mouth of Yellowhawk Creek to monitor passage and habitat use, and one at Blue Mountain Station Road on Couse Creek to document movement in the headwaters.

Improvements to steelhead tagging methods will include fitting radio tags with surgical tubing to improve tag retention, visually confirming proper tag insertion before releasing the fish, and recovering and reusing tags to tag additional fish.

Improvements to the telemetry stations may include solar arrays at remote sites to reduce person-hours spent replacing batteries, reconfiguring and tuning stations to better detect fish passage in the ladders, adding underwater “dropper” coaxial antennas at ladder entrances and exits, and adding upstream and downstream yagi antennas. Field experience gained last season will result in improved coverage at the fish passage facilities in 2003.

Bull Trout

ODFW radio-tagged twenty adult bull trout (> 38 cm fork length) captured in the trap at the old Nursery Bridge Dam between 10 May and 6 June 2001 (Table 6-6). Radio-tagged fish were allowed to recover from the surgical tagging procedure and then released into a backwater area directly above the dam. CTUIR monitored the movements of these fish with radio telemetry techniques (Appendix E). On average, bull trout required six days to move the first mile from the release site at NBD upstream past LWWR, forty-seven days to travel the fourteen miles to Harris Park, and 111 days to move the entire twenty miles from NBD and enter the upper headwaters above Burnt Cabin Creek. On average, bull trout moved 0.2 miles per day (n=10) during their migration upstream (Table 6-7).

Of the twenty fish radio-tagged at NBD, twelve (60%) provided data upstream past Harris Park, reaching that telemetry station by 24 July. Ten of these fish were then tracked upstream to an area between Skiphorton Creek and Reser Creek. We did not observe spawning in bull trout. However, based on movement, these ten fish probably spawned between mid-September and early October. By the end of October, eight radio-tagged bull trout had returned from the headwaters to over-winter in the Walla Walla River near Milton-Freewater. Upstream migration by bull trout was generally “sporatic” with fish folding in pools or woody debris for a period and then continuing upstream. On average bull trout required 178 days to return from the headwaters to below NBD and moved 0.1 (n=4) miles/day during their migration downstream (Table 6-8).

By June 2002, fifteen (75%) of the bull trout tagged during the previous season had either lost the transmitter or died (Table 6-6). There were substantial indications that much of the tag loss was due to study effects (post-operative infection, poor water quality and stress). During the winter of 2002, project cooperators convened to review study design and address the problem of tag loss and mortality in bull trout. New protocols were developed and tested on hatchery rainbow trout for the 2002-03 field seasons. As of December 2002, we have confirmed tag retention and survival in eighteen of nineteen bull trout radio-tagged in spring 2002.

We were able to document seasonal distribution and critical habitat (rearing, spawning, and migratory corridors) for bull trout in the Walla Walla River. However, we did not document any movement of bull trout between the three known populations of bull trout in the basin: the Touchet River, Mill Creek, and upper Walla Walla River populations. This suggests that our sample size and study design may have been insufficient to detect migration or that physical and/or thermal barriers may be preventing exchange of genetic material between these three populations.

Additional work is needed to evaluate bull trout passage efficiency at the Burlingame, Nursery Bridge, and Little Walla Walla River facilities. As of December 2002, we have documented only two bull trout moving upstream at NBD and LWWR and none at BGD (Table 6-9). Average delay below NBD was 67:34 (range 19:34 -115:34). Average delay below LWWR was 00:25 (range 00:23 – 00:25). As of December 2002, it remains uncertain if the fish tagged in during the spring will move into the passage facilities and provide data for evaluation.

In 2003, better tag retention and a larger study group should yield results on bull trout movement that will help guide ongoing watershed restoration efforts by the coalition of public and private groups working towards ecosystem recovery in the Walla Walla Basin.

<u>Tag Loss</u>

In 2001, we experienced a problem with fish mortality and "tag shedding." However, we did not quantitatively evaluate these effects on fish movement. Concerns about the health of study fish led to repeated snorkeling observations on tagged fish, and tagging was aborted once the problem was identified. Apparent physiological and behavioral effects were noted. These included secondary infections near the incision, "puckered," loose, or missing sutures, internal "bulging" of the tag area, deep hematoma, open antenna exit wounds, fungal infection, emaciated bodies, lack of fright response, prolonged holding downstream, downstream movement, tag shedding, and death. We did not observe every fish and not all symptoms were recorded in observed fish.

As of July 2002, we had recovered fifteen (75%) of the twenty radio tags out-planted in 2001 (Table 6-6). Of the five radio-tagged fish that remained, three (tags 61, 62 and 80) were moving upstream above Milton-Freewater, and two (tags 65 and 68) were in the headwaters, their status uncertain.

In 2001, tag loss in bull trout was probably due to post-operative infection and effects, illegal harvest, and natural causes. We were unable to quantify the importance of each factor. Five of the fifteen recovered tags were found with a partial bull trout carcass either in the stream or on the bank, four were recovered in animal dens without a carcass, and six were found on the stream bottom or up on the bank. It is certain that at least nine of the fifteen fish died a short time after release probably due to surgical infection; four of these were probably scavenged by predators. Of the remaining six fish, four tags were recovered from angling areas and although circumstantial these fish were probable illegally harvested and the tag discarded. In addition, some of these remaining six tags may have been expelled or "shed" by the fish and the fish may have survived. Tag "shedding" is well documented in the literature (Summerfelt and Mosier 1984, Chisholm and Hubert 1985, Marty and Summerfelt 1986, Lucas 1989, Clapp et al. 1990, Moore et al. 1990, Knights and Lasee 1996, Bunnell and Isely 1998). While snorkeling, we observed "bulging" tag incisions in two bull trout that may have been a precursor to tag shedding. In 2001, WDFW reported on bull trout shedding tags in the Touchet River and presumably surviving (Glen Mendel, WDFW, personal communication). However, all the fifteen "lost" tags in the Walla Walla River are presumed to be from dead fish.

Fish Movement

Twelve radio-tagged bull trout provided data to document critical habitat in the Walla Walla River. The seasonal movements of the twelve bull trout that retained radio-tags past Harris Park were similar (Figure 6-21 and 6-22). Twelve tagged bull trout moved from NBD to above Harris park by late-July; one fish (tag 66) that later lost its tag did tend to lag behind (Table 6-7). Eleven fish moved past Burt Cabin Creek by early August. Tag 66 was recovered roughly two miles above Harris Park near Elbow Creek (Appendix E). Ten fish continued upstream to known bull trout spawning areas between Skiphorton (RM 17) and Reser Creek (RM 20). Tag 63 was presumably illegally harvested just above Burnt Cabin Creek (RM 13, Appendix E.). The ten surviving fish remained on the spawning ground between early August and September. Eight radio-tagged bull trout moved downstream past the telemetry station at Harris Park by mid-October, (Table 6-8); tags 65 and 68 did not return from the headwaters. Tag 68 held near Skiphorton Creek, and tag 65 moved down near Bear Creek (RM 12). Neither fish seemed to move until August 2002, when tag 65 moved upstream past the telemetry station at Burnt Cabin Creek, and tag 68 moved a short distance up to below Reser Creek and then fell back (based on aerial surveys).

Eight radio-tagged bull trout over-wintered near Milton-Freewater between Joe West Bridge and the Washington state line. These results probably overestimate the portion of the bull trout population (80%) that migrate from the headwaters and over-winter in the Walla Walla River near Milton-Freewater because all eight of the returning fish were initially radio-tagged in Milton-Freewater.

On average, bull trout took twenty-one days to move down from above Burnt Cabin Creek to below Harris Park, 102 days to pass below LWWR and 178 days to depart below NBD (Table 6-8). We did not track any fish moving below the Washington-Oregon state line. Further work is needed to document bull trout in the lower Walla Walla and connectivity between the major tributaries and the Columbia River.

There was little recorded movement by radio-tagged bull trout in winter. We tracked sporadic movement in five bull trout (tags 61, 62, 64, 69, and 80). Most of it was downstream and seemed to be associated with high flow events. It is possible that the fish were forced from their holding locations by flow due to the lack of adequate large woody debris or deep pools within the Milton-Freewater reach. It is also possible that the fish moved downstream to feed on out-migrating Chinook smolts, or that the fish were hooked and released by anglers and thereby displaced to recover downstream.

Tag 61 held near Tum-a-lum Bridge, roughly two miles above the Washington state line, from early January until late April. Tag 62 held near Joe West Bridge, roughly three miles above Milton-Freewater (M-F), from mid-October to late February, and then took up residence above and in the new fish ladder at NBD until early May. Tag 64 held near Lampson's, roughly two miles above M-F, from late September until it moved or possibly drifted to an area below Couse Creek about a mile above M-F. Tag 64 was recovered in this area on the stream bottom in July 2002. Tag 69 held between the LWWR and NBD facilities in M-F, from late November through March. In early April, tag 69 moved to below NBD and there remained until June when it approached but did not pass NBD. Tag 69 was recovered on the stream bank roughly a mile below NBD; this fish may have been illegally harvested. Tag 80 held near the confluence of the North and South Fork Walla Walla Rivers, roughly eight miles above M-F, from late September through October, it then moved downstream to remain between the LWWR and NBD facilities between November and mid-April. From late April until early May, tag 80 held between Tum-a-lum Bridge and the Washington state line.

Tags 72 and 76 remained within a mile of Joe West Bridge from Late October on; both were recovered in July 2002 near the bridge—a popular fishing spot. Tag 77 held near Joe West Bridge between mid October to late November until it moved or possibly drifted to an area above Couse Creek. Tag 77 was recovered buried in two feet of cobble adjacent to a screened irrigation canal above Couse Creek. We were unable to confirm the status of tags that did not move. We were able to recover tags 64, 72, 76, and 77 in July during lower flow.

In the spring of 2002, fish 61, 62, and 80 all departed NBD within a week of their tagging anniversary, suggesting migration of fluvial bull trout from the Walla Walla River in Milton-Freewater to the headwaters of the South Fork Walla Walla River. Further study is needed to document fluvial and resident life histories. In addition, a greater enforcement presence or educational outreach is needed to address the problem of illegal harvest of bull trout in the Walla Walla River.

<u>2003 Study Design</u>

In 2003, we will implement changes to our study design to address additional information needs for bull trout as identified by this season's results and field observations.

In 2001, project cooperators stopped radio-tagging bull trout once the problem of tag loss was identified. In winter 2002, cooperators reviewed the existing study design then researched and developed new tagging methods and protocols to address the problem of tag shedding and fish mortality experienced in 2001.

In 2002, our surgical procedure for radio-tagging bull trout changed. Improvements included practicing surgical techniques on rainbow trout as surrogates to improve proficiency prior to handling bull trout, buffering the MS-222 to reduce pH shock in anesthetized fish, and using smaller radio tags (Lotek MCTF-3BM, 7.7g in air—roughly 1% of the fish's body weight). Surgeons maintained high-quality sterilization techniques (e.g. not using river water to rinse), closed the incision with non-absorbable sutures to prevent "wicking" of stream water into the wound, and experimented with tissue staples to reduce surgery time. A topical antibiotic was applied after closing, and the sutures were sealed with vet-bond tissue adhesive. The antenna exit wound was moved forward of the pelvic girdle to minimize the chance of damage to internal organs and bruising. We also experimented with a water buffer (Stress Coat) to reduce handling stress to the fish.

In addition to the improvements to surgical technique, we captured bull trout for tagging by hook and line in the headwaters above Milton-Freewater. Most fish were taken from above Harris Park. The headwaters provide tagged fish with better refuge areas and water quality in which to recover. The fish trap at the old Nursery Bridge Dam fish ladder, our previous tagging site, had the advantages of predictability and convenience for collecting bull trout from the trap. However, it lacked suitable upstream habitat and water quality for fish recovery. In late spring, irrigation water removal, increasing temperatures, and agricultural and urban run-off reduce the suitability of the Milton-Freewater reach for bull trout. By tagging fish above Harris Park we avoided these physical barriers. We may have also reduced some incidental harvest of radio-tagged bull trout by moving the tagging site above the angling pressure in Milton-Freewater.

All nineteen bull trout tagged in 2002 retained the transmitter and moved upstream. Fifteen fish returned, most to the reaches in which they were initially tagged. As of December 2002, we have recovered one tag on the stream bank, our best guess is that the fish was illegally harvested and the tag discarded. We will continue to ground-truth the status of bull trout tags as time allows.

In 2003, with better tag retention and a larger study group, we hope to evaluate bull trout passage at LWWR, NBD, and BGD, and to document downstream movement of bull trout in the lower Walla Walla River, both of which are critical information needs.

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Table 6-1. Location and purpose of telemetry stations in the Walla Walla River Basin. This the Key for the map in Figure 6-1.

Map ID	Agency	Dates	Location	Purpose / Comments
A	WDFW		Waitsburg (Touchet/Coppei Creek)	Habitat / passage between sites D and A. Coppei Creek usage.
B	WDFW	2001-2003	Dayton (NF/SF Touchet Rivers)	Fish ladder evaluation, habitat / passage between A and B. South Fork Touchet R. usage.
C	WDFW	TBA	Wolf Fork / North Fork Touchet R.	Habitat / passage between B, C and Above C.
D	CTUIR	2001-2002	Touchet / Walla Walla Rivers	Habitat / passage between P, D, & A.
E	CTUIR	2001-2003	Gose Street Dam (Mill Creek)	Passage at Gose St. Dam & through USACE flood control channel between E and F on Mill Creek.
F	CTUIR	2001-2003	Yellowhawk Dam on Mill Creek	Passage through USACE concrete channel between F and E. Passage at Mill Creek/Yellowhawk Diversion.
G	CTUIR	2001-2003	Burlingame Dam	Passage evaluation at dam, Habitat usage between D/E, G, and H/J.
H	CTUIR	TBA	Yellowhawk / Cottonwood	Passage / habitat between G/J, H, and F. Cottonwood Creek usage.
I	CTUIR	TBA	Mill Creek Dam	Passage at fish ladder. Habitat information between I, F, and the headwaters.
J	CTUIR/OWEB	2001-2003	Nursery Bridge Dam	Fish ladder evaluation. Habitat use between G/H, J and K.
K	CTUIR/OWEB	2001-2003	Little Walla Walla River Dam	Fish ladder evaluation, habitat information between J, K, and L.
L	CTUIR/OWEB	2001 & 2003	Couse Creek/Walla Walla River	Habitat information between K, L, and M. Passage into and usage of Couse Creek.
M	CTUIR/OWEB	2001-2003	NF/SF Walla Walla Rivers	Habitat usage between L, M, and N. North Fork Walla Walla River usage.
N	CTUIR/OWEB	2001-2003	Harris Park (South Fork WW River)	Habitat information between M, N, and headwaters.
P	U of I	2001-2003	Nine Mile Ranch (lower WW River)	Passage into & out of the subbasin, habitat use and passage time.
Q	CTUIR	2001-2003	Mill Creek/Bennington Lake Dam	Fish ladder evaluation, habitat use, passage time in Mill Creek.
R	CTUIR	2001-2002	SF WW River/Burnt Cabin Creek	Habitat use and passage time in the SF Walla Walla River.
S	CTUIR	2001	SF WW River/Reser Creek	Habitat use and passage time in the SF Walla Walla River.
T	CTUIR	2002-2003	Hofer Dam on Touchet River	Passage at fish ladder. Habitat / passage between P/ T, and A
U	CTUIR	2002-2003	Yellowhawk / Walla Walla R.	Habitat use and passage between G, U and F.
V	CTUIR	2003	Bear Creek / SF Walla Walla R.	Habitat use and passage time in the SF Walla Walla River.
Y	WDFW	2001-2002	Mobile Receiver	Not shown on Map; used during aerial and ground surveys.
Z	CTUIR	2001-2002	Mobile Receiver	Not shown on Map; used during aerial and ground surveys.

Table 6-2. Stream use by radio-tagged steelhead in the Walla Walla River Basin 2001-2002.

	All Fish		Hatchery		Wild	
Reach	Number	Percent	Number	Percent	Number	Percent
Touchet River[a]	7	19	3[b]	14	4	25
Lower Walla Walla River[c]	10	27	10	48	0	0
Dry Creek	3	8	0	0	3	19
Mill Creek[d]	9	24	8	38	1	6
Upper Walla Walla River[e]	8[d]	22	0	0	8	50
Total	37		21		16	

[a] Includes Wolf Fork of the Touchet River.

[b] Includes one hatchery fish harvested on 20-January near Dayton, Washington.

[c] Includes the mainstem Walla Walla River below Burlingame Dam and Pine Creek.

[d] Includes Yellowhawk Creek.

[e] Includes the mainstem Walla Walla River above Burlingame Dam, Couse Creek, North and South Fork Walla Walla Rivers.

Table 6-3. Disposition of radio-tagged steelhead 30 June 2002.

	All Fish		Hatchery Fish		Wild Fish	
Disposition	Number	Percent	Number	Percent	Number	Percent
Tag expelled or fish expired	24	42	11	30	13	62
Harvested	10	18	10	28	NA[a]	NA[a]
Escaped to the Columbia River	23	40	15	42	8[b]	38
Total	57		36		21	

[a] The percent of wild fish harvested is unknown because no tags were returned by anglers.

[b] Two radio-tagged wild fish returned to the Columbia River immediately after release.

Table 6-4. Fish ladder passage at the Burlingame, Nursery Bridge, and Little Walla Walla facilities for radio-tagged steelhead in the Walla Walla River, 2002.

	Burlingame			Nursery Bridge			Little Walla Walla River		
		Duration (hours:minutes)			Duration (hours:minutes)			Duration (hours:minutes)	
Tag Number	Arrival Date	Dam	Ladder	Arrival Date	Dam	Ladder	Arrival Date	Dam	Ladder
59	11-Jan	23:45	23:18	21-Feb	44:40	31:16	22-Feb	00:19	NA
52	10-Feb	29:44	NA	27-Feb	44:01	43:21	28-Feb	00:49	NA
53	18-Feb	64:32	NA	13-Mar	5:15	3:47	26-Mar	NA	NA
53[a]	NA	NA	NA	25-Mar	1:56	1:28	NA	00:17	NA
45	22-Feb	00:15	NA	11-Mar	1:35	1:10	11-Mar	0:19	NA
46	23-Feb	22:25	NA	6-Mar	4:39	3:43	6-Mar	00:16	NA
47	1-Mar	70:30	00:11	12-Mar	1:54	1:51	13-Mar	00:58	NA
43	26-Mar	00:48	NA	2-Apr	74:25	45:12	3-Apr	00:19	NA
41	13-Apr	00:25	NA	23-Apr	29:21	27:57	25-Apr	00:17	NA
Average		15:55	11:45		23:05	16:34		0:28	NA

[a] Tag number 53 passed above Nursery Bridge Dam, then fell back over the dam and later returned to pass above the dam a second time.

[b] We did not directly evaluate passage in the fish ladder.

Table 6-5. Passage time between the Burlingame and Little Walla Walla River facilities for radio-tagged steelhead, 2002.

Tag Number	Burlingame Arrival Date (mile 36)	Nursery Bridge Departure Date (mile 44)	Passage Time (Days)	Little Walla Walla River Departure Date (mile 45)	Passage Time (Days)	Distance (Miles per Day)
59	11-Jan	21-Feb	42	22-Feb	43	0.2
52	10-Feb	27-Feb	18	28-Feb	19	0.5
53	18-Feb	25-Mar	36	26-Mar	37	0.3
45	22-Feb	11-Mar	18	11-Mar	18	0.6
46	23-Feb	6-Mar	12	6-Mar	12	0.8
47	1-Mar	12-Mar	12	13-Mar	13	0.8
43	26-Mar	2-Apr	8	3-Apr	9	1.1
41	13-Apr	23-Apr	11	25-Apr	13	0.8
Average			19.6		20.5	0.5

Table 6-6. Disposition of bull trout radio-tagged at the old Nursery Bridge fish ladder trap.

Tag Number	Date Tagged	Fork Length (mm)	Weight (g)	Date	Fish Carcass Recovered	Tag Active and in Fish	USGS 7.5 Quad.	Stream	Mile	Site
61	10-May-01	450	NA	12-Dec-02	NA	Yes	Bowlus Hill	WWR	45	> Grove School Brdg.
62	11-May-01	515	1370	12-Dec-02	NA	Yes	Blalock M.	SFWW	2	> Steel brdg.
63	14-May-01	520	1500	23-Aug-01	No	No	Tollgate	SFWW	15	Swede Canyon
64	14-May-01	520	1423	8-Jul-02	No	No	Bowlus Hill	WWR	46	>Grove School Brdg.
65	14-May-01	495	1253	2-Dec-02	NA	Yes	Tollgate	SFWW	12	> Bear Creek
66	14-May-01	400	611	13-Aug-01	No	No	Blalock M.	SFWW	8	< Elbow Creek
67	14-May-01	390	610	28-Jun-02	No	No	Bowlus Hill	WWR	46	< Couse Creek
68	14-May-01	480	1206	2-Dec-02	NA	Yes	Tollgate	SFWW	18	> Skiphorton Creek
69	22-May-01	560	1569	2-Jul-02	No	No	M-F	WWR	42	< Nursery Bridge
70	22-May-01	380	603	27-Jun-01	Yes	No	M-F	WWR	44	<> NBD & LWWR
71	25-May-01	445	940	18-Jun-02	Yes	No	M-F	WWR	44	<> NBD & LWWR
72	25-May-01	430	782	11-Jul-02	No	No	Bowlus Hill	WWR	48	> Joe West Brdg.
73	25-May-01	520	1450	9-Jul-01	No	No	Bowlus Hill	SFWW	3	> North / South Forks
74	27-May-01	530	1700	18-Jun-01	Yes	No	M-F	WWR	44	<> NBD & LWWR
75	30-May-01	565	1690	27-Jun-01	Yes	No	M-F	WWR	45	< LWWR
76	30-May-01	515	1270	11-Jul-01	No	No	Bowlus Hill	WWR	48	< Joe West Brdg.
77	30-May-01	385	640	16-Jul-02	No	No	Bowlus Hill	WWR	46	< Couse Creek
78	30-May-01	460	970	25-Jun-01	Yes	No	M-F	WWR	44	> Nursery Bridge
79	6-Jun-01	445	1000	16-Aug-01	No	No	Bowlus Hill	SFWW	6	< Harris Park
80	6-Jun-01	470	1128	12-Dec-02	NA	Yes	Bowlus Hill	WWR	48	< Joe West Brdg.

Table 6-7. Passage time from below Nursery Bridge Dam to above Burnt Cabin Creek for bull trout radio-tagged in the Walla Walla River, 2001.

Tag Number	Nursery Bridge Departure Date (mile 44)	Little Walla Walla Departure Date (mile 45)	Passage Time (Days)	Distance (Miles per Day)	Harris Park Departure Date (mile 57)	Passage Time (Days)	Distance (Miles per Day)	Burt Cabin Creek Departure Date (mile 63)	Passage Time (Days)	Distance (Miles per Day)
61	10-May	NA[1]	NA	NA	4-Jun	26	0.5	NA[2]	NA	NA
62	11-May	NA[1]	NA	NA	23-Jun	44	0.3	4-Aug	86	0.2
63	14-May	26-May	13	0.1	24-Jun	42	0.3	13-Aug	92	0.2
64	14-May	26-May	13	0.1	8-Jun	26	0.5	18-Aug	97	0.2
65	14-May	17-May	4	0.3	19-Jun	37	0.4	28-Aug	107	0.2
66	14-May	20-May	7	0.1	24-Jul	72[a]	0.2	NA	NA	NA
68	14-May	22-May	9	0.1	22-Jun	40	0.4	18-Aug	97	0.2
69	22-May	26-May	5	0.2	4-Jul	44	0.3	8-Aug	79	0.3
72	25-May	26-May	2	0.5	30-Jun	36	0.4	6-Aug	74	0.3
76	30-May	31-May	2	0.5	26-Jun	28	0.5	18-Aug	81	0.2
77	30-May	1-Jun	3	0.3	1-Jul	32	0.4	22-Aug	85	0.2
80	4-Jun	7-Jun	4	0.3	13-Jul	40	0.4	2-Sep	91	0.2
Average			6.2	0.2		46.7	0.3		111.1	0.2

[1] Tag 61 past this site before the telemetry station was operational for the season on 17-May.
[2] Tag 61 past this site before the telemetry station was operational for the season on 19-July.
[a] Concerns regarding the health of fish-66 led to repeated snorkel observations, which revealed it to be in poor condition; transmitter 66 was recovered on the stream bed 13-August 2001.

Table 6-8. Passage time for radio-tagged bull trout from above Burnt Cabin Creek to Below NBD, 2001.

Tag Number	Burt Cabin Creek Departure Date (mile 63)	Harris Park Departure Date (mile 57)	Passage Time (Days)	Distance (Miles per Day)	Little Walla Walla Departure Date (mile 45)	Passage Time (Days)	Distance (Miles per Day)	Nursery Bridge Departure Date (mile 44)	Passage Time (Days)	Distance (Miles per Day)
61	15-Sep	30-Sep	16	0.4	2-Dec	78	0.2	3-Dec	79	0.3
62[a]	14-Sep	25-Sep	12	0.6	26-Feb	197	0.1	11-Mar	210	0.1
64[b]	NA	24-Sep	NA	NA	NA	NA	NA	NA	NA	NA
65[c]	2-Oct	NA	NA	NA	NA	NA	NA	NA	NA	NA
68[c]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
69[d]	18-Sep	27-Sep	10	0.7	18-Nov	68	0.3	30-Mar	211	0.1
72[e]	7-Aug	11-Oct	52	0.2	NA	NA	NA	NA	NA	NA
76[e]	29-Aug	27-Sep	30	0.3	NA	NA	NA	NA	NA	NA
77[e]	NA	4-Oct	NA	NA	NA	NA	NA	NA	NA	NA
80	17-Sep	23-Sep	7	1.4	21-Nov	66	0.3	15-Apr	210	0.1
Average			21	0.5		102	0.2		178	0.1

[a] Fish-62 remained near the NBD fish ladder until it moved past LWWD on 12-May, 2002.
[b] Transmitter 64 was recovered above LWWR on 7-July, 2002
[c] Tag number 65 & 68 did not return from the headwaters.
[d] Transmitter 69 was recovered below NBD on 2-July, 2002
[e] Transmitters 72, 76 and 77 were recovered near Joe West Bridge (mile 48) in July, 2002.

Table 6-9. Passage time for radio-tagged bull trout at LWWR and NBD, 2001[a].

	Downstream						Upstream					
	Little Walla Walla River			Nursery Bridge			Nursery Bridge			Little Walla Walla River		
		Duration (hours: minutes)			Duration (hours: minutes)			Duration (hours: minutes)			Duration (hours: minutes)	
Tag Number	Arrival Date	Dam	Ladder	Arrival Date	Dam	Ladder	Arrival Date	Dam	Ladder	Arrival Date	Dam	Ladder
61	2-Dec-01	1:19	NA	3-Dec-01	18:54	0:41	8-May-02	19:34	1:56	10-May-02	0:27	NA
62	26-Feb-02	0:02	NA	9-Mar-02	43:10	43:10[b]	NA	NA	NA	NA	NA	NA
62	NA	NA	NA	3-Apr-02	39:13	30:32[c]	NA	NA	NA	12-May-02	0:23	NA
69[c]	18-Nov-01	0:06	NA	30-Mar-02	0:08	NA	NA	NA	NA	NA	NA	NA[d]
80	NA	NA	NA	2-Apr-02	296:42	13:12[e]	NA	NA	NA	NA	NA	NA
80	NA	NA	NA	9-Apr-02	296:42	2:30[e]	NA	NA	NA	NA	NA	NA
80	NA	NA	NA	12-Apr-02	296:42	68:03[e]	7-Jun-02	115:34	0:24	6-Jun-02[f]	NA	NA

[a] No radio-tagged bull trout were recorded at the telemetry station at Burlingame Dam.

[b] Fish 62 remained above NBD near and in the ladder from 9-March to 11-March, 2002.

[c] Fish 62 remained above NBD near and in the ladder from 3-April to 4-April, 2002.

[d] Transmitter 69 was recovered below NBD on 2-July, 2002.

[e] Fish 80 remained near NBD between 2-April and 15 April; it entered the fish ladder on three occasions before passing below the dam.

[f] Fish 80 moved past LWWR when the station was off line due to power loss on 6/12/02

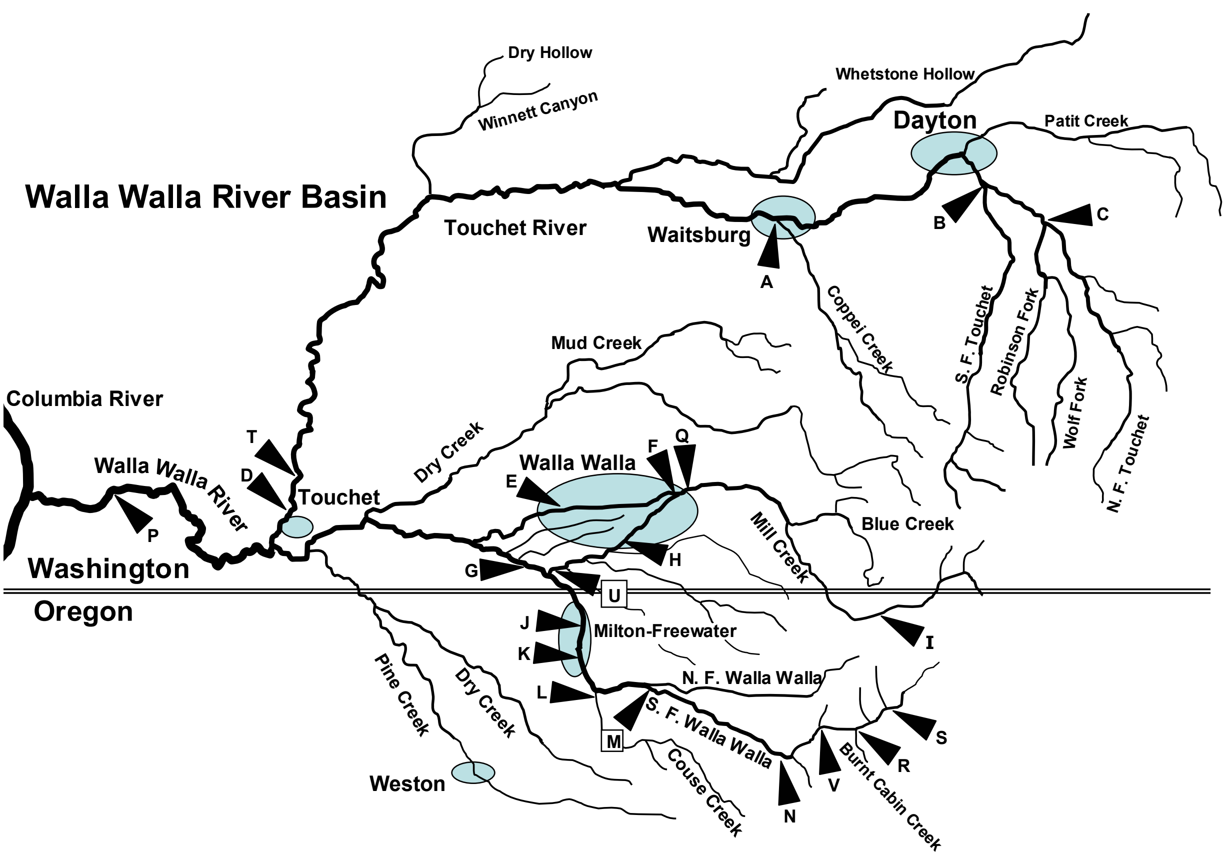

Figure 6-1. Location of radio-telemetry stations in the Walla Walla River Basin 2001-2002. Map Key is listed in Table 6-1

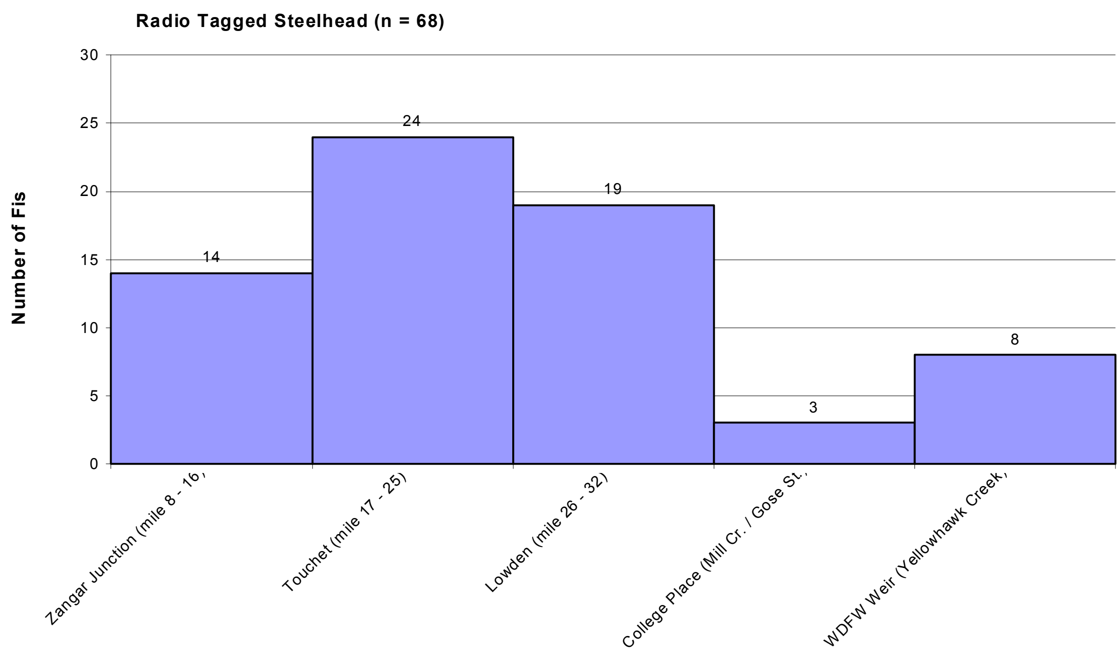

Figure 6-2. Steelhead capture location (USGS 7.5 Minute Topographic Quadrangle).

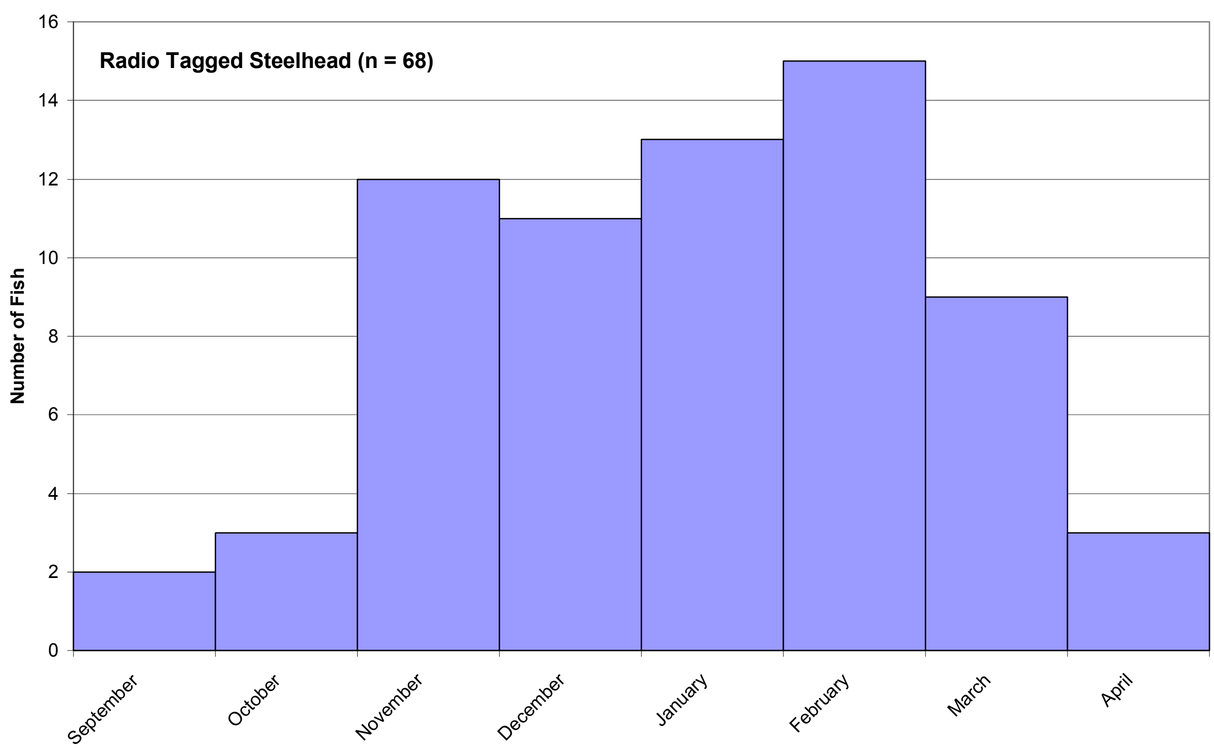

Figure 6-3. Number of steelhead radio-tagged per month, September 2001 to April 2002.

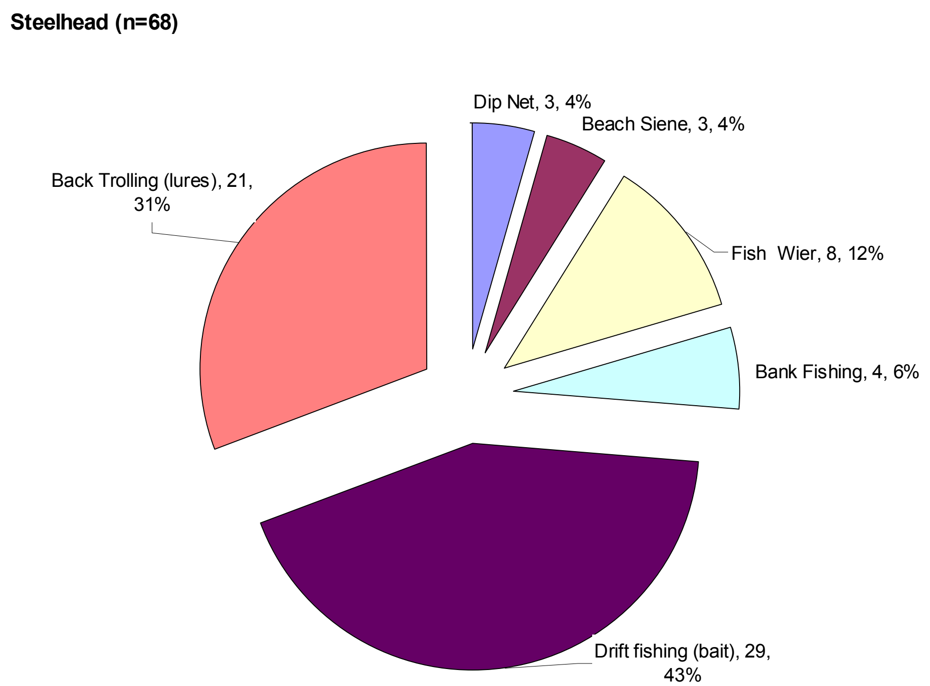

Figure 6-4. Capture method for steelhead radio-tagged in the Walla Walla Basin 2001-2002.

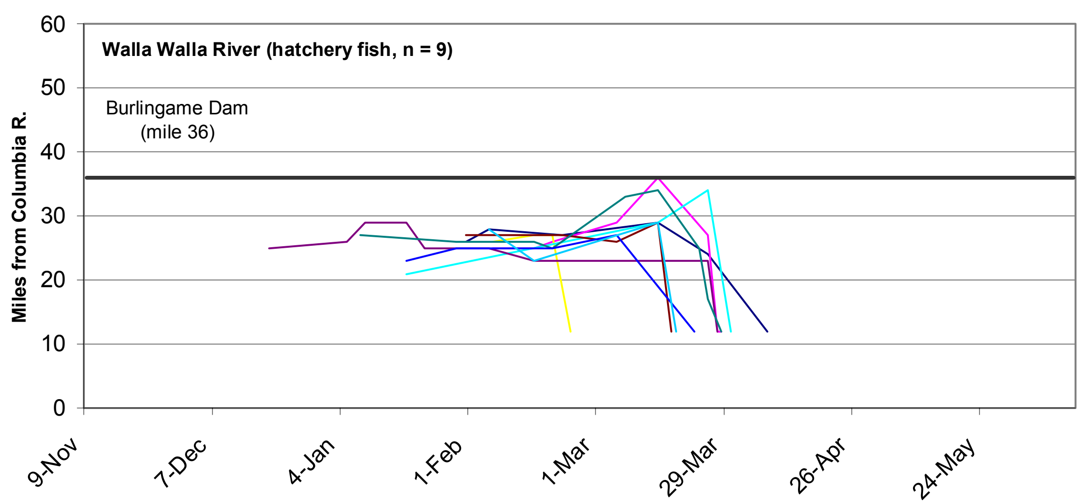

Figure 6-5. Movement of radio-tagged hatchery steelhead below Burlingame Dam.

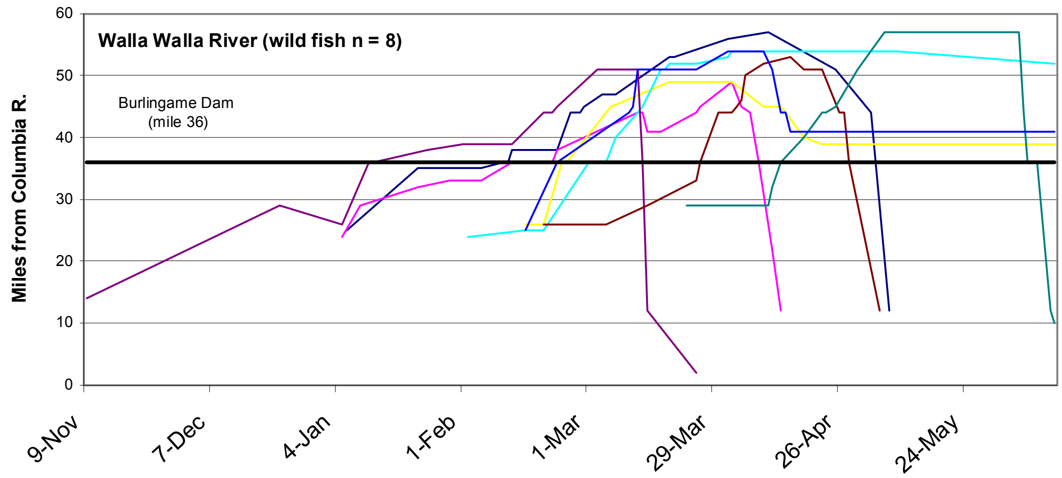

Figure 6-6. Movement of radio-tagged wild steelhead past Bulingame Dam.

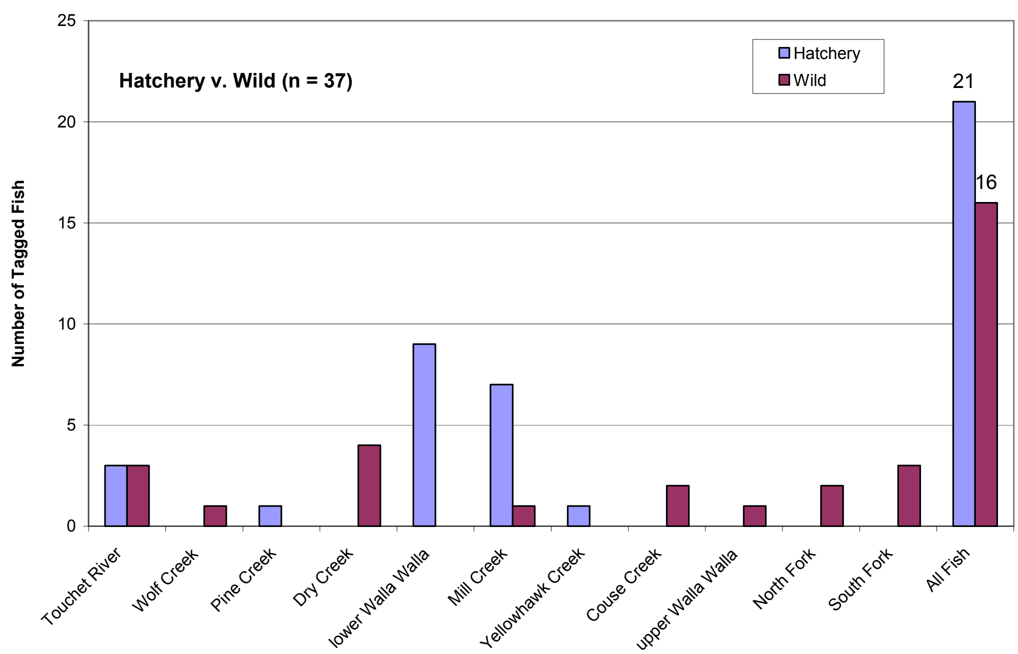

Figure 6-7. Steam use by radio-tagged steelhead in the Walla Walla River Basin 2001-2002.

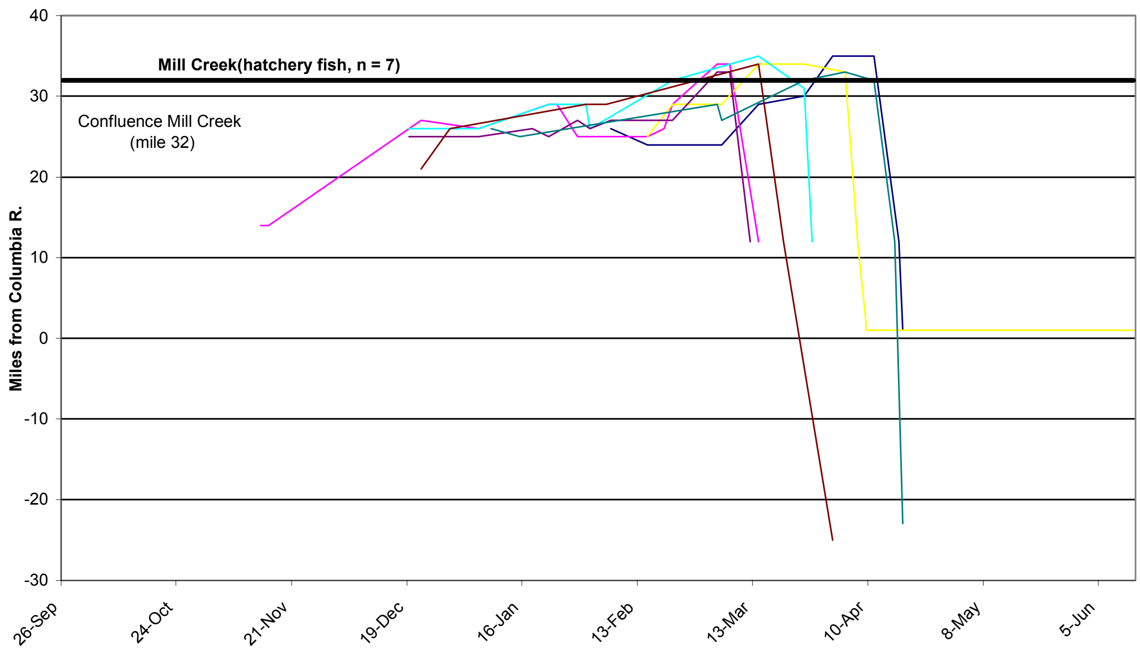

Figure 6-8. Movement of radio-tagged hatchery steelhead near the confluence of Mill Creek.

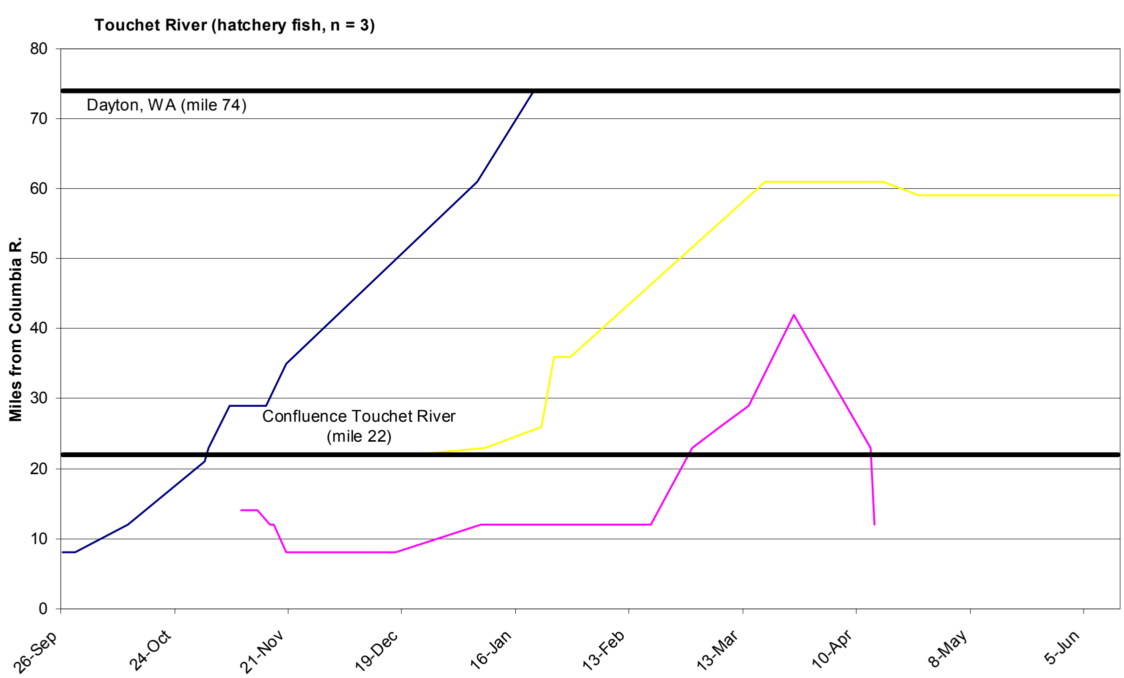

Figure 6-9. Movement of three radio-tagged hatchery steelhead into the Touchet River.

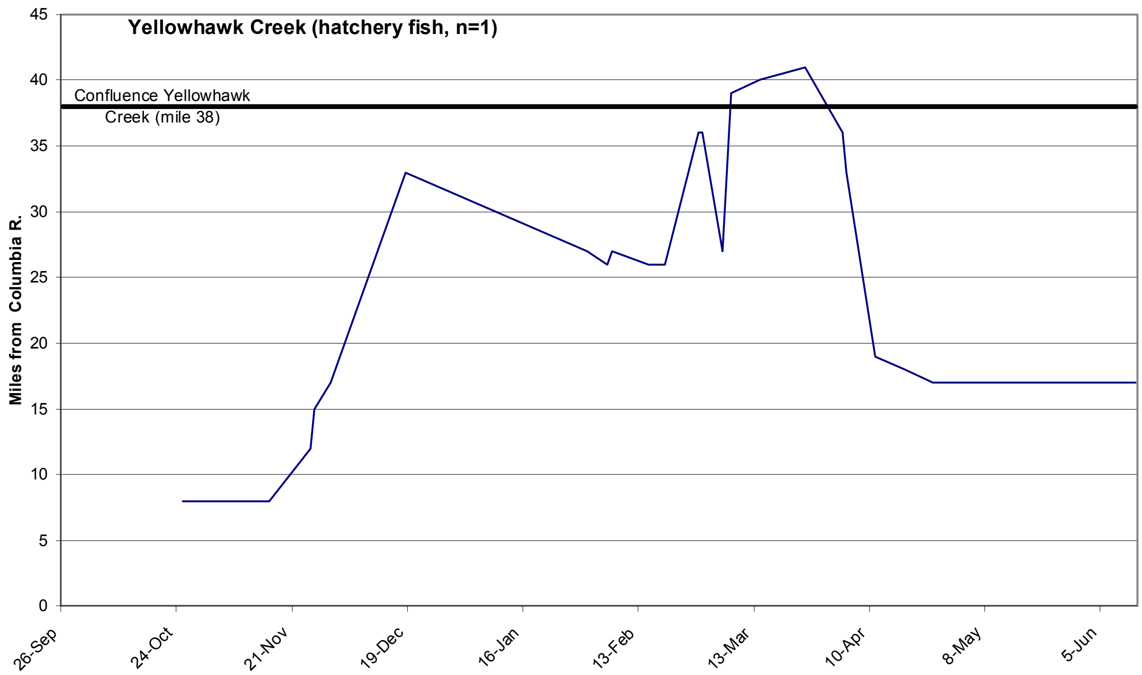

Figure 6-10. Movement of a radio-tagged hatchery steelhead into Yellowhawk Creek.

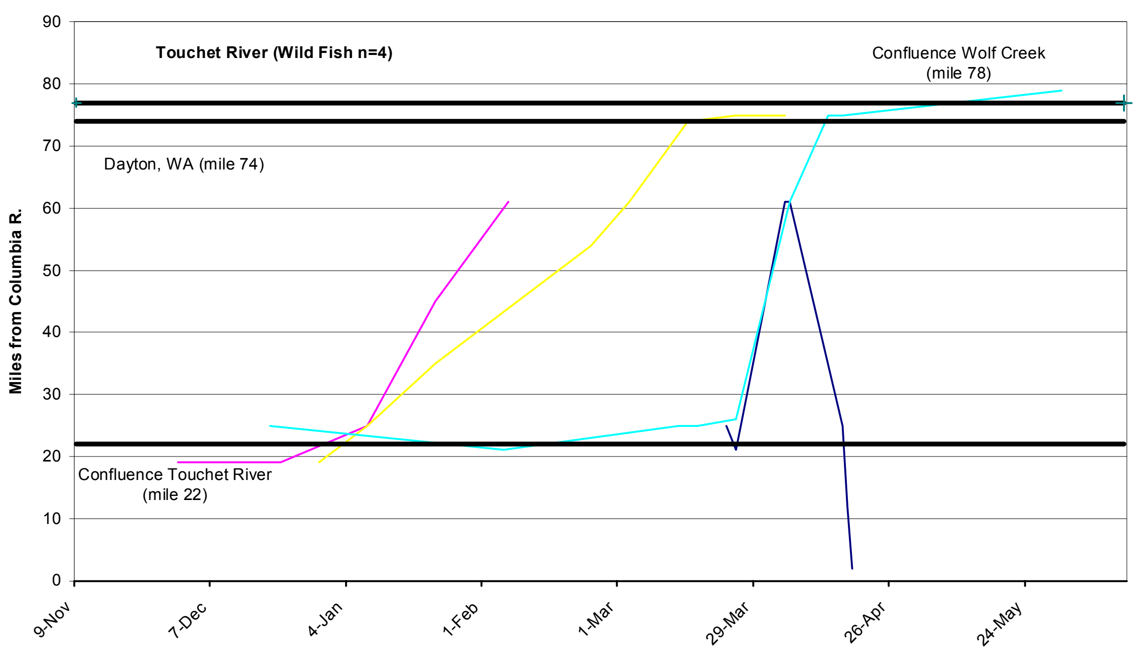

Figure 6-11. Movement of radio-tagged wild steelhead into the Touchet River.

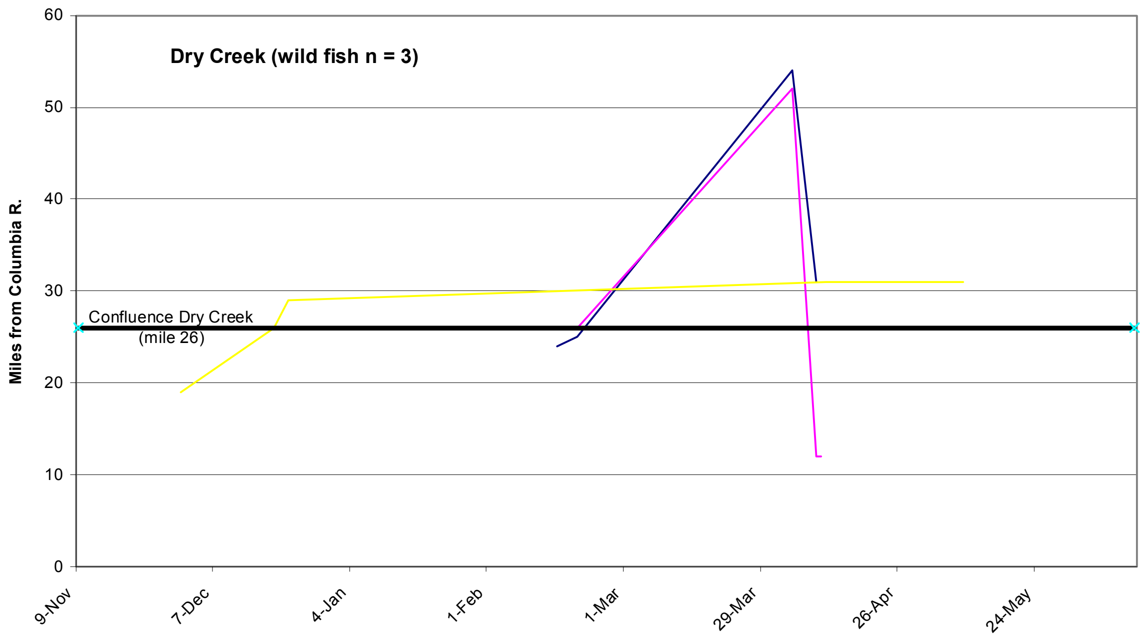

Figure 6-12. Movement of three radio-tagged wild steelhead into Dry Creek, Washington.

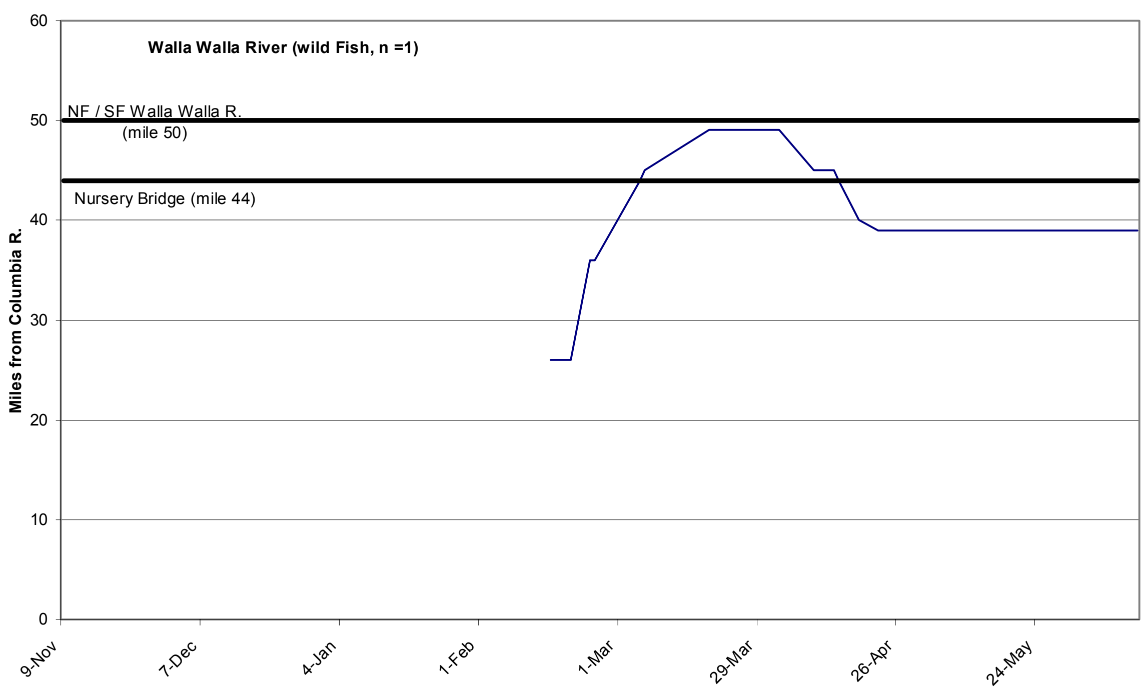

Figure 6-13. Movement of a radio-tagged wild steelhead between Nursery Bridge Dam and the confluence of the North and South Forks of the Walla Walla River.

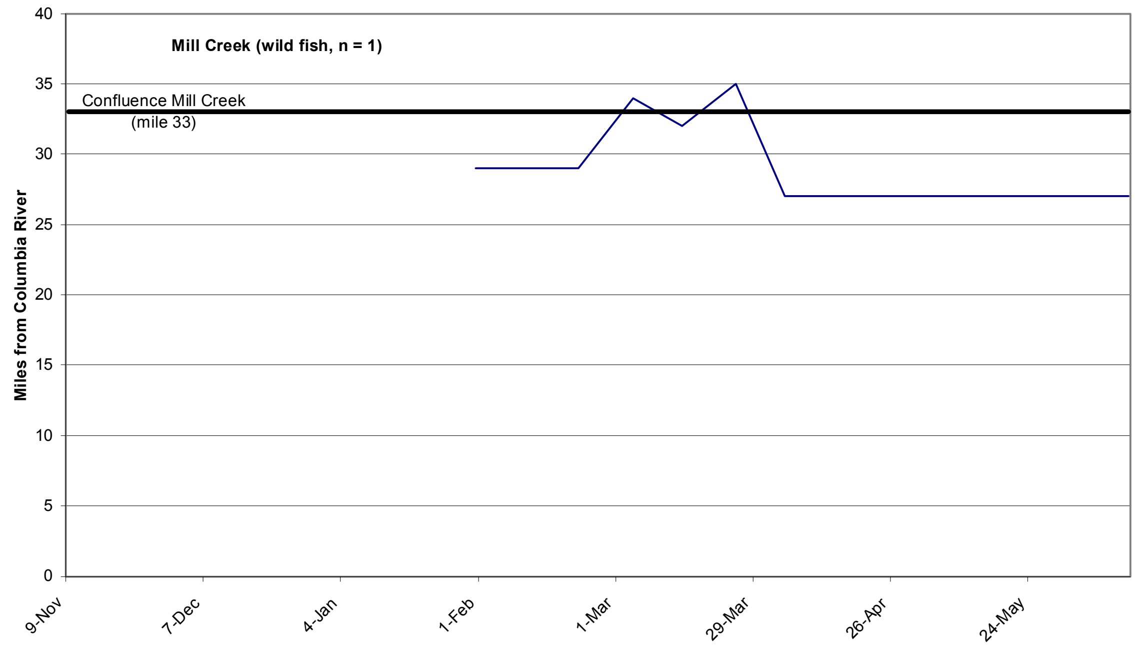

Figure 6-14. Movement of a radio-tagged wild steelhead into Mill Creek.

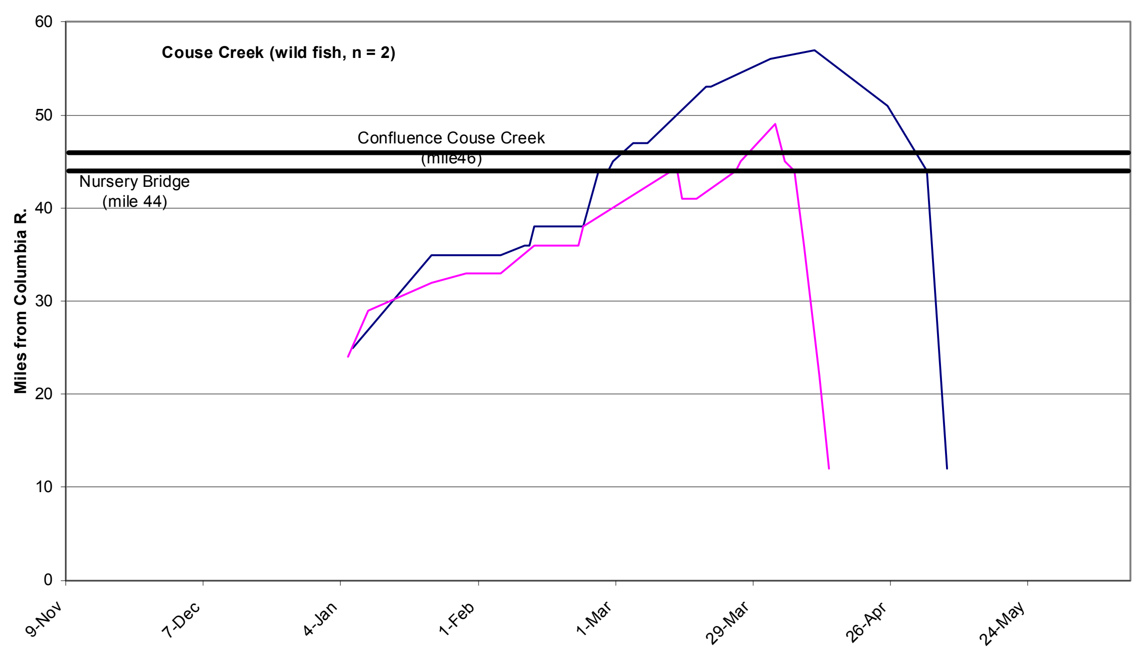

Figure 6-15. Movement of two radio-tagged wild steelhead into Couse Creek.

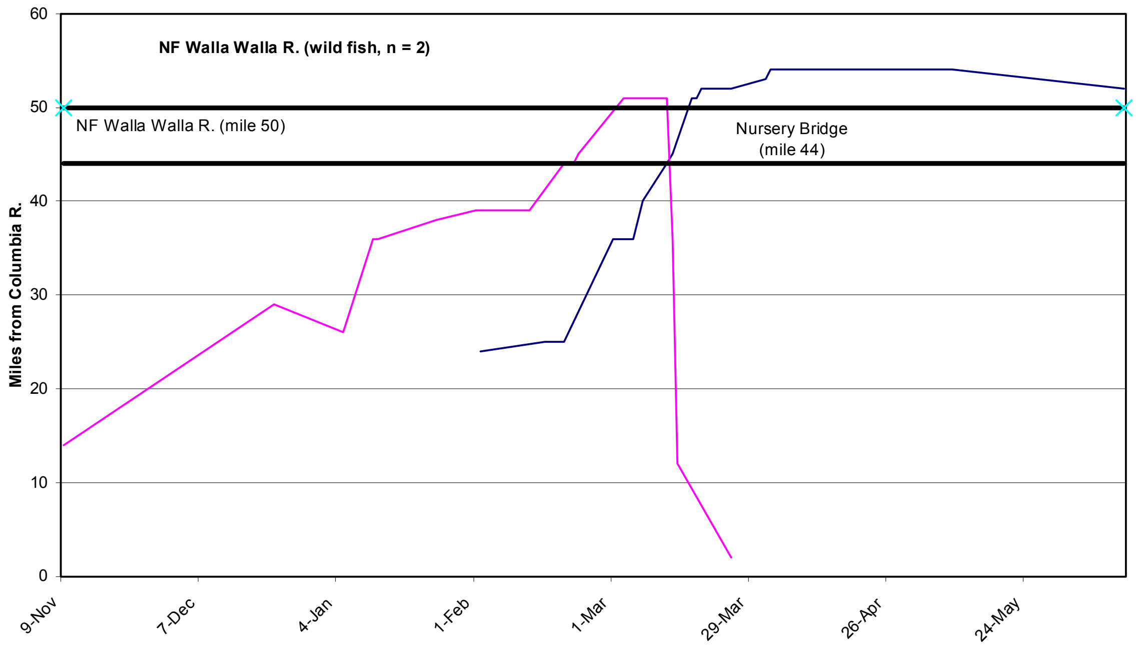

Figure 6-16. Movement of two radio-tagged wild steelhead into the North Fork Walla Walla River.

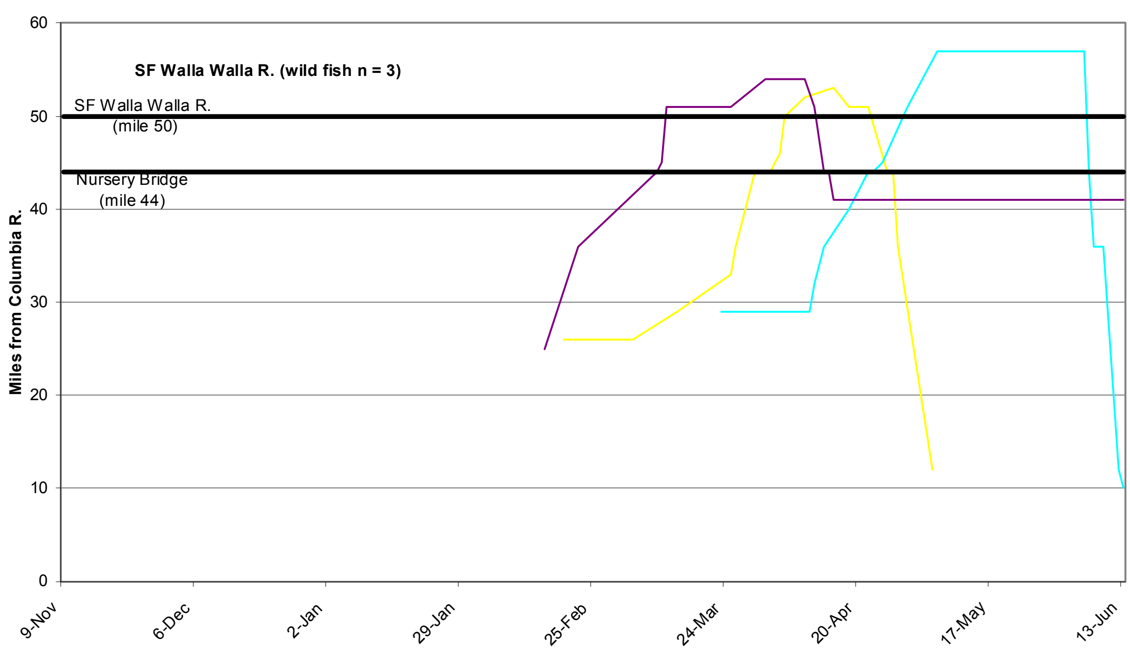

Figure 6-17. Movement of three radio-tagged wild steelhead into the South Fork Walla Walla River.

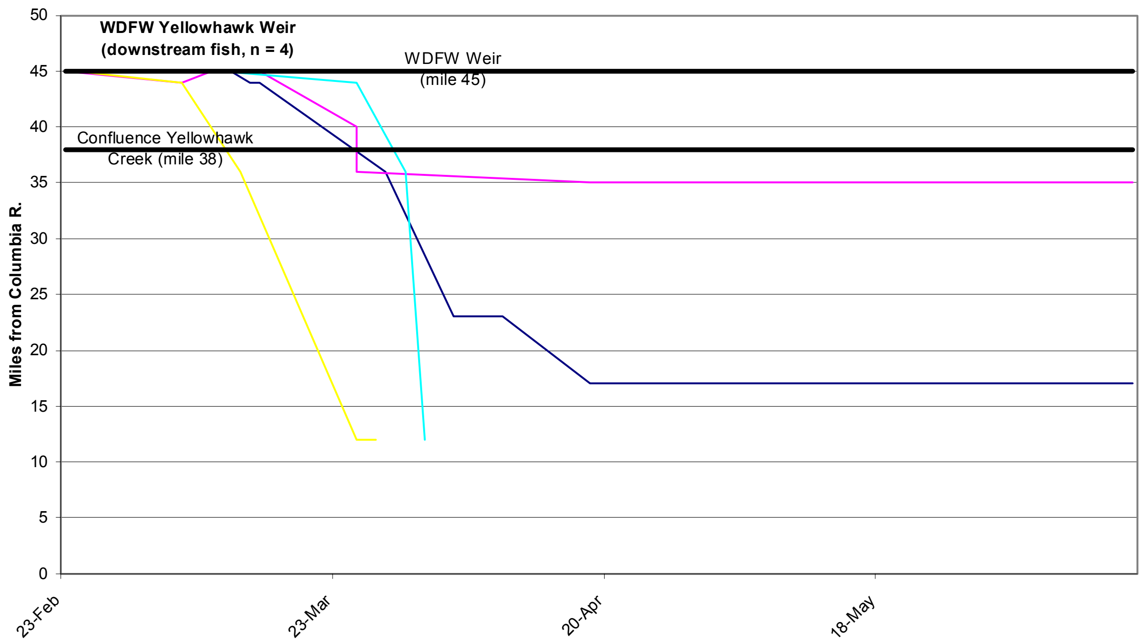

Figure 6-18. Movement of four radio-tagged steelhead after release from the WDFW weir on Yellowhawk Creek.

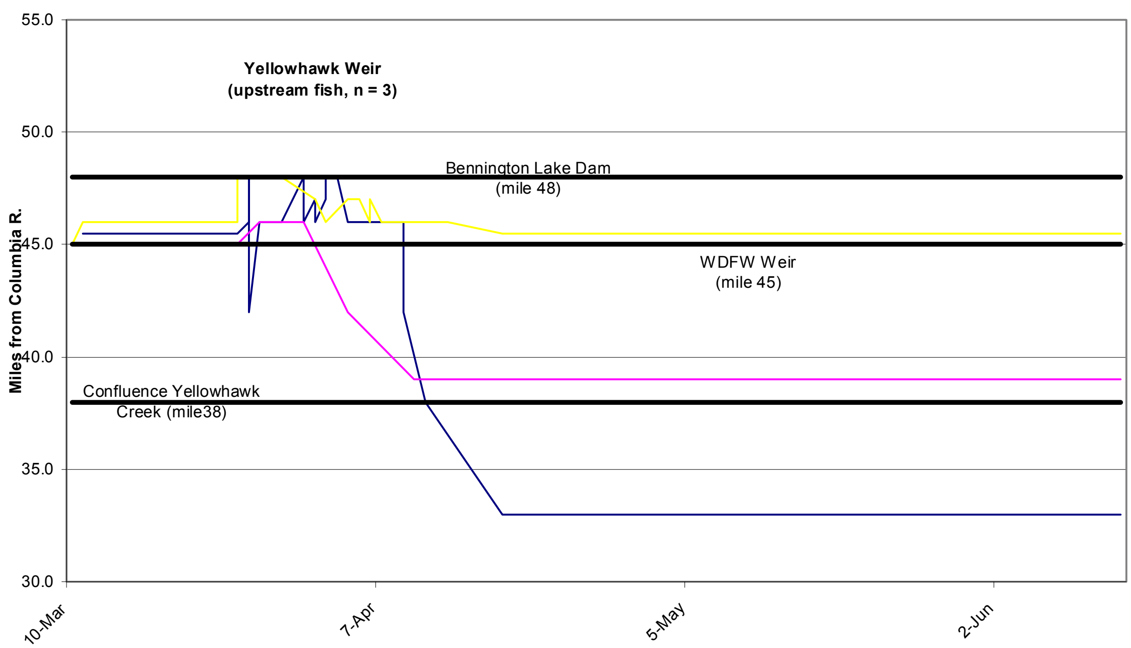

Figure 6-19. Movement of three radio-tagged wild steelhead upstream from the WDFW weir into Mill Creek.

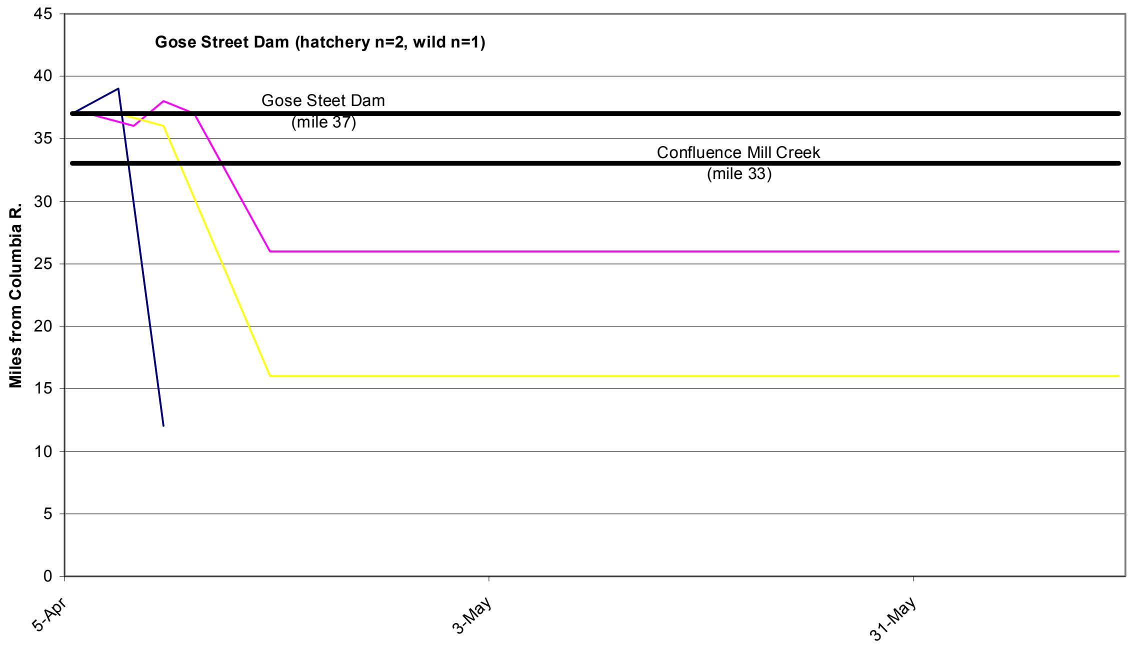

Figure 6-20. Movement of three radio-tagged steelhead after release from the Gose Street Dam on Mill Creek.

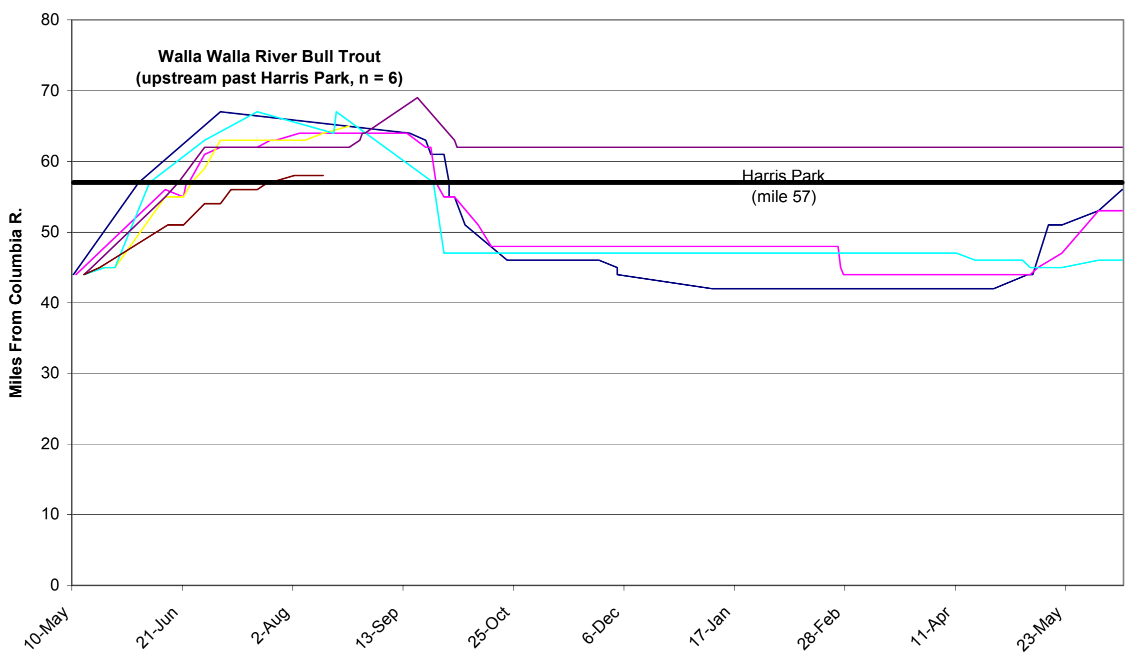

Figure 6-21. Seasonal movement of six radio-tagged bull trout after release from the old fish ladder traps at Nursery Bridge Dam, May 2001 to June 2002.

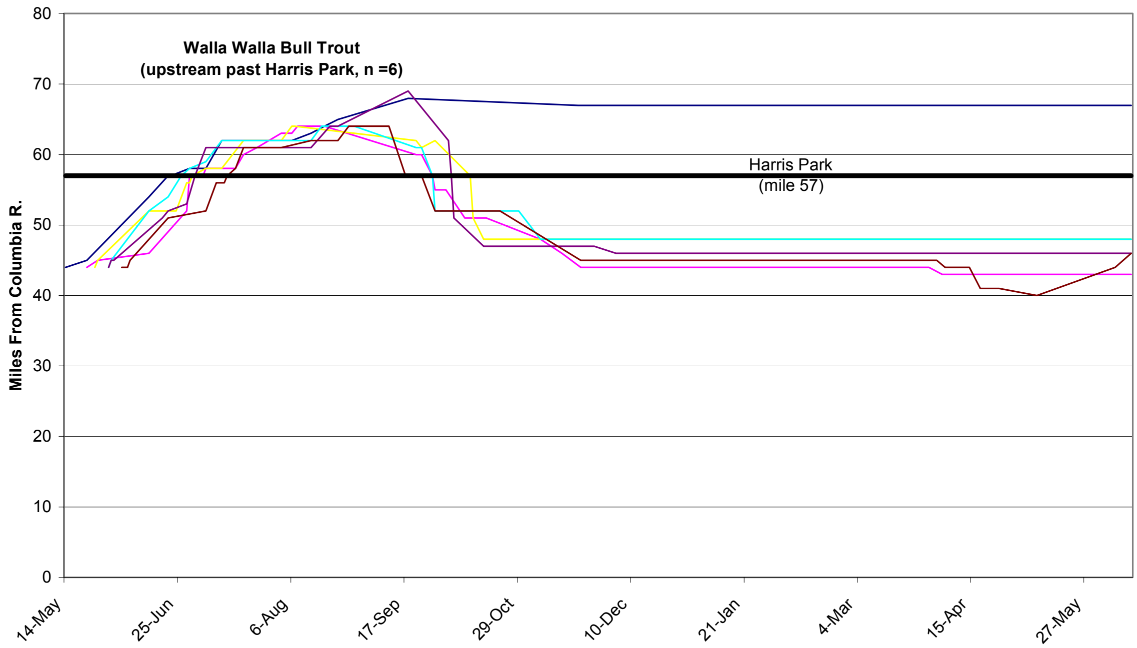

Figure 6-22. Seasonal movement of six radio-tagged bull trout after release from the old fish ladder trap at Nursery Bridge Dam, May 2001 to June 2002.

Appendix 6-A. Landmarks used record the location of radio-tagged steelhead and bull trout in the Walla Walla Basin.

Site	USGS 7.5 Quad.	Stream	Mile
Old RR Crossing	Zangar Junction	Walla Walla	8
9-Mile Ranch / U of I Station	Zangar Junction	Walla Walla	12
High Rocks Pool	Zangar Junction	Walla Walla	12
Byrnes Road	Zangar Junction	Walla Walla	13 - 14
Pump Houses	Zangar Junction	Walla Walla	14
Beaver Pool	Zangar Junction	Walla Walla	15
Cummings Bridge	Zangar Junction	Walla Walla	15
Wind Farm Corner	Zangar Junction	Walla Walla	16
Big Bend	Touchet	Walla Walla	17
USGS gauge / Sheep Ranch	Touchet	Walla Walla	18
Touchet Cemetery	Touchet	Walla Walla	20
Confluence Touchet	Touchet	Walla Walla	21
Touchet Bridge	Touchet	Walla Walla	22
Pine Creek	Touchet	Walla Walla	23
Bob W. boat ramp	Touchet	Walla Walla	24
Last Chance Hole	Touchet	Walla Walla	24
Borgens Hole	Touchet	Walla Walla	24
Big Eddy Hole	Touchet	Walla Walla	25
House Hole	Lowden	Walla Walla	26
Confluence Dry Creek	Lowden	Walla Walla	26
Lowden Road	Lowden	Walla Walla	27
Ready-Mix Hole	Lowden	Walla Walla	27
Macdonald Road	Lowden	Walla Walla	29
Detour Road	College Pl.	Walla Walla	32
Confluence Mill Creek	College Pl.	Walla Walla	33
Swegal Road	College Pl.	Walla Walla	34
Last Chance Road	College Pl.	Walla Walla	35
Burlingame Dam (FX-07)	College Pl.	Walla Walla	36
Confluence Yellowhawk Cr.	College Pl.	Walla Walla	38
Hwy 11 / 125	College Pl.	Walla Walla	38
Pepper's Bridge	College Pl.	Walla Walla	39
Stateline Road	College Pl.	Walla Walla	40
Tum-a-lum Bridge	M-F	Walla Walla	42
Gravel pit / Drive-in	M-F	Walla Walla	43
Nursery Bridge Dam (FX-10)	M-F	Walla Walla	44
Cemetery Bridge. Dam (FX-11)	M-F	Walla Walla	45
Grove School Bridge	Bowlus Hill	Walla Walla	46
Couse Creek	Bowlus Hill	Walla Walla	46
Lampsom's	Bowlus Hill	Walla Walla	47
Joe West Bridge	Bowlus Hill	Walla Walla	48
Lincton Mnt / Cache Hollow	Bowlus Hill	Walla Walla	48
North / South Fork (FX - 13)	Bowlus Hill	South Fork	0
Steel Bridge	Blalock Mnt.	South Fork	2
CTUIR Hatchery	Blalock Mnt.	South Fork	4
Cosper's	Blalock Mnt.	South Fork	6
Harris Park (FX-14)	Blalock Mnt.	South Fork	7
Elbow Creek	Blalock Mnt.	South Fork	9
Demaris Cabin	Blalock Mnt.	South Fork	11
Bear Creek	Tollgate	South Fork	12
Burnt Cabin Creek	Tollgate	South Fork	13
Swede Canyon	Tollgate	South Fork	13
Table Creek	Tollgate	South Fork	15
Skiphorton Creek	Tollgate	South Fork	17
Reser Creek	Jubilee Lake	South Fork	20

Appendix 6-B. CTUIR radio-tag reward poster 2002.

ATTENTION ANGLERS

REWARD

FOR

RADIO TRANSMITTERS

We are catching, radio-tagging, and releasing about 60 adult steelhead in the Walla Walla River Basin to document their movement and distribution. A radio transmitter is inserted into the stomach of each fish and is evident by a flexible wire antenna protruding from the mouth. We monitor the radio signals by mobile tracking (air and ground) and at listening stations along the migration route and at diversion dams. A $ 25 reward is paid for each radio transmitter returned. However, please do not remove transmitters from any fish that will be released; removing tags could injure fish. Releasing tagged fish will assist the study.

$25 REWARD

If you catch a fish with a radio transmitter or have any questions or information regarding the study please call Brian Mahoney CTUIR Fish Biologist at (541) 938-5785. Returned radio tags will be reused.

OR

Mail transmitters with your name, address, phone #, social security number, date and location fish was caught to:

Brian Mahoney
South Fork Research Office
79772 South Fork Walla Walla River Rd.
Milton-Freewater, OR 97862

Information provided by anglers will help increase angling opportunities in the Walla Walla River Basin.

CTUIR WDFW

Appendix 6-C. Radio-tagging schedule 2002-2003.

The Confederated Tribes of the Umatilla India Reservation (CTUIR) is authorized to take 45 adult, threatened, middle Columbia River (MCR) steelhead (*Oncorhynchus mykiss*) annually (Table 6-1, January 1 through December 31). CTUIR is authorized to take MCR steelhead associated with research designed to evaluate the effectiveness of recently constructed adult fish passage facilities in the Walla Walla subbasin (NMFS permit number 1365). This study will benefit MCR steelhead by determining where in the subbasin passage barriers exist (if any), by showing spatial and temporal habitat use, and spawning distribution of MRC steelhead in the subbasin. These results will be used to help develop a basin wide recovery strategy for these listed fish. We plan to capture adult MCR steelhead with a variety of techniques: hook and line, trapping, seining, gillnetting, and dip netting. Some of the fish will simply be measured and released, but most will be implanted with radio tags before release. The fish will be tracked with both permanent and mobile tracking units to determine where in the subbasin they go.

Table 6-C1. Take descriptions and levels per CTUIR scientific research permit 1365.

ESU	Life Stage	Origin	Type of Take	Maximum Take
MCR steelhead	Adult	Naturally-Produced	Capture, handle, tag, release	45
MCR steelhead	Adult	Naturally-Produced	Indirect mortality	4

TableC2. Proposed CTUIR radio-tag distribution.

Origin	**Number of tags**	**Percent total**
Naturally-Produced	45	~ 60 %
Hatchery	32	~ 40 %

Appendix 6-C. Continued.

Table 6-C3. Proposed CTUIR radio-tagging schedule September 2002 through March 2003.

Stream Reach	**Origin**	**September 2002 – December 31, 2002**	**January 1, 2003 – March 31, 2003**	**Total (n=76)**
Walla Walla River < Mill Creek	Hatchery	15	15	30 (~40%)
Walla Walla River < Mill Creek	Naturally-Produced	10	05	15 (20%)
Walla Walla River @ Nursery Bridge	Naturally-Produced	0	10	10 (13%)
Mill Creek < Gose St. Dam	Naturally-Produced	0	10	10 (13%)
Yellowhawk Creek < Peppers Rd.	Naturally-Produced	0	05	5 (7%)
Yellowhawk Creek @ WDFW Weir	Naturally-Produced	0	05	5 (7%)
Total		25	50	75

Notes: we are proposing to tag the maximum number (45 fish) of naturally produced (wild) MCR steelhead for which are permitted. The remained of our current tag inventory (31 tags) will be implanted in hatchery fish. Last season (September thru April) we tagged 30 wild MCR steelhead: 6 before January 1, 2002 and 24 between January and April 2002. The 24 fish tagged in 2002 count towards our annual allowable take of 45 MRC steelhead. Thus the maximum number of wild fish we are authorized to tag (if available) this fall would be 21. We have projected a catch of 10 wild fish for the fall (September to January) based on last years efforts. The remaining 35 wild fish will be tagged after January 1 and count towards our 2003 totals.

Appendix 6-D. Disposition of radio-tagged steelhead in the Walla Walla Basin, 2002.

		Water	Fork			Location						Location			
	Date	Temp	Length		Capture	USGS						USGS			
Tag	Tagged	(C°)	(cm)	Sex	Method	7.5 Quad.	Stream	Mile	Site	Disposition	Date	7.5 Quad.	Stream	Mile	Site
HATCHERY STEELHEAD															
1A	31-Jan-02	4	62	M	Bait	Lowden	WWR	26	< Lowden Road	Escaped	7-Apr-02	Zangar	WWR	12	9-Mile Bridge
5A	6-Feb-07	4	63	M	Lure	Touchet	WWR	25	< Lowden Rd.	Escaped	13-Apr-02	Zangar	WWR	12	9-Mile Bridge
8	9-Nov-01	5	50	F	Bait	Zangar	WWR	14	Byrnes Rd.	Escaped	14-Apr-02	Zangar	WWR	12	9-Mile Bridge
10	13-Nov-01	6	53	F	Bait	Zangar	WWR	14	Byrnes Rd.	Escaped	14-Mar-02	Zangar	WWR	12	9-Mile Bridge
12A	18-Jan-02	4	60	M	Lure	Touchet	WWR	21	Touchet / WWR	Escaped	30-Mar-02	Zangar	WWR	12	9-Mile Bridge
14	19-Dec-01	4	67	M	Bait	Lowden	WWR	26	< Lowden Rd.	Escaped	27-Mar-02	Zangar	WWR	12	9-Mile Bridge
18	19-Dec-01	5	58	F	Bait	Touchet	WWR	25	> Pine Creek	Escaped	26-Mar-02	Zangar	WWR	12	9-Mile Bridge
19	19-Dec-01	5	61	F	Bait	Touchet	WWR	25	> Pine Creek	Escaped	12-Mar-02	Zangar	WWR	12	9-Mile Bridge
22A	31-Jan-02	4	62	F	Bait	Lowden	WWR	27	> Lowden Rd.	Escaped	17-Mar-02	Zangar	WWR	12	9-Mile Bridge
23	8-Jan-02	2	66	F	Bait	Lowden	WWR	27	> Lowden Road	Escaped	28-Mar-02	Zangar	WWR	12	9-Mile Bridge
24	8-Jan-02	4	63	M	Lure	Lowden	WWR	26	< Lowden Rd.	Escaped	18-Apr-02	McNary	Columbia	291	> Mc Nary Dam
26	18-Jan-02	4	69	M	Bait	Touchet	WWR	23	> Pine Cr.	Escaped	22-Mar-02	Zangar	WWR	12	9-Mile Bridge
27	31-Jan-02	4	55	F	Bait	Lowden	WWR	27	> Lowden Rd.	Escaped	10-Apr-02	Zangar	WWR	12	9-Mile Bridge
28	5-Feb-02	3	61	M	Bait	Lowden	WWR	28	< Macdonald Rd.	Escaped	18-Mar-02	Zangar	WWR	12	9-Mile Bridge
21	22-Dec-01	3	66	F	Bait	Touchet	WWR	21	Touchet / WWR	Escaped	1-Apr-02	McNary	Columbia	289	McNary Dam [tag recovered]
78A	5-Apr-02	10	60	M	Dip	College Pl.	Mill	4	Gose St.	Escaped	11-Apr-02	Zangar	WWR	12	9-Mile Bridge
1	26-Sep-01	17	64	F	Seine	Zangar	WWR	8	> Old RR Xing	Harvested	20-Jan-02	Dayton	Touchet	52	< Dayton Bridge
3	25-Oct-01	7	66	F	Seine	Zangar	WWR	8	> Old RR Xing	Harvested	19-Dec-01	Lowden	WWR	27	> Lowden Rd.
5	26-Oct-01	10	67	M	Bait	Zangar	WWR	8	> Old RR Xing	Harvested	26-Dec-01	Touchet	WWR	24	> Pine Cr.
9	9-Nov-01	5	54	F	Bait	Zangar	WWR	13	Byrnes Rd.	Harvested	23-Dec-01	Lowden	WWR	29	< Macdonald Rd.,
9A	15-Feb-02	3	79	M	Lure	Lowden	WWR	26	< Lowden Rd.	Harvested	6-Apr-02	Irrigon	Columbia	282	Irrigon Hatchery
12	13-Nov-01	6	58	M	Bait	Zangar	WWR	14	Byrnes Rd.	Harvested	29-Dec-01	Lowden	WWR	26	< Lowden Rd.
13	13-Nov-01	7	50	F	Bait	Zangar	WWR	14	Byrnes Rd.	Harvested	8-Dec-01	Touchet	WWR	21	Touchet / WWR
15	30-Nov-01	9	58	M	Bait	Touchet	WWR	21	Touchet / WWR	Harvested	15-Feb-02	Touchet	WWR	24	> Pine Cr.
16	19-Dec-01	5	59	M	Bait	Touchet	WWR	25	> Pine Creek	Harvested	10-Feb-02	College Pl.	WWR	35	> Confl. Mill / WWR
22	22-Dec-01	4	63	M	Lure	Lowden	WWR	26	> Lowden Rd.	Harvested	24-Jan-02	Touchet	WWR	17	< Touchet Rd.
3A	6-Feb-02	4	58	M	Lure	Lowden	WWR	26	< Lowden Rd.	Lost	18-Apr-02	Zangar	WWR	0	Confl. Columbia /WWR
16A	5-Mar-02	6	64	M	Lure	Lowden	WWR	29	< Macdonald Rd.	Lost	13-Apr-02	Zangar	WWR	12	9-Mile Bridge
2	26-Sep-01	17	60	F	Seine	Zangar	WWR	8	> Old RR Xing	Lost	6-Dec-02	Touchet	Touchet	0	Confl. Touchet / WWR
4	25-Oct-01	9	64	M	Bait	Zangar	WWR	8	> Old RR Xing	Lost	10-Dec-02	Touchet	WWR	17	> Cummings Bridge
7	9-Nov-01	5	61	F	Bait	Zangar	WWR	15	< Cummings Bridge	Lost	13-Jun-02	Zangar	WWR	15	< Cummings Bridge
13A	15-Feb-02	3	70	F	Lure	Touchet	WWR	25	> Pine Creek	Lost	13-Jun-02	Zangar	WWR	1	Confl. WW / Columbia R.
17	19-Dec-01	5	53	F	Bait	Touchet	WWR	25	> Pine Creek	Lost	17-Jun-02	Touchet	WWR	25	> Pine Creek
20	21-Dec-01	4	72	M	Lure	Touchet	WWR	22	< Touchet Rd.	Lost	13-Jun-02	Waitsburg	Touchet	38	< Bolles Bridge
25	8-Jan-02	4	63	F	Lure	Touchet	WWR	24	> Pine Cr.	Lost	13-Jun-02	Touchet	WWR	24	> Pine Creek
6	7-Nov-01	8	59	M	Bait	Zangar	WWR	13	Byrnes Road	Lost	13-Jun-02	Zangar	WWR	13	Byrnes Road [tag recovered]
11	13-Nov-01	6	60	F	Bait	Zangar	WWR	14	Byrnes Rd.	Lost	23-Aug-02	Zangar	WWR	14	Byrnes Road [tag recovered]
75A	6-Apr-02	7	58	F	Dip	College Pl.	Mill	4	Gose St.	Lost	13-Jun-02	Lowden	WWR	26	< Lowden Rd.

Appendix 6-D. Continued.

Tag	Date Tagged	Water Temp (C°)	Fork Length (cm)	Sex	Capture Method	Location: USGS 7.5 Quad.	Location: Stream	Location: Mile	Location: Site	Disposition	Date	Location: USGS 7.5 Quad.	Location: Stream	Location: Mile	Location: Site
WILD STEELHEAD															
38	6-Feb-02	4	57	F	Lure	Lowden	WWR	26	< Lowden Rd.	Escaped	9-Apr-02	Zangar	WWR	12	9-Mile Bridge
40	6-Feb-02	4	66	F	Lure	Touchet	WWR	24	< Lowden Rd.	Escaped	12-Feb-02	Zangar	WWR	12	9-Mile Bridge
42	23-Mar-02	5	60	F	Lure	Touchet	WWR	25	> Pine Creek	Escaped	18-Apr-02	Zangar	WWR	2	9-Mile Bridge
43	19-Feb-02	5	59	F	Lure	Lowden	WWR	26	< Lowden Rd.	Escaped	5-May-02	Zangar	WWR	12	9-Mile Bridge
50	25-Jan-02	4	64	F	Lure	Lowden	WWR	26	< Lowden Rd.	Escaped	10-Apr-02	Zangar	WWR	12	9-Mile Bridge
52	6-Jan-02	4	58	M	Lure	Touchet	WWR	25	< Lowden Rd.	Escaped	7-May-02	Zangar	WWR	12	9-Mile Bridge
53	5-Jan-02	4	61	F	Lure	Touchet	WWR	24	< Lowden Rd.	Escaped	13-Apr-02	Zangar	WWR	12	9-Mile Bridge
59	9-Nov-01	5	61	F	Bait	Zangar	WWR	14	Byrnes Rd.	Escaped	25-Mar-02	Zangar	WWR	2	> Confl. WW / Columbia R.
30	24-Feb-02	6	61	F	Trap	Walla W.	YHC	6	WDFW Weir	Escaped	27-Mar-02	Zangar	WWR	12	9-Mile Bridge
37	10-Mar-02	6	59	M	Trap	Walla W.	YHC	6	WDFW Weir	Escaped	1-Apr-02	Zangar	WWR	12	9-Mile Bridge
57	30-Nov-01	13	58	F	Bait	Touchet	Touchet	19	Touchet / WWR	Lost	9-May-02	Lowden	Dry	4	Dry Creek
41	23-Mar-02	5	50	M	Bait	Lowden	WWR	29	< McDonald Rd.	Lost	6/1302	Zangar	WWR	10	Oasis rd.
44	15-Feb-02	3	61	M	Bait	Touchet	WWR	24	< Lowden Rd.	Lost	9-Apr-02	Lowden	Dry	4	Dry Creek
45	15-Feb-02	4	71	M	Bait	Touchet	WWR	25	< Lowden Rd.	Lost	9-Jul-02	College Pl.	WWR	41	< Tum-a-lum Bridge [tag recovered]
46	15-Feb-02	3	74	M	Lure	Lowden	WWR	26	< Lowden Rd.	Lost	9-Jul-02	College Pl.	WWR	39	< Peppers Bridge [tag recovered]
47	2-Feb-02	4	64	M	Lure	Touchet	WWR	24	< Lowden Rd.	Lost	20-Oct-02	Peterson R.	NFWW	2	Cup Gulch [tag recovered]
48	31-Jan-02	4	66	M	Bait	Lowden	WWR	29	> Macdonald Rd.	Lost	13-Jun-02	Lowden	WWR	26	< Lowden Rd.
49	15-Feb-02	3	81	M	Lure	Lowden	WWR	26	< Lowden Rd.	Lost	13-Jun-02	Lowden	WWR	26	< Lowden Rd.
51	6-Jan-02	4	63	F	Lure	Lowden	WWR	27	< Lowden Rd.	Lost	28-Aug-02	College Pl.	WWR	32	> Swegal Rd. [tag recovered]
54	29-Dec-01	4	70	M	Lure	Touchet	WWR	19	Touchet / WWR	Lost	4-Apr-02	Dayton	Touchet	54	> Snake River Lab
55	19-Dec-01	5	58	M	Bait	Lowden	WWR	25	> Pine Creek	Lost	13-Jun-02	College Pl.	WWR	35	< Last Chance Road
56	19-Dec-01	5	64	M	Bait	Lowden	WWR	25	> Pine Creek	Lost	31-May-02	Robinet	Wolf F.	58	Wolf Fork
58	30-Nov-01	7	64	M	Bait	Touchet	WWR	19	Touchet / WWR	Lost	6-Feb-02	Waitsburg	Touchet	40	> Bolles Bridge (FX-02)
15A	5-Mar-02	5	60	F	Trap	Walla W.	YHC	6	WDFW Weir	Lost	10-Dec-02	Touchet	WWR	16	> Cummings Bridge
29	23-Feb-02	4	64	M	Trap	Walla W.	YHC	6	WDFW Weir	Lost	13-Jun-02	College Pl.	WWR	35	> Mojonnier Rd.
35	11-Mar-02	5	62	M	Trap	Walla W.	YHC	6	WDFW Weir	Lost	13-Jun-02	College Pl.	Mill	0	< Detour Rd. [tag recovered].
36	10-Mar-02	6	63	M	Trap	Walla W.	YHC	6	WDFW Weir	Lost	9-May-02	Walla W.	Mill	6	< 9th Street Bridge [tag recovered]
39	10-Mar-02	6	61	F	Trap	Walla W.	YHC	6	WDFW Weir	Lost	26-Aug-02	Walla W.	YHC	7	YHC [tag recovered]
79A	12-Mar-02	5	57	F	Trap	Walla W.	YHC	6	WDFW Weir	Lost	9-Jul-02	Walla W.	YHC	6	WDFW weir [tag recovered]
34	8-Apr-02	9	61	M	Dip	College Pl.	Mill	4	Gose Street	Lost	10-Dec-02	Zangar	WWR	16	> Cummings Bridge

Appendix 6-E. Detailed fish tracking data (35 pages) for radio-tagged steelhead and bull trout in the Walla Walla River Basin 2001-2002.

Appendix 6-E is 35 pages long and is currently available at http://www.umatilla.nsn.us (CTUIR website).

CHAPTER SEVEN: INTER AGENCY COORDINATION

THE WALLA WALLA BASIN NATURAL PRODUCTION MONITORING AND EVALUATION PROJECT

PROGRESS REPORT
1999-2002

Prepared By:

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Confederated Tribes of the
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Contract Period
September 30, 1998 to December 31, 2002
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INTRODUCTION

The Walla Walla Basin Natural Production Monitoring and Evaluation Project (WWNPME) was funded by Bonneville Power Administration (BPA) as directed by section 4(h) of the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (P. L. 96-501). This project is in accordance with and pursuant to measures 4.2A, 4.3C.1, 7.1A.2, 7.1C.3, 7.1C.4 and 7.1D.2 of the Northwest Power Planning Council's (NPPC) Columbia River Basin Fish and Wildlife Program (NPPC 1994). Coordination and process related activities were conducted through the WWNPME project under Objective 6 in the 2001 and 2002 statements of work. Project reports and data will be available at http://www.umatilla.nsn.us (summer 2003, CTUIR website).

Even though coordination activities have been an integral part of the WWNPME project since before its formal inception, they were not formally outlined in the proposal process or the work statements until 2001. Coordination, planning, joint efforts and various processes were grouped together when cost estimates by objective became a required part of annual project proposal processes. Without identifying these activities in a formal objective, funding would not have been available for personnel to attend meetings, conduct joint field activities, complete proposals, write ESA permit applications and reports, contribute to basin planning, and the other activities outlined below.

Objective and Tasks
Objective H (Objective 6 in the 2001 and 2002 statements of work): Coordinate and cooperate with the regulatory and management entities involved with Walla Walla Basin salmonid recovery and management. Complete the various processes, proposals, permit applications and permit reports as required by the various funding, management and regulatory agencies.

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

Coordination with managers and other monitoring projects is an important and useful exercise and requires a substantial commitment of time and effort. It is critical that researchers and managers work together to explore, evaluate and prioritize monitoring needs, opportunities and methods. Coordination and cooperation is important in meeting the primary goal for the monitoring program which is to provide data, information and insight to local and regional managers. The extensive information generated by this project has been frequently requested by a wide range of individuals and groups. Considerable time and effort is involved in completing these processes, attending meetings and filling data requests in various formats.

COORDINATION, JOINT PROJECTS AND PROCESS

This section summarizes WWNPME activities related to interagency coordination and planning. The format of this chapter deviates from the other chapters because Objective H is not a monitoring and evaluation objective and therefore it does not have distinct methods, results and discussion sections. The following synopsis is not comprehensive but it does describe the primary activities conducted under Objective H. Below are brief summaries of activities and citations for reports and plans regarding activities we cooperated with at varying degrees.

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

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

1) Coordinate RM&E activities and standardize methods and reporting
   Adult steelhead and bull trout passage and distribution study
   Fish distribution, abundance, life histories and age and growth
   Spawning surveys
   Smolt out-migration
   Habitat inventories-surveys-monitoring
   Water temperature monitoring
   Flow monitoring, instream flow evaluations
   Lamprey, freshwater mussels
2) Coordinate and plan fisheries management actions
   Harvest
   Habitat restoration and alteration projects
   Chinook out-planting
   Chinook Hatchery Master Plan
   Hatchery steelhead programs
   Bull trout management

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

BPA: Benjamin Zelinsky, Roy Beaty, Peter Lofy, Jay Marcotte
CTUIR: Gary James, Carl Scheeler, Brain Zimmerman, Jed Volkman, Craig Contor
NMFS: Rob Jones
ODFW: Tim Bailey, Bill Duke, Rich Carmichael, Dale Chess, Paul Sankovich
USACE: Chris Hyland, Ben Tice
USFS: Dave Crabtree
USFWS: Michelle Eames
WDFW Glen Mendel Mark Schuck
WWBWC: Brian Wolcott, Gena Massoni, Bob Bower

The WWMMOC was disbanded during the fall of 2002 because folks in the Walla Walla Basin were not bringing fisheries issues to the committee. Instead, separate and redundant meetings were being held by various groups. WWBWC now chairs a technical work group (TWG) that convenes three times a year for basin coordination of fisheries management and RM&E activities. One of these meeting each year is a conference to report M&E findings and management actions and to share information with the public and TWG committee members.

Walla Walla Basin Watershed Council
CTUIR M&E staff attend various WWBWC meetings including the fisheries related meetings that replaced the WWMMOC meetings.

Telemetry
WWNPME biologists work cooperatively with ODFW, WDFW, WWBWC and the irrigation districts on the steelhead and bull trout telemetry projects (Mahoney 2003a).

Rainwater
Our staff worked cooperatively with Allen Childs (CTUIR Project Leader for the Rainwater Wildlife Area) on a Washington GSRO habitat project on the South Fork of the Touchet River near Dayton Washington. Our staff assisted Childs (2001) with stream habitat surveys and salmonid abundance assessment. Effectiveness monitoring demonstrated approximately 100% increase in salmonid abundance in treated sites in relation to untreated sites as outlined below in a paragraph quoted from Childs' report (2001).

> "*CTUIR staff conducted additional post-project monitoring during summer 2001. An abbreviated habitat survey, developed by CTUIR staff based on Moore, 1993, was completed for the 1 mile Griffin Fork reach treated with large wood additions and road obliteration. In addition, tribal staff repeated sampling on four fish population index sites, two of which were located in the Griffin Fork restoration reach. To evaluate the potential benefits of large woody debris additions, staff selected an index site affected by whole tree additions and a site without whole tree additions to assess potential differences in habitat selection by the fishery resources. Results of fish and habitat surveys document improvements in several parameters. Data from the paired fish population index sites (Sites 2 and 3) indicate that fish density nearly doubled from pre-project density (0.30 fish/square meter of habitat compared to 0.16 in Site 3). Site 3 is located in the area affected by the failed bridge structure and large wood/grade control structure installation. See Photo Point 4 series later in this section. Fish density in Index Site 2 (control, non-treatment site) remained comparable to pre-project conditions. Data suggests large, complex pool habitat provides quality rearing conditions and is readily selected by fish. Our repeat data is too limited to suggest there has been an increase in the Griffin Fork fish population. Future index site surveys will assist in assessing affects of enhancement activities on fish populations. Post-project habitat survey documented improvements in several habitat parameters including: increased large pool habitat (30 pools/mile compared to 8 pools/mile pre-project); increased mean depth (0.16m compared to 0.1m); increased large woody debris (25 pieces, plus/mile compared to 16 pieces/mile); and increased in undercut streambanks (18.3% undercut compared to 13.2% undercut streambanks).*"

Walla Walla Flow Feasibility Study for Flow Management and Augmentation
CTUIR M&E staff have spent considerable time working with USACE as sponsors of a feasibility study to examine flow enhancement options for fish in the Walla Walla River Basin. This USACE work was developed initially through a reconnaissance study (USACE 1997) and has progressed to a basin-wide feasibility study.
There is also a Civil Penalty Settlement Agreement between the USFWS and irrigation districts in the Walla Walla River to provide flows and increase instream flows below Milton-Freewater to avoid take of listed bull trout and summer steelhead. CTUIR RM&E personnel have been involved in providing data, comments, recommendations and technical review of documents for these issues.

Project personnel prepared the following material in response to repeated requests for a single recommended instream flow target for the Walla Walla River below Nursery Bridge. It should be understood that there is not a single flow quantity that suddenly transforms unsuitable habitat into optimum salmonid habitat once the final cfs is added. The essential principle about setting fish flow targets has been difficult for many to understand and the lack of a single hard number has prevented many from initiating flow augmentation planning. Recommending a single discharge for the Walla Walla River is somewhat counter intuitive for fluvial and biological systems that are constantly in flux. The flow concept we propose has several components including: 1) spring flows for migrating adults and smolts; 2) summer rearing flows with an initial range of around 50 cfs, and 3) improved summer rearing flows with a range of about 100 cfs (Table 7-1, Figure 7-1 and 7-2). These ranges are not optimum for fish but represent a workable compromise. Optimum flows for fish are unrealistic and include all of the water all of the time. Spring migration and summer rearing flows recommended by CTUIR for salmonid restoration in the Walla Walla River below Milton Freewater (Table 7-1) have been updated and are now based on several independent processes.

Table 7-1. Flow augmentation needs in the Walla Walla River below Milton-Freewater.

Flow (CFS)	Purpose	Timing	Acre Feet Needed
150	Salmon and Steelhead Migration	Spring through June	15,000
50	Juvenile Rearing Habitat	July through October	
100	Expand Rearing Habitat	July through October	12,000
		TOTAL	27,000

Estimates of the acre feet needed for fish flows assumes: 1) the 2002 minimum flow of 25 cfs would contribute; 2) additional flows developed through the HCP process were not considered, and 3) the table does not include water needs for the minimum pool of a storage site, wildlife needs, and other beneficial uses.

Flows for Adult and Juvenile Migration

Adult migration of spring Chinook[5] salmon and summer steelhead need sufficient flows from March through June. Flows in Table 7-2 show that flows during these months historically

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

ranged from 254 to 665 cfs at Milton Freewater. While these flows would be beneficial for outmigrants and returning adults, CTUIR experience on the Umatilla River with spring Chinook suggests that 150-200 cfs would be an adequate minimum. CTUIR provides this target flow based on comparisons of flows needed in the Umatilla Basin, observations of strays in 1998 and historical records discussed above and listed in Table 7-2. CTUIR has monitored adult returns and flows in the Umatilla Basin since 1989 and 150-200 cfs appears to be adequate for migrating adults and smolts. However, addition flows would be considered beneficial and desirable. In 2001, 47 adult spring Chinook salmon from hatchery programs in adjacent basins returned to the Walla Walla River and were observed at Nursery Bridge Dam (Figure 7-3). Adult returns appeared to end abruptly in association with reduced flows. This data matches the conceptual charts presented in Figures 7-1 and 7-2. These figures suggest that for adult spring Chinook to migrate safely to the headwaters, flows should be augmented through June. Otherwise portions of the run will not be able to return to the headwaters to spawn. IFIM flow studies conducted by Hal Beecher and reported in Mendel (et al. 2001) reported that steelhead spawning habitat weighted usable area was optimum and 182 CFS. While the current conditions do not provide suitable rearing habitat for steelhead below Stateline, flow augmentation during the summer could provide suitable conditions. Adequate flows for steelhead spawning would then be important.

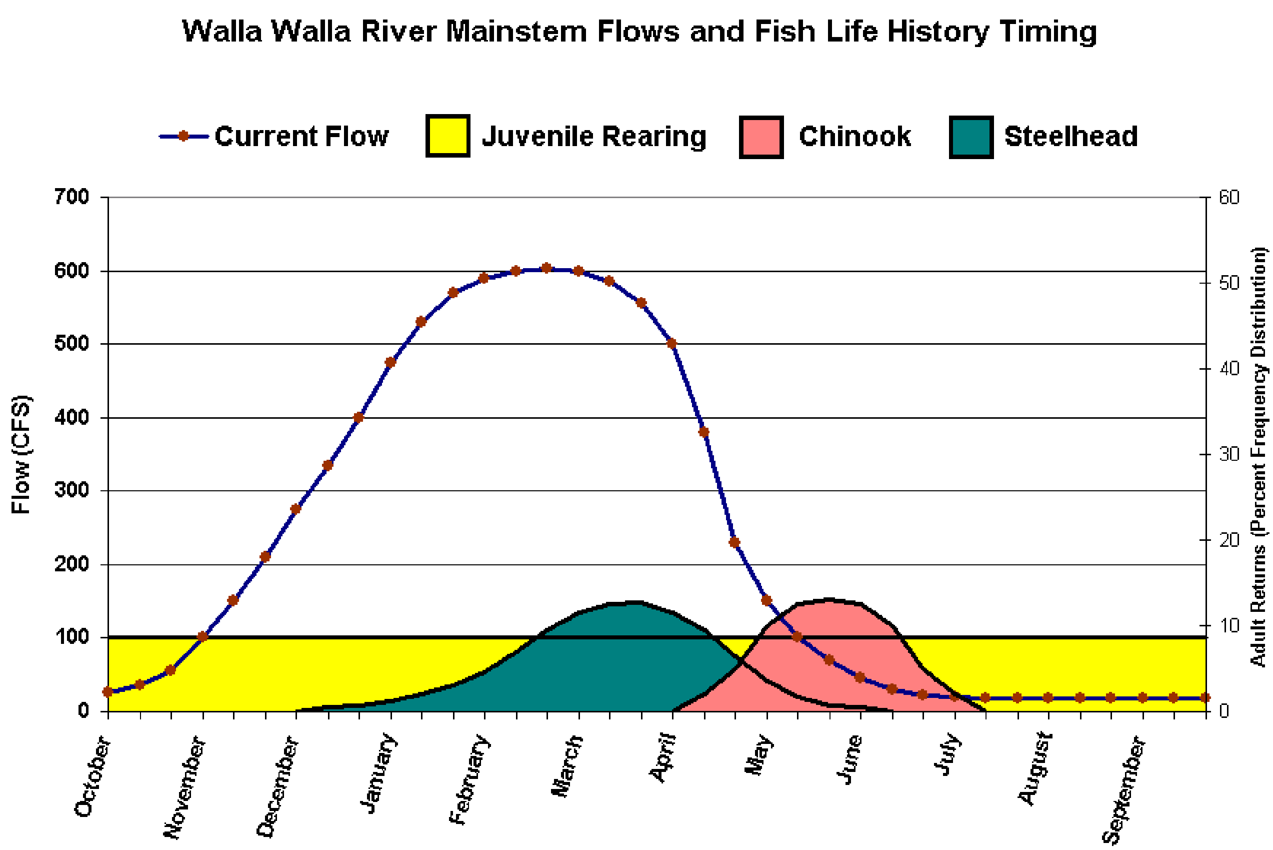

Figure 7-1. Conceptualized schematic of current flow overlaid with flow needs of adult spring Chinook and summer steelhead, year-around rearing of juvenile salmonids, and out-migration flows for smolts.

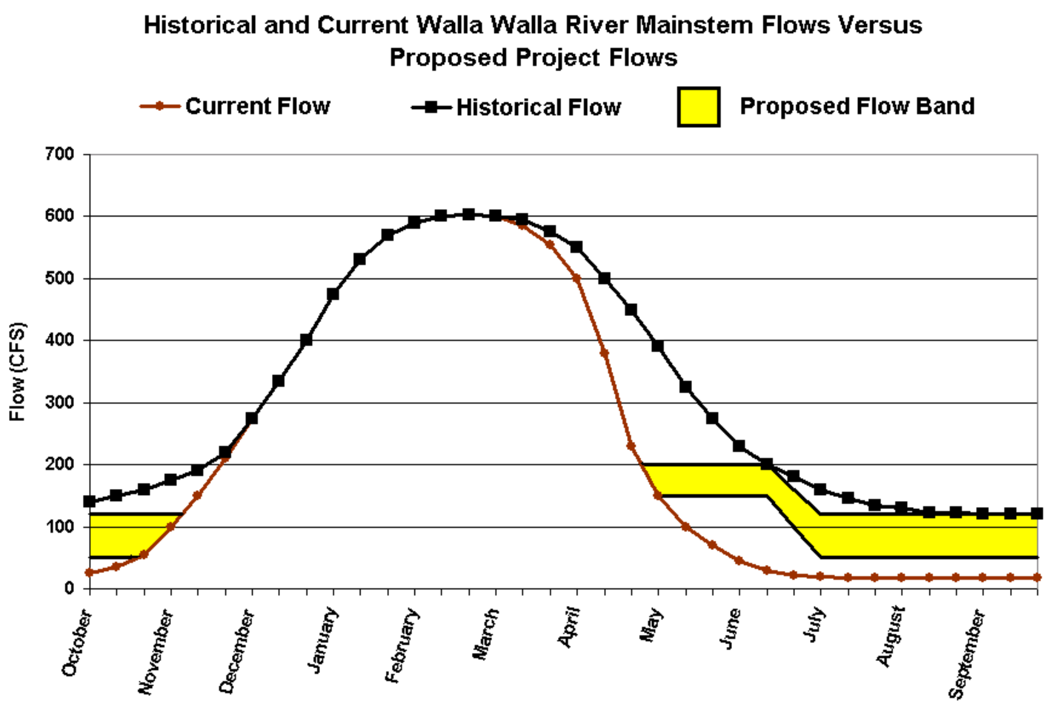

Figure 7-2. Conceptualized schematic of current and historic flows overlaid with proposed augmentation flows to provide for passage of adult spring Chinook and summer steelhead, year-around rearing of juvenile salmonids, and out-migration flows for smolts.

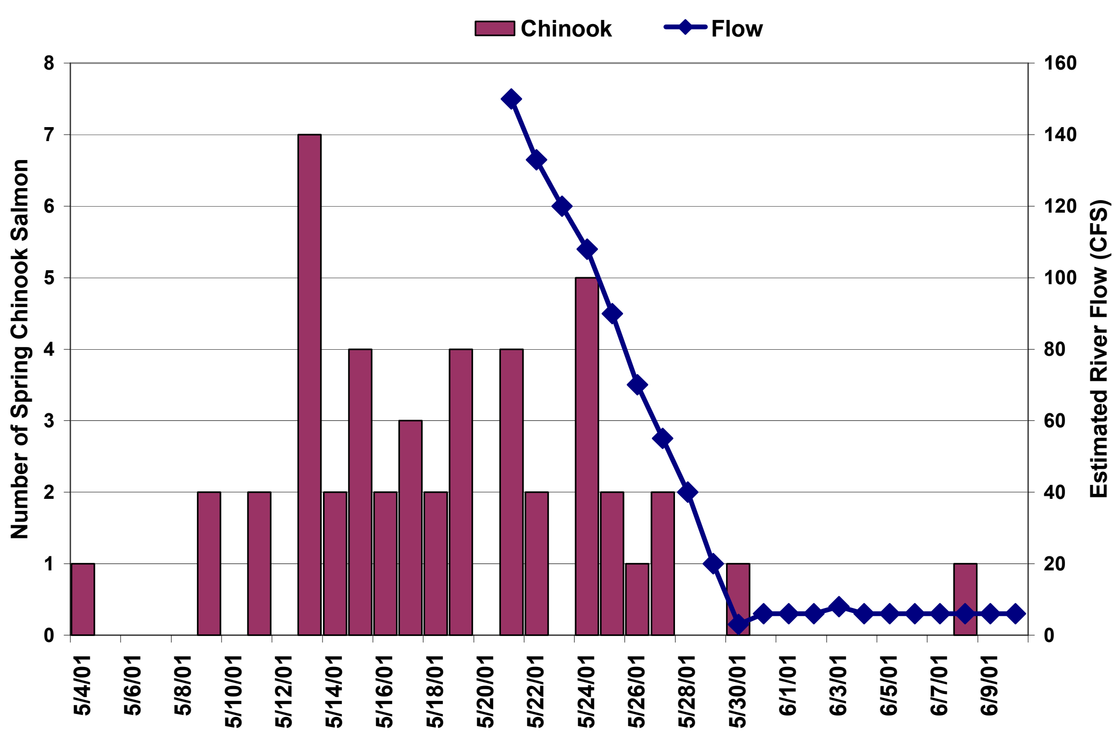

Figure 7-3. Adult spring Chinook salmon returns to Nursery Bridge Dam in 2001 and associated Walla Walla River flow estimates.

Flows for Salmonid Rearing Below Milton-Freewater

During most of the 1900s, the Walla Walla River below Milton-Freewater became unsuitable for juvenile salmonids each summer when irrigators diverted water for agricultural needs (Volkman 2001 cites several sources). Recently, ESA related flow requirements (25 cfs) have provided enough flow for salmonids to migrate through the reach (Figure 7-1). Currently some juvenile salmonids rear in the reach all summer (see Chapter 2 of this report). The 25 cfs represents an important beginning. However, considerably more cold water in the summer would greatly enhance and extend suitable salmonid rearing habitat downstream from Milton-Freewater.

Summer flows below Milton-Freewater from 120 to 160 cfs would provide more salmonid habitat than 100 cfs. However, it does not seem reasonable to recommend flows that would frequently exceed natural low flow conditions. Furthermore, incremental improvements in salmonid habitat generally diminish as flows increase. The essential principle about setting summer rearing flows is that small increments in flow quantity will not suddenly transform unsuitable habitat into optimum salmonid habitat.

Clearly, the costs and benefits of various summer rearing flow augmentation strategies will likely drive the quantity of augmented flows. The first priority is to secure flows for adult and juvenile passage so that abundant habitat in the headwaters can be utilized. The second priority is to secure additional flows for summer rearing (Table 7-1). Obtaining 80 cfs for the entire summer may be much more cost effective relative to 100 cfs. Eighty cfs would be the preferred alternative under that scenario. On the other hand, conditions may allow a design that could provide 110 cfs for only a little more than it would cost to provide 90 cfs. In that situation, augmenting 110 cfs would likely be the preferred action.

The Washington Department of Fish and Wildlife (WDFW), the Oregon Department of Environmental Quality (ODEQ) and the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) each developed flow estimates of about 100 cfs using separate methods.

Oregon Department of Environmental Quality Draft Process

Oregon Department of Environmental Quality estimated what August flows would be without human factors (primarily irrigation). They used hydrologic modeling techniques and accounted for flow losses for the reach below Milton-Freewater. They estimated the natural discharge in August below Milton-Freewater would average 118 cfs with a range from 109 to 139.

Washington Department of Fish and Wildlife's Suitable Flow Estimate

Washington Department of Fish and Wildlife reported that "juvenile steelhead habitat increased most rapidly up to 100 cfs in the Walla River" below Mill Creek (Mendel, et al. 2001). Their estimate was based on the incremental use of an IFIM model called the Physical Habitat Simulation (PHABSIM) model using three calibration flows at nine transects. Their model is considered suitable for flows from 10 to 300 cfs. The 100 cfs value is similar to historical flows and what CTUIR recommends.

CTUIR Flow Recommendations for Salmonid Summer Rearing Habitat

CTUIR based their flow recommendations on historical data when spring Chinook were abundant (Volkman cites various sources, 2001). This is a very basic use of empirical data. Adequate flows had to exist historically for Chinook to be abundant, and we assume that similar flows would be sufficient for recovery today. This does not mean that recovery will occur if other limiting factors are ignored.

CTUIR looked at flow records from 1903-1905 obtained from the U.S. Geological Survey and the Oregon Water Resources Department (Table 7-2). The flow of 100 cfs represents the low summer flow at Milton-Freewater before significant irrigation diversions. The average flows during the summer and late fall ranged from 120 cfs to 140 cfs. Combining flows from the North and South Forks, using USGS data through 1991, also indicates that at least 100 cfs flowed in the mainstem during the summer down to the diversions at Milton-Freewater. CTUIR crews have sampled juvenile spring Chinook, summer steelhead and bull trout in the Milton-Freewater reach, above the diversions, during August 1999, when flows were near the recommended 100 cfs. Securing augmentation flows for irrigation needs and keeping 100 cfs of cold water in the main channel would improve existing habitat and extend salmonid rearing for many miles below Milton-Freewater. To estimate acre feet of water needed to augment flows below Milton-Freewater (Table 7-1), we assumed the existing 25 cfs would continue to contribute. We did not include HCP flows in the table or storage needs for minimum pools, wildlife needs or other beneficial uses of water that may be reasonable and prudent.

From a hydraulic and fish habitat perspective, it would be hard to conceive of a reasonable flow recommendation that did not match the basin and stream channel. Channels normally form in proportion to basin attributes (peak discharge, valley slope, geology, area, climate, topography etc). PHABSIM utilizes channel attributes in concert with flow, depth and velocity combined with known habitat suitability data for salmonids (depth, velocity etc). It is not surprising that the PHABSIM method showed that benefits increased most rapidly until discharge was similar to historical summer flows. One would also expect similar values when using ODEQ's methods to estimate what contemporary summer flows would be without diversions. These rudimentary relationships between watershed and base flow (exceptions granted) is why CTUIR considers 100 cfs a reasonable summer flow target (July through October).

Water temperature is an important factor in flow management when salmonid rearing is involved. Not only will 100 cfs provide more habitat at most Walla Walla River transects than 50 cfs, it will also provide more miles of suitable habitat downstream. In the summer, water temperatures generally increase as the water moves downstream. The justification for securing 100 cfs instead of securing 75 or 50 cfs is based in part on thermodynamics. While some are focused on a few river miles near Milton-Freewater, CTUIR is interested in a much larger reach. Many additional miles of summer salmonid rearing habitat would be gained with higher flows because the cold water would persist much farther downstream.

Flow augmentation planning for summer rearing habitat should strive to keep cold clean water in natural channels. Cold water from springs and cold tributaries should be managed so that it reaches the river. Water sources with thermal, sedimentary and agricultural pollutants should be routed into irrigation canals and not through salmonid habitat in natural streams. In addition to the restoration of flows, aggressive restoration of riparian vegetation and other efforts could further expand the number of river miles of suitable salmonid rearing area by improving habitat and temperature profiles in the lower river. Securing adequate flows is an essential part of basin restoration and must occur in unison with these other projects and processes.

Table 7-2. Summary of mean daily discharge estimates from gages in the Walla Walla River Basin (Oregon Water Resources Department, www.wrd.state.or.us).

North Fork Walla Walla River, gage number 14010800, discharge in cubic feet per second, period of record: 10/1969 ~ 10/1991

Month (CFS)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Period of Record	
Maximum Discharge	644.0	872.0	670.0	339.0	473.0	394.0	40.0	41.0	23.0	108.0	243.0	475.5	Max	872.0
Mean Discharge	70.0	77.6	95.2	115.2	94.4	41.6	11.8	8.0	7.4	9.5	25.9	48.1	Mean	50.2
Minimum Discharge	5.8	11.0	24.0	32.0	13.0	6.5	4.0	3.4	3.5	4.3	4.4	5.9	Min	3.4

South Fork Walla Walla River, gage number 14010000, discharge in cubic feet per second, period of record: 02/1903 - 10/1991

Month (CFS)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Period of Record	
Maximum Discharge	1800	1190	890	930	996	914	299	210	425	310	708	1870	Max	1870
Mean Discharge	174.0	188.0	214.2	279.5	302.7	203.3	123.2	108.6	106.9	110.2	134.5	165.2	Mean	175.8
Minimum Discharge	80	74	98	129	110	88	81	77	75	74	76	80	Min	74

Walla Walla River near Milton-Freewater, gage number 14012000, discharge in cubic feet per second, period of record: 02/1903 - 09/1905.

Month (CFS)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Period of Record	
Maximum Discharge	460.0	436.0	2220.0	2220.0	830.0	472.0	225.0	198.0	369.0	488.0	820.0	560.0	Max	2220.0
Mean Discharge	214.4	222.7	434.8	665.1	497.0	253.9	148.0	121.7	134.3	159.2	233.2	232.7	Mean	285.6
Minimum Discharge	150.0	128.0	200.0	310.0	275.0	145.0	100.0	97.0	100.0	125.0	143.0	140.0	Min	97.0

Walla Walla River near Touchet, gage number 14018500, discharge in cubic feet per second, period of record: 10/1951 - 09/1987

Month (CFS)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Period of Record	
Maximum Discharge	14500	9310	7390	5610	2770	3210	457	268	850	1630	2770	20300	Max	20300
Mean Discharge	1168.6	1340.6	1205.2	1118.5	699.1	253.2	42.6	19.4	44.6	92.9	291.8	849.3	Mean	590.0
Minimum Discharge	200	162	117	65	37	4.9	0.0	0.0	2.6	3.8	33	84	Min	0.0

WDOE TMDL Fish Contaminant Study

Art Johnson and Brandee Era-Miller of WDOE conducted a fish contaminants study in the Walla Walla River. CTUIR staff assisted with sampling fish using electrofishing gear and seines. Johnson and Era-Miller's project is related to the ongoing TMDL project which can be examined online:
Jhttp://www.ecy.wa.gov/programs/wq/tmdl/watershed/wallawalla/index.html

The link to their Quality Assurance Project Plan (QAPP) for the Walla Walla Chlorinated Pesticide TMDL and be found at: http://www.ecy.wa.gov/biblio/0203068.html

Endangered Species Act and Cooperation with USFWS and NMFS
In addition to working on the bull trout recovery plan, CTUIR personnel also worked with the services to obtain collecting permits and complete annual permit reports in order to continue RM&E activities. CTUIR staff have completed all the necessary permit applications and activity reports related to the steelhead and bull trout listing and associated oversight by USFWS and NMFS (Contor 1999, 2000, 2001 and Mahoney 2002, 2003b 2003c).

Columbia River Inter-Tribal Fisheries Commission
WWNPME personnel work with CRITFC on a variety of salmonid restoration issues related to the Walla Walla River Basin. The genetics work conducted by Narmum et al. is a prime example (see Chapter 5 of this report). CTUIR and CRITFC researches also work together on issues related to natural production and supplementation, kelt reconditioning, steelhead population dynamics, and monitoring and evaluation techniques and strategies.

Oregon Department of Transportation

Research biologists routinely provide data and discuss salmonid distribution and life histories with ODOT personnel that are developing biological assessments for road repair and construction activities.

Chinook Hatchery Master Plan
WWNPME biologists are working with other CTUIR staff to develop the master plan for the Tribes Walla Walla spring Chinook restoration initiative. The plan will contain RM&E plans to monitor the success of proposed actions.

Sub-Basin Planning
WWNPME personnel were significantly involved with providing data, text and review for the fisheries status section of the Walla Walla Subbasin Summary Plan (James et al. 2001).

Project Administrative Processes

Considerable project resources and efforts are expended on administrative processes such as hiring, training, scheduling, planning, and employee evaluations. Additional administrative efforts include tracking expenditures, budgeting, purchasing, inventory, maintenance, repair etc. Hiring quality personnel to fill vacancies and complete deliverables has been extremely difficult during 2002. Contract delays prevented the hiring process to proceed because CTUIR Administration requires secure funding before personnel can be hired. Furthermore, limits in salary for the project leader position discourage potential applicants from applying and selected applicants from accepting our job offer. Without appropriate numbers of quality personnel, RM&E projects cannot deliver quality products.

BPA, ISRP, Northwest Power Planning Council

During the 1999-2002 contract years WWNPME staff have developed multiple versions of project proposals, reviews, statements of work and budgets. These proposal and contract processes only required one or two weeks to complete during the early 1990s. The process took 15.5 months for the 2002 contract alone. This represents a huge derailment of human resources away from planned RM&E objectives and tasks.

RECOMMENDATIONS

Eliminate Programmed Failure

The WWBNPME project was placed in an impossible situation. It is imperative that RM&E projects are not placed in similar situations in the future, otherwise programmed failure will be guaranteed. The guaranteed recipe for failure had three primary components:

1) The 2003 contract could not be obtained until 2002 deliverables were met;
2) 2002 deliverables could not be completed without personnel, and
3) Personnel could not be hired without the 2003 contract (go back to 1).

In 2002 we were not able to hire appropriate staff without a signed contract. We did not obtain the contract until Nov 11, 2002, even though our original 2002 statement and work and budget were submitted in September of 2001. The problem was related to ISRP mandates that required sample design changes. CTUIR adopted the recommended changes and re-submitted the proposed statement of work in November 2001 through a joint project with ODFW. BPA staff did not want to fund the new sampling strategies recommended by ISRP. Multiple negotiations and iterations continued through July 2002. From July through October the statement of work remained unchanged but was frozen somewhere in BPA. These delays caused significant problems for the project and eliminated the opportunity to complete some objectives and tasks.

When the 2002 contract was finalized (November 11, 2002), it was too late to fill personnel vacancies given the uncertainty in funding for 2003. For a brief period in the fall of 2002, we were allowed to proceed with hiring the project leader based on a letter of intent provided by BPA. However, we were restricted on the salary level which precluded the recruitment of quality applicants. The selected individual turned down our offer because he was offered another position for about $15,000 more/year. Project staff had summarized current salaries advertised on the American Fisheries Website for similar research project leaders from throughout the nation. Our recommended salary was reduced by $12,000 in the official job announcement. Predictably, we were not able to recruit the outstanding researcher we needed to develop and direct the Walla Walla RM&E project to the required level of performance and credibility.

Standardize and Reduce Processes
We suggest that consistent standards for deliverables and proposal processes would improve projects throughout the Columbia River Basin. Without consistent standards, formats and processes, it may be impossible to complete contract deliverables on time each year because it will be impossible to know how many man-days are needed to complete the various processes.

The project proposal process has been different every year since 1993. For the most part CTUIR RM&E projects consist of basic long-term monitoring tasks and have changed little over the years. However, we have had a wide range of proposal formats and an even wider range of review comments. One year we were told that we had one of the best RM&E project proposals and that some of the material could be published in a reputable journal with only a little revision. Several years later, we submitted the same proposal with the latest proposal format. Reviewers eluded that it was a poor proposal and did not recommended the proposal for funding. Other comments made it clear that some ISRP members had not even read the proposal as they asked questions that we clearly addressed in the text. In light of these inconsistencies and other problems, we recommend that administrators and policy leaders consider the following suggestions:

1) Standardize BPA and NPPC processes and required formats. Maintain consistent proposal, budget and SOW standards and processes from year to year and from COTR to COTR. In this way the proposals, SOW and budgets can be completed correctly the first time, with only minor annual revisions related to actual changes in objectives and tasks.
2) Detail reporting formats and standards and maintain consistency between COTRs and between years.
3) Require all project leaders to complete and submit draft statements of work and budgets 15 weeks before the project start date (send to CTUIR administration and BPA COTR).
4) Require all BPA COTRs to review and edit draft SOW and budgets and return to Project Leaders will all comments 13 weeks before the project start date. Stop the endless cycle of review, change, review, change.
5) Require CTUIR administration to complete and submit to BPA all SOW and budgets 11 weeks before the project start date.
6) Require all BPA COTRs to review and edit the second draft of SOW and Budgets and return to CTUIR administration nine weeks before the project start date.
7) Complete final contract four weeks before project start date.
8) Mandate that the implementation of new processes and formats cannot be required

unless CTUIR administration and project leaders are notified, in writing, of such changes at least 20 weeks before the project start date. This will allow project leaders to develop just one version of SOW and budgets each year. Project leader time is much too valuable to be working on endless drafts of SOW and budgets.

There should be consistent, reliable, effective formats that are followed each year. The constant addition of new requirements by BPA and individual COTRs creates a huge waste of manpower and delays the entire process. If another great idea is developed in the middle of the process, it should be added to the list of changes for ***next year***. The new idea should not be allowed to muddle up and delay the current process. Huge improvements in process efficiency can and must be made. Streamlining processes into more efficient means is a worthy goal. However constant change and multiple reformatting is much less efficient than a consistent method that is not perfect.

I suggest a change in the process, format and procedures ***once*** (including purchasing and accounting). These changes should mimic proven and efficient techniques used in the private sector. These changes would allow more of the NPPC Fish and Wildlife Program funds to be directed to salmonid restoration. Once the change is made, the formats, processes and policy should be fixed so that maximum efficiency can be developed and maintained.

Currently only 43% of WWNPME project funds were spent on action items in 2002. The remainder was consumed by various processes. In 1993, 60% of project funds related to actual salmonid M&E tasks. That is a 16% percent reduction over all and a 28% reduction of project funds that reach the ground. Examination of total Fish and Wildlife expenditures, including costs for BPA, NPPC and ISRP staff, would show that only a small proportion of total program funds actually benefit salmonid recovery. It is my opinion that many of the problems that reduce project effectiveness are caused by inefficient and constantly changing administrative processes and policy. In the end, the fisheries and individual citizens pay the cost of these problems. I urge real and immediate change and action to solve these problems.

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CHAPTER EIGHT: RM&E PLANNING

RESEARCH, MONITORING AND EVALUATION PLANNING

THE WALLA WALLA BASIN NATURAL PRODUCTION MONITORING AND EVALUATION PROJECT

PROGRESS REPORT
1999-2002

Prepared By:

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INTRODUCTION

This draft Research, Monitoring and Evaluation Plan (RM&E Plan) was developed with Bonneville Power Administration (BPA) funds through the Walla Walla Basin Natural Production Monitoring and Evaluation Project (WWBNPME, Project Number 200003900). Funding by BPA was in accordance with and pursuant to section 4(h) of the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (P. L. 96-501) and 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. This draft RM&E plan will be available during the summer of 2003 at http://www.umatilla.nsn.us (CTUIR website).

Objective and Tasks
Objective I (Objective 7 of the 2002 statement of work) This chapter summarizes RM&E planning for the Walla Walla Basin during the contract year January 1, 2002 through December 31, 2002. This document should be considered an initial draft as it does not include contributions from the BPA, Columbia River Intertribal Fisheries Commission (CRITFC), Columbia Basin Fish and Wildlife Authority (CBFWA), Oregon and Washington Departments of Fish and Wildlife (ODFW and WDFW), the National Marine Fisheries Service (NMFS), and the US Fish and Wildlife Service (USFWS).

The approach and goal of work involved: 1) Summarizing past salmonid related RM&E (see Chapters 2-7); 2) Updating a prioritized list of information needs, and 3) working with fisheries managers and regulatory agencies to develop a comprehensive RM&E Plan to address the most important management information needs regarding salmonid restoration in the Walla Walla River Basin.

> *Task I.1* Work with ODFW and WDFW and write a synthesis of results of past RM&E efforts in the Walla Walla River Basin related to salmonid restoration and recovery.
>
> *Task I.2* Update RM&E priorities for salmonid management, restoration and recovery efforts in the Walla Walla River Basin
>
> *Task I.3* Coordinate with ODFW and WDFW on a draft RM&E plan for salmonid natural production monitoring in the Walla Walla Basin. Develop a comprehensive RM&E plan outline.
>
> *Task I.4* Submit draft natural production RM&E plan for review by fisheries managers, funding agencies and regulatory authorities.
>
> *Task I.5* Finalize natural production RM&E plan and combine with the other RM&E sections (i.e. hatchery and habitat RM&E sections)

REGIONAL RM&E STANDARDS AND GUIDELINES

This section summarizes the various regional RM&E standards, guidelines and frameworks mandated or recommended by various regulatory, management and/or funding agencies and groups.

Northwest Power Planning Council and the Independent Scientific Review Panel
The Northwest Power Planning Council (NPPC) and the Independent Scientific Review Panel (ISRP) developed standards and guidelines for research, monitoring and evaluation projects. They state that projects must have measurable, quantitative and biological related objectives. Projects must either collect or identify data that are appropriate for measuring the biological outcomes identified in the objectives. Projects that collect their own data for evaluation must make this data and accompanying metadata available to the region in electronic form. Data and reports developed with Bonneville funds are considered public information. Data and metadata must be submitted within six months of their collection. The methods and protocols used in data collection must be consistent with guidelines approved by the council.

The NPPC and ISRP have also formulated standards and guidelines for planning monitoring and evaluation efforts. They state that the RM&E plan must relate and identify monitoring and evaluation tasks associated with each objective. The plans must identify the individual researchers and the schedules of evaluation efforts. RM&E plans must document independent review of the plans if primary participants in planning are also the primary participants in the monitoring and evaluation effort. Plans must include a budget for the proposed monitoring and evaluation work. Local monitoring efforts should provide information that is suitable for evaluations on the subbasin and regional scales.

Regional Assessment of Supplementation Programs
Regional Assessment of Supplementation Programs (RASP) provided a monitoring and evaluation framework for supplementation efforts. They recommended that projects monitor in-hatchery performance, post releases survival, reproductive success, long-term fitness and ecological interactions.

National Marine Fisheries Service
In December 2002, National Marine Fisheries Service (NMFS) defined key research, monitoring and evaluation components and a framework for their reasonable and prudent alternatives (RPA) for their Biological Opinion (BiOp) (NMFS 2000) Endangered Species Act-Section 7 Consultation for the Federal Columbia River Power System (FCRPS). NMFS identified 199 RPA actions in the 2000 FCRPS BiOp of which actions 158-162 and 179-199 are specifically RM&E related. NMFS RM&E framework includes: 1) population and environmental status monitoring including the status and trends of fish populations, survival rates, and environmental attributes; 2) action effectiveness research; 3) critical uncertainty research, such as relative hatchery spawner reproductive success etc.; 4) implementation and compliance monitoring; 5) data management, regional data storage and access, and 6) regional coordination.

The Columbia Basin Fish and Wildlife Administration
The Columbia Basin Fish and Wildlife Administration (CBFWA) has proposed a system-wide monitoring and evaluation program to integrate local and regional fisheries RM&E efforts and to address the NMFS and the USFWS BiOps and Recovery Plans as well as the NPPC Fish and Wildlife Program. The CBFWA program will work collaboratively to integrate RM&E efforts by: 1) gathering and integrating regional data from local subbasins; 2) assessing the strengths and deficiencies of existing RM&E efforts in addressing key questions related to fish population monitoring and the evaluation of management actions, and 3) design improved RM&E projects with consistent performance standards and protocols to meet local and regional informational needs and fully address critical uncertainties.

The CBFWA proposal outlines the following three levels of RM&E activities: Tier 1, coarse monitoring; assess current and historical spatial distributions of fish and conditions of their habitats; examine associations between habitat and fish distributions, and identify subbasins or watersheds that may serve as references or controls for Tier 3 effectiveness evaluations. Tier 2, annual monitoring; assess status and trends of fish populations and their habitat using statistically robust and regionally consistent sampling designs and protocols; assess fish abundance and trends; determine survival rates of various life histories; determine measures of habitat best related to fish populations abundance and survival; asses status and trend of key habitat measures, and assess changes in fish distribution and relate to key habitat measures. Tier 3, explicit experiments; evaluate the effectiveness of specific recovery actions using fish based response measures, and reference and control conditions; evaluate habitat restoration efforts and other management actions designed to increase fish abundance and/or survival; utilize recent statistical design work and evaluation methods in the design, implementation and evaluation phases of studies examining habitat restoration efforts and other management actions, and evaluate harvest and harvest management effects on listed stocks

MANAGEMENT GOALS AND OBJECTIVES

The Confederated Tribes of the Umatilla Indian Reservation (CTUIR) has similar restoration goals and objectives for the Walla Walla River Basin as developed for the Umatilla River Basin. Both basins have experienced similar anthropogenic impacts and loss of anadromous salmonids. Salmon were extirpated by agricultural development in the Walla Walla basin in the 1900's. The most notable events were the construction and operation of irrigation projects. Restoration efforts in the Walla Walla Basin have or will include improving flows, enhancing adult and juvenile salmonid passage facilities, rehabilitating habitat, restoring spring Chinook[6] salmon (CTUIR), and supplementing steelhead (WDFW). The Walla Walla Subbasin Summary (James et al. 2001) includes

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

CTUIR's goals for salmon and steelhead adult returns (Table 1).

Table 8-1. Current natural and artificial production goals for each side of the Walla Walla River Basin as established by the Confederated Tribes of the Umatilla Indian Reservation.

Species/Location	Hatchery Production	Natural Production	Total
Adult Spring Chinook, Oregon Side	2,500	3,000	5,500
Adult Spring Chinook, Washington Side	Undetermined	Undetermined	
Adult Summer Steelhead, Oregon Side	1,000	1500	2,500
Adult Summer Steelhead, Washington Side	1,600	1,500	3,100
Total			11,100+

PRIORITIZED MANAGEMENT INFORMATIONAL NEEDS

Managers made a recent review of their informational needs related to monitoring, evaluation and research. Managers responded with a preliminary assessment and prioritization of management information needs (MIN). In some instances they also suggested the frequency and duration of RM&E efforts that address these questions and uncertainties. Priority rankings should be considered preliminary because we had not completed the estimated consequences of not addressing MIN or the estimated costs for each Study Action Item (SAI). Managers expressed concerns about the premature schedule of this plan given current processes that will provide information and direction to modify this document. WDFW has not yet participated in the development of this draft RM&E plan. ODFW research staff did not participate in the development of this draft RM&E plan or the prioritization exercise because they were in the middle of a ten year review and synthesis of Umatilla Basin Monitoring and Evaluation efforts. Enen with these difficulties, we remain committed to developing this initial plan to start the process and fulfill a contract obligation with BPA. This RM&E plan is preliminary and only began formally in November 2002. We expect considerable modifications and changes in MIN prioritization and SAI approaches once WDFW ODFW, NMFS and USFWS staff begin to contribute to the planning process (and review by ISRP, BPA, et al.) Furthermore, ongoing developments in regional RM&E standardization efforts (CBFWA Collaborative, Systemwide Monitoring and Evaluation Plan) will precipitate additional modifications through time. We expect to incorporate local and regional recommendations in ways that minimize the disruption of existing databases.

The MIN are organized into three basic categories: monitoring, evaluation and research. While the separation between these categories can be unclear, there are general differences in intensity, duration and approach used to address information needs and critical uncertainties in each category. Priority rankings (1-10) are denoted numerically within brackets [9] with noted qualifiers. A ranking of 10 denotes the highest priority.

The MIN listed under basic monitoring generally require longer-term data collections and relate mostly to basic accounting, trend analysis and general population status monitoring of both hatchery and natural salmonids. Data sets developed by these actions are frequently requested for a variety of reasons by a number of groups and agencies including Universities, NMFS, USFWS, ISRP, NPPC, BPA, Oregon and Washington Departments of Environmental Quality (ODEQ and WDEQ), Oregon Department of Transportation (ODOT), Bureau of Reclamation (BOR), and the US Forest Service (USFS). This information is important for adaptive management as well as developing and updating biological opinions, HGMPs, master-plans, annual operations plans and subbasin plans.

The MIN listed under the evaluation category can frequently be addressed periodically by using the data generated through routine efforts listed in the basic monitoring category. Other evaluation efforts in this category may require three to five year projects and include more intensive study designs, field sampling efforts, data analysis and reporting. The products from these evaluation efforts include annual reports, formal presentations, and published articles in refereed journals.

The MIN listed under the research category frequently require the assistance of experts and specialized equipment, facilities and methods. Research projects in this category normally require complex study designs, rigorous statistical analysis and innovative techniques including advanced modeling. The products from these evaluation efforts include annual reports, formal presentations, and published articles in refereed journals.

Basic Monitoring Questions
Priority rankings are denoted numerically within brackets [9] with noted qualifiers in various places depending on the scope and range of the qualifier. MIN are ranked from 1 to 10, with 1 denoting low priority.

<u>MIN-1 Adult Returns/Population Estimates</u>

MIN-1.1 [10] How many adult salmon and steelhead return each year to the upper Walla Walla River, Touchet River and Mill Creek by species and stock; and how many bull trout and mountain whitefish are present in the basin?
MIN-1.2 [8] What is the run timing of each species and stock for each year?
MIN-1.3 [9] What are the sizes and ages of adult returns?
MIN-1.4 [9] What is the final disposition of adult steelhead and salmon returning to the Walla Walla Basin.

MIN-2 Spawning Surveys

MIN-2.1 [10] What is the distribution and abundance of adults and redds in the Walla Walla River Basin each year for spring Chinook, steelhead and bull trout?
MIN-2.2 [8] What is the spawn timing of each species?
MIN-2.3 [7] What proportion of redds were made by hatchery females?
MIN-2.4 [7] What proportion of the steelhead/rainbow and bull trout spawners had resident, fluvial or anadromous life histories each year?
MIN-2.5 [8] What is the size and age of salmon, steelhead, bull trout and rainbow trout spawning naturally in the basin?

MIN-3 Spring Chinook Carcass Surveys

This is related to the adult-out-planting program

MIN-3.1 [9] Were there any naturally produced adult spring Chinook spawners?
MIN-3.2 [9] What was the egg retention and proportion of pre-spawn mortalities by reach?

MIN-4 Juvenile and Resident Salmonid Abundance Surveys

MIN-4.1 [9] What is the relative abundance and distribution of salmonids, by species, seasonally, throughout the basin?
MIN-4.2 [9] What are the summer densities of salmonids, by species, throughout the basin?
MIN-4.3 [9] What are the sizes, age and growth rates of salmonids, by species throughout the basin?

MIN-5 Smolt and Parr Outmigration Monitoring

MIN-5.1 [9] What is the timing of parr and smolt outmigrations, by species and stock?
MIN-5.2 [10] What is the total abundance of salmonid outmigrants, by species and stock?
MIN-5.3 [9] What is the survival of salmonid outmigrants to McNary Dam and the lower Columbia River, by species and stock?

MIN-6 [5] Fish Habitat Surveys

Min-6.1 What are the conditions, trends, quantities and connectivity of various salmonid habitat types in the basin?
Min-6.2 Are fish habitat conditions improving or degrading and what are the rates of change by stream and reach?

MIN-7 Water Temperatures

MIN-7.1 [8] What are the water temperatures in the basin from the mouth to the headwaters, May through October?
MIN-7.2 [5] What are the water temperatures in the basin during the winter?

MIN-8 Harvest

MIN-8.1 [9] What was the annual sport harvest of salmonids by species in the basin?
MIN-8.2 [9] What was the annual tribal harvest of salmonids by species in the basin?
MIN-8.3 [9] What was the annual out-of basin harvest of Walla Walla Basin origin salmon and steelhead?

MIN-9 Straying

MIN-9.1 [8] What are the stray rates of Walla Walla Basin steelhead and salmon into other basins?
MIN-9.2 [8] How many salmon and steelhead stray into the Walla Walla Basin each year from other basins, by species and stock?

MIN-10 Hatchery Program Monitoring

MIN-10.1 [9] How many broodstock were collected, where, when and how, including sizes and condition?
MIN-10.2 [9] How, where and when were adult broodstock held prior to spawning, including numbers, sizes and condition?
MIN-10.3 [9] How, where and when were broodstock artificial spawned, including numbers, sizes and condition?
MIN-10.4 [9] How, where and when were eggs incubated?
MIN-10.5 [9] How, where and when were fry and parr reared, including numbers, sizes and condition?
MIN-10.6 [9] How, where and when were parr and smolts acclimated and/or liberated, including numbers, sizes, and condition?
MIN-10.7) [9] What was the disease and treatment history of each life history stage?

Evaluation Questions

MIN-11 Adult Migration Evaluations of Steelhead, Salmon and Bull Trout

MIN-11.1 [10] How well do steelhead, salmon and bull trout negotiate the passage facilities, especially through the lower Mill Creek-Yellowhawk Creek complex.
MIN-11.2 [10] Are there delays at passage facilities, and if so, how many, where, when and under what conditions?
MIN-11.3 [9] What is the average passage time at each passage facility and between facility reaches?
MIN-11.4 [8] What are the migratory patterns, distributions and maximum upstream ranges of migrants?
MIN-11.5 [5] What is the average daily movement by species, month and reach?
MIN-11.6 [10] How do flows, temperatures, seasons, facility operation and other factors affect adult migration?

MIN-12 Juvenile Passage Facility Evaluations

MIN-12.1 [5] How well do downstream migrants negotiate the passage facilities?
MIN-12.2 [5] Are there delays, injuries and mortalities at passage facilities, and if so, how many, where, when and under what conditions?
MIN-12.3 [5] What are the passage times, injury rates and mortality rates at each passage facility and between facility reaches?
MIN-12.4 [5] What is the average daily downstream movement by species, month and reach?
MIN-12.5 [5] How are migratory patterns influenced by flows, temperatures, seasons, facility operation and other factors?

MIN-13. Salmonid Productivity, Fitness and Survival Rates

MIN-13.1 [9] What are the primary factors that influence adult to adult production and survival rates?
MIN-13.2 [9] What are the primary factors that influence the egg to smolt (or parr) survival rates?
MIN-13.3 [9] What are the primary factors that influence smolt (or parr) to adult survival rates?
MIN-13.4 [9] What is the natural production capacities for each sub-watershed in the basin?
MIN-13.5 [9] What is the optimum adult escapement for natural production for each species?
MIN 13.6 [6] How does salmonid natural productivity and capacity in the basin compare to neighboring basins?

MIN-14 Interactions between Fish and Habitat

MIN-14.1 [8] What are the primary physical, chemical, and climatic factors and relationships that influence survival, productivity, condition, abundance and distribution of each species, stock and life history stage?
MIN-14.2 [8] How effective are various physical habitat management and restoration actions and strategies in improving survival, productivity, condition, abundance and distribution of each species and stock, by life history stage and reach?
MIN-14.3 [8] What habitats are the most important to rehabilitate, maintain and preserve?
MIN-14.4 [6] What are the most cost effective and most reliable management actions that restore and preserve critical habitats?
MIN-14.5 [6] What and where are the landscape scale problems affecting fish habitat?

MIN-15 Optimal Hatchery Practices

These questions may have different answers depending on the management objectives and whether the questions are in regard to hatchery efficiency or related to reducing potential risks to natural stocks, etc. Some of these MIN were ranked low because of completed studies. Other MIN are related to ongoing evaluations in neighboring basins that reduce the urgency of similar studies in the Walla Walla Basin.

MIN-15.1 [9] What are the processes, standards and criteria needed to develop hatchery practices that balance the needs to be efficient, cost effective and minimize ecological and genetic risks to natural and hatchery stocks?

MIN-15.2 [2] What are the best stocks to use for each species for the hatchery programs?

MIN-15.3 [4] What are the best strategies and methods to collect broodstock for hatchery programs for each species and stock?

MIN-15.3 [6] What are the best methods to hold and spawn broodstock for each species and stock?

MIN-15.4 [7] What are the optimal breeding practices for each species and stock?

MIN-15.5 [8] What are the optimal incubation practices for each species and stock?

MIN-15.6 [8] What are the optimal rearing methods for each species, stock and life history stage?

MIN-15.7 [8] What are the optimal growth and feeding rates for each species, stock and life history stage?

MIN-15.8 [6] What are the optimal times, methods, and protocols for tagging hatchery reared fish for each species and stock?

MIN-15. 9 [8] What are the optimal sizes, times, locations and conditions to liberate hatchery reared fish into the basin.

MIN-15.10 [6] For each relevant disease, what are the best disease management practices for the prevention and treatment of each species, stock and life history stage?

MIN-16 Evaluate Similarities and Differences between Hatchery and Natural Fish

MIN-16.1 [8] What are the similarities and differences in the sex ratio, fecundity, run timing and spawning time of adult hatchery and natural steelhead and Chinook?

MIN-16.2 [8] What are the similarities and differences in size, age, migration timing, migration survival and smoltification of hatchery and natural steelhead and Chinook?

MIN-16.3 [8] What are the similarities and differences in genetic characteristics of hatchery and natural steelhead and Chinook?

MIN-16.4 [6] What are the similarities and differences in the types, incidence and severity of diseases in hatchery and natural steelhead Chinook?

MIN-17 Harvest Related Evaluations

MIN-17.1 [7] What are the cumulative affects of harvest management on wild steelhead and bull trout?

MIN-17.2 [6] What are the most cost effective and statistically robust harvest monitoring strategies and protocols for the sport and tribal fishing seasons?

Research Questions

MIN-18 Genetic Studies

MIN-18.1 [9] What are the general genetic characteristics and geographic stock structures of steelhead and Chinook in the Walla Walla and surrounding subbasins?

MIN-18.2 [9] What is the rate of change in the genetic characteristics of the various steelhead and Chinook stocks through time?

MIN-18.3 [7] How variable are changes in genetic characteristics and what are the magnitudes, frequencies and permanence of the changes?

MIN-18.4 [9] Are there negative or deleterious changes (based on current genetic theory) to the genetic characteristics of Walla Walla steelhead and Chinook stocks?

MIN-18.5 [6] How are management actions, population dynamics, straying and other factors related to changes in the genetic characteristics of each salmonid stock?

STUDY ACTION ITEMS

The task of writing this plan was delineated in Objective 7 of the 2002 statement of work and was formalized through a contract dated November 11, 2002. However, this objective was not completed as planned. The revised schedule calls for an improved draft in August and a completed plan by the end of 2003. This draft RM&E plan should be considered a premature working document. It may be a useful tool for review and constructive criticism in the development of improved drafts. Current adaptive management forums and processes will continually modify the draft through the coordination of local and regional managers. Considerable progress is expected when the new project leader is hired. We also expect additional regional review of this plan and the associated modifications that will follow after we receive suggestions from ISRP, BPA, ODFW, WDFW, USFWS, NMFS et al.

Managers prioritized the MIN above to best assist with the adaptive management of salmonid restoration and recovery programs in the Walla Walla River Basin. RM&E teams will continue to develop plans, approaches, experimental designs, objectives, tasks, methods, protocols, work statements, budgets, schedules, performance standards, reports, presentations and publications to address the most important MIN. RM&E teams endeavor to utilize reasonable and cost-effective approaches and protocols to answer management questions with sufficient accuracy and precision. Deliverables will also be in regionally compatible formats once regional standards are established.

The wide spectrum of salmonid management philosophies and restoration objectives will likely generate considerable differences of opinion in MIN prioritization. Given the large number of high priority MIN, we suggest that the MIN be re-prioritized by a broader range of managers and with greater scrutiny during future revisions of this plan. Recent ISRP comments suggest that priority rankings would be considerably different if ISRP ranked the MIN. We also suggest that each MIN be ranked with and without consideration of the cost and duration of Study Action Items (SAI). Some MIN can be addressed through staggered and/or rotating SAI. Research teams could work through these SAI in 3-5 year cycles. Some SAI could be repeated every 9 to 15 years depending on priority. Some SAI would occur once, others would be continuous. Advantages of staggered and rotating SAI would be to keep costs down and to maintain quality staff. Study Action Items are organized in a similar manner as the MIN above. The SAI below are incomplete and not fully developed.

Basic Monitoring SAI

SAI-1 Estimate Adult Returns

Determine the number, run timing, size and age of adult salmon and steelhead returns to the upper Walla Walla River, Touchet River and Mill Creek. Determine the abundance of adult resident rainbow trout, bull trout and mountain whitefish.

SAI-1 Summary: SAI-1 is a basic monitoring activity and addresses MIN-1.1-1.4 which managers gave priority rankings of 10, 8, 9 and 9 respectively (section 4.1). SAI-1 will document the adult returns if anadromous fish and adult population of resident salmonids. Determine if goals are being met in terms of numbers, and whether run timing, and size and age characteristics are changing over time.

Consequences without SAI-1: Without SAI-1 managers will not know the numbers, run timing, sizes or age characteristics of adult salmonid in or returning to the Basin. They could not evaluate salmonid restoration efforts in the Basin, or changes in run timing, size and age characteristics of each stock.

MPSM: Related Management Performance Standards and Measures (MPSM) for MIN-1.1-1.4 are the adult return goals for each species (11,100 adult salmonids combined, Table 1). There are no specific size or age standards but there is a goal to maintain general run timing, and size and age structures through time.

Past Efforts: Monitoring for SAI-1 has been conducted by WDFW, CTUIR and ODFW. The run counts are incomplete and are collected at Nursery Bride Dam Ladder, Yellowhawk and Mill Creek traps and at the Dayton trap on the Touchet River.

SAI-1 Goal and Approach: The goal is to estimate salmon, steelhead, bull trout and mountain whitefish for the upper Walla Walla River, Mill Creek and the Touchet River. Because fish weirs are problematic, trapping will be minimized. Video taping in the Nursery Bridge Dam ladder and basin wide spawning surveys may be used to estimate adult abundance.

SAI-2 Spawning Surveys

Determine adult spawner abundance, natural spawning success, spawning habitat utilization, prespawning mortality, and redds per adult spring Chinook salmon (CHS), summer steelhead (STS) and bull trout in the Walla Walla River and tributaries.

SAI-2 Summary: SAI-2 addresses MIN-2.1-2.5, which were given priority rankings of 10, 8, 7,7 and 8 respectively. SAI-2 is a basic monitoring effort to estimate adult escapement and record the number and location of redds.

Consequences: Not addressing this MIN would create a general lack of information regarding adult returns and natural spawning activities. For the Walla Walla Basin, spawning surveys are the only consistent source of information for adult population abundance estimates. Spawning survey data are also the primary monitoring tool used in most Columbia subbasins to monitor adult returns.

Summary of Past Efforts for SAI-2: Spawning surveys have been conduced by WDFW, ODFW, USFWS, and CTUIR. Bull trout spawning surveys are the most complete for the Oregon side of the basin. Spring Chinook spawning surveys during 2000, 2001 and 2002 were fairly extensive in the reaches where adults were out-planted. The most consistent steelhead spawning surveys was conducted by WDFW in Washington. On the Oregon side of the basin, CTUIR and ODFW have conducted preliminary surveys without consistency or a formal study design.

Goal and General Approach: The goal is to enumerate bull trout, steelhead and spring Chinook salmon and their redds in a consistent manner throughout the respective spawning seasons across the entire basin. For CHS most of the spawning habitat localized and is surveyed entirely each week and a complex sample design is not needed. For STS and bull trout, w propose to adopt a sampling strategy that combines an unbiased sample design across the basin in a rotating panel design as described by Firman and Jacobs (2001). An important goal of the new survey design is to provide the best coverage with the least cost. One main benefit to this approach is that our steelhead data will be directly comparable (and nest into) regional data sets that use the same stratified-random sample design (John Day and possibly others in coming years). This is an important consideration, because our goal is to make all our RM&E products compatible with both local and regional MIN.

Methods: For STS and bull trout, we will work with ODFW and WDFW to randomly pre-select sites and alternates according to protocol developed by Don Stevens, Tony Olsen, Phil Larsen and Tom Kincaid of the U.S. Environmental Protection Agency, Corvallis, Oregon (see Firman and Jacobs, 2001, Jacobs and Nickelson 1998, Riggers et al. 1999, and Jacobs et al. 2001). We will produce a master list of pre-selected sites and alternates. During the winter (Dec- Mar), we will contact landowners, visit and mark survey areas, use pre-selected alternates for sites where landowner permission is denied or otherwise unsuitable, and train staff.

Survey methods will follow regional standard once they are established in order to compare between basins. We will conduct spawning surveys and document the number and location of redds and examine carcasses in the index and random sites as conditions and landowners allow. Crews will estimate survival to spawning and total egg deposition for steelhead and spring Chinook; collect and record length, sex, pre and post-spawn mortality data, coded wire tags, marks, fin clips, kidney samples and scales from the appropriate spring Chinook carcasses examined on the spawning grounds; summarize the data and vital statistics of bull trout, spring Chinook and summer steelhead in table and text report format, and submit coded wire tags, associated data and other information collected for ODFW and Pacific States Marine Fisheries Commission (PSMFC)

The new protocol for steelhead will require crews to walk one to four one-mile reaches each day, spread out over a larger area. Some of the more remote sites will require a full day to access and sample. Crews will walk alone along the margins of the smaller tributaries or in pairs on opposite banks of larger streams. Surveyors will wear polarized glasses to assist observation. To minimize stress on prespawning salmonids, we will not probe debris jams or throw rocks into holding pools. Poor water conditions or landowners may prevent surveys at certain times and locations.

Redds are judged to be complete based on redd size and depth, location, and amount and size of rock moved. All redds are reviewed by our most experienced surveyors for consistency. Orange flagging is tied to trees nearby to mark redds. The flagging is labeled with the date, location, species and number of males and females observed on or near the redds. Crews also record information in data books or data loggers. For each redd, surveyors record the stream name, location, date when the redd was first observed, sex and number of fish observed on or near the redd, carcasses sampled in the areas, and habitat type. Carcasses found during the survey are measured from the middle of the eye to the hypural plate (MEHP). Fork length is also recorded if severe caudal fin erosion has not occurred. We describe obvious injuries and attempt to determine the cause of death in prespawning salmonids. We cut open carcasses to determine egg retention of the females and spawning success of the males. Prespawning mortality is defined as death of a fish before spawning. Females with egg retention estimated near 100% and males with full gonads are classified as prespawning mortalities. Tails of sampled fish are removed at the caudal peduncle to prevent re-sampling.

We collect snouts from salmon and steelhead carcasses with coded wire tags (based on fin clips). The snout is removed by cutting through the head from behind the orbit and down to the mouth. Snouts are placed in plastic bags and given an individual snout number for identification. Snouts and accompanying biological data are sent to ODFW's Mark Process Center in Clackamas for coded wire tag extraction and reading. If requested by ODFW, kidney samples are collected on the spawning ground from spring Chinook salmon that have been dead for less than 48 hours. Samples are frozen and taken to the ODFW pathology laboratory in La Grande, Oregon for analysis and reporting.

Study Performance Standards and Measures (SPSM): 1) Sample each site every 7 to 10 days during the spawning season; 2) Accurately and completely record all required information on data sheets for each visit to each site and make daily backup copies of each data sheet; 3) Maintain errors of spawning abundance estimates within 20%.

Reporting: Prepare data summaries and report findings. Examine if SPSM were met and discuss all spawning survey data in relation to MIN, MPSM, past data and results from neighboring basins.

Potential Problems and the Probability of Success: There are few problems associated with spring Chinook and bull trout spawning surveys. While work can be physically challenging due to terrain and climatic conditions, potential problems are minimal and success is highly probable. Most spawning areas of both species are readily accessible with very few landowner issues. Consistency in redd classification can be problematic between surveyors. Currently, Paul Kissner, CTUIR's most experienced surveyor, reviews all new redds. Paul has decades of spawning survey experience. After Paul Kissner retires, there may be some consistency issues develop for several years while experience is gained.

Steelhead spawning surveys have a number of potential problems that frequently postpone and limit data collection. Steelhead spawn in a wide area from the headwater tributaries to the mainstem. Steelhead spawning survey conditions can be highly variable and freshets can easily hide redds. High flows and associated turbidity often prevent spawning surveys. Access to private land is also a problem, because steelhead spawning distribution is broad and almost basin-wide.

Man Days Needed: We estimate that SAI-2 will require approximately 345 man days each year. Current spring Chinook spawning surveys in the Walla Walla Basin require 55 man-days in the field for full coverage. We expect that the new method for steelhead will require 170 days in the field each year. Additional effort will be required to contact landowners, find the sites, and mark them prior to spawning surveys. Bull trout spawning surveys in the Walla Walla Basin require 55 man days in the field. Writing proposals, study plans, budgets, ESA permit applications and reports, and project reports also require additional effort. WDFW, CTUIR and ODFW managers may need separate steelhead escapement estimates for the Touchet, Walla Walla and Mill Creek systems. This would add an additional 300 man days/year for steelhead surveys.

Schedule: Establish randomized sample sites for STS and bull trout surveys based on the rotating panel design, contact landowners and train crews (December to March). Conduct summer steelhead spawning surveys March through June

(CTUIR, WDFW). Conduct spring Chinook spawning surveys during August and September (CTUIR, WDFW). Conduct bull trout spawning surveys from September through November (ODFW, WDFW and USFWS). Digitize and summarize data within 60 days of collection. Complete the spawning survey section of the annual report by and post online by April of the following year. Deliver coded wire tag data, mark data, pathological samples, and other information to the appropriate agency with 60 days of collection.

Special Equipment Needed: None

<u>SAI 3 Carcass Surveys</u>
Examine spring Chinook carcasses on spawning grounds.

Summary: SAI-3 is an ongoing monitoring activity and addresses MIN-3.1-3.2. It was given a priority rank of 9. Related CTUIR management goals include the restoration of naturally producing spring Chinook salmon in the basin. Spawning surveys are associated with the adult out-planting projects..

Consequences: Consequences of ending carcass surveys for spring Chinook salmon would impact the evaluation of the adult out-planting project.

Summary of Past Efforts: CTUIR has conducted carcass surveys in the upper Walla Walla River and Mill Creek during 2000, 2001 and 2002.

Goal and General Approach: The goal for spring Chinook is to examine as many carcasses as possible to determine spawning success by reach and to recover CWT, scales, lengths and other data.

Methods: The carcass survey related details in the spawning survey methods and protocols are the same for SAI-2.

Study Performance Standards and Measures: Sample carcasses from each reach every 7 days from August through September. We try to examine the carcasses from at least 50% of the adults released into the Walla Walla River and Mill Creek.

Reporting: Prepare data summaries and report findings each April. Examine if SPSM were met and discuss all spawning survey data in relation to MIN, MPSM, past data and results from neighboring basins.

Potential Problems, Probability of Success: Carcass surveys for spring Chinook present very few problems. Probability of success is high. Carcass surveys can require considerable effort, during peak spawning on heavy return years. Sometimes double crews are required to meet performance standards. Bears can also be abundant, remove large numbers of carcasses, and can be perceived as a threat by surveyors.

Man Days Needed: Spring Chinook carcass surveys will not require additional personnel as crews conducting spawning surveys will be able to sample carcasses in the Walla Walla Basin until adult returns increase significantly.

Schedule: August through September

<u>SAI-4 Juvenile and Resident Salmonid Abundance Surveys</u>

Summary: Juvenile abundance surveys are an ongoing monitoring activity and addresses MIN-4.1-4.4 which ranked 9 in priority in all four subsections. Primary interest in this action is related to trends in abundance, distribution and species composition but also includes interest in carrying capacity, seeding rates, interactions between species, and natural production goals for reintroduced salmon and endemic steelhead. Existing design and protocol need modification. The primary change might be from fixed index site sample design to a stratified-random panel design as described by Firman and Jacobs (2001) and Rodgers (2000) and recommended by ISRP.

Consequences of ending SAI-4: Surveying juvenile salmonids through time provides inference to the natural reproductive success of reintroduced salmonids and documents the expansion and contraction of suitable habitat associated with changes in land-use, riparian features and climate. The documentation of juvenile salmonids produced by hatchery reared salmon is a key step in understanding the potential and limitations of this strategy. Monitoring juvenile salmonids is also important in evaluating the response of endemic steelhead juveniles to the reintroduction of salmon fry and parr in natural rearing areas.

Summary of Past Efforts: CTUIR began seasonal presence/absence surveys in the Walla Walla basin in 1993. However, other than salvage efforts associated with irrigation dewatering, sampling did not resume sampling until 1999. In 2002, ISRP recommended the abandonment of existing sampling strategies and the adoption of methods described by Rodgers (2000). Rodgers methods are superior for certain RM&E questions but are inadequate for others. Under the direction of BPA staff, CTUIR sampled several sites throughout the Umatilla and Walla Walla Basin using the old techniques and the techniques recommended by ISRP as described by Rodgers (2002). There were advantages and problems associated with both methods. Methods developed by Glen Mendel (2002), combined with those used by CTUIR and Rodgers will likely provide the most effective methods and maintain consistency between watersheds and across state lines.

Early in the development of the CTUIR RM&E projects, CTUIR examined stratified random sampling and dismissed it because of a host of problems that would bias the design. For example, landowners prevent access to large areas, so obtaining a true unbiased sample design is impossible. We knew that collecting information from different sites each year from only part of the basin would further violate the strengths of a stratified-random design. We would have unequal sampling of various habitat types. Furthermore, we knew that each sampling technique had its own biases. Those biases were also variable between different habitat types. We estimated smaller overall bias and uncertainty could be obtained by holding both the methods and locations constant. This seemed reasonable because were more interested in year to year variation associated with adult spawners and climatic conditions of stream reaches than we were in annual estimates of juvenile production basin-wide. We knew this concept and design would preclude the annual basin-wide salmonid estimates but it would provide more consistent data for trend and population dynamics information at selected sites. Because fish abundance can change dramatically with habitat features on both large and small scales, CTUIR selected permanent sites at more stable areas for the fixed index sites. Additional presence/absence surveys conducted throughout the basin documented fish distributions seasonally.

CTUIR did not give up on estimating total abundance and production potential of the basin. We used ODFW habitat survey methods to stratify reaches into individual habitat features in the Umatilla Basin and initiated similar efforts in the Walla Walla Basin. We used a modified Hankin and Reeves (1988) approach and estimated salmonid densities in 5-20 % of each habitat type. We then expanded the estimate based on the quantity of each habitat type. This was done for Elbow Creek, a tributary of the S.F. Walla Walla River. Habitat surveys we conducted on 9 miles of the S.F. of the Walla Walla River but salmonid abundance surveys were not conducted.

Goal and General Approach: The primary goal is to document abundance, densities, distributions, species composition in a statistically robust, reliable and cost effective manner using snorkeling and electrofishing techniques.

Methods: CTUIR has used a number of methods to examine juvenile salmonid abundance and distribution over the years throughout the neighboring Umatilla Basin (presence/absence, modified Hankin and Reeves, CPUE index sites, and density index sites). In 2000, ISRP found CTUIR methods unsuitable during the last provincial review process. During the summer of 2002, we documented that CTUIR methods (Contor et al. 2000) and those described by Rodgers (2002) were both inadequate in consistently assessing juvenile salmonid abundance across different habitat types.

Useful annual basin-wide salmonid abundance estimates require a number of key components. A primary requirement is an unbiased sample design. Theoretically, there will always be some bias in every sample design in the real world; however certain designs are more effective at minimizing or at least randomize that bias. This is the goal of ISRP in recommending the stratified-random design and methods described by Rodgers (2000). A second primary requirement is that each site is sampled in an equal manner and results reflect true abundance or at least has similar biases in estimates for all sites. The effectiveness and bias of every sampling method is variable between different habitat types. Rodgers (2002) solved the problem of assessing abundance in various habitats by ignoring all but one class of habitat. His methods only samples pools greater than 40 cm deep. Hankin (1984, 1986) and Hankin and Reeves (1988) solved the problem another way by stratifying by individual habitat type. CTUIR used a modified Hankin and Reeves method when estimating population abundance in large stream reaches associated with physical habitat surveys (Contor et al. 1995, 1996, 1997, 1998, 2000). However, the Hankin and Reeves method is too labor intensive to conduct every year (basin wide) without significant modification.

Snorkeling selected pools in Walla Walla Basin streams as described by Rodgers (2000) does not appear to be an effective technique for O. mykiss. Juvenile steelhead and rainbow trout can be very abundant in fast water habitats, (Contor et al. 1995, 1996, 1997) they can also conceal themselves during the day (Mullen et al 1992, Contor and Griffith 1995), and they may also move into and out of pools to feed. Furthermore, may of the stream reaches in this area lack pools greater than 40 cm deep. Typically we see a few larger rainbows dominating pools. Many of the younger age classes are found outside of the deeper pools.

Other monitoring projects in the region have tried different approaches. For example; Glen Mendel (2002) of WDFW conducted juvenile abundance monitoring in the Washington portion of the Walla Walla Basin. Mendel used snorkeling and electrofishing based on habitat features. Pheadra Budy et al. of the USFWS utilized body tags and visual recapture techniques during snorkeling. CTUIR suggests that each approach has valuable components that should be synthesized into a standardized methodology that would be effective in a broad range of habitat types.

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

Study Performance Standards and Measures (SPSM): to be determined.

Reporting: Findings will be examined and discussed in relation to MIN-4. Trends from multiple years will be examined in relation to adult spawners, relative abundance, climatic conditions, flow, temperatures, and physical habitat condition. Data generated by this SAI are used in other evaluations but the specific methods and results of analysis for those efforts are discussed separately

Potential Problems, Probability of Success: It will be difficult to develop a sampling strategy and protocol that will be approved by ISRP, BPA, ODFW, CTUIR and WDFW so that a consistent approach can be deployed region wide.

Man Days Needed: This is dependant on the sample design, including the number, size and location of sites including the methodology used. Interim monitoring requires approximately 115-120 man days/year if automated data entry tools are used in the field. An additional 10 man days are needed if data is entered by hand from field data sheets.

Schedule: This is also dependant on the final sample design. If seasonal distribution and abundance information is required, sampling could occur during three seasons. Interim monitoring will be conducted during July and August.

Special Equipment Needed: The project has the necessary equipment including contemporary electrofishers, dry suits, masks, snorkels, and hand-held data loggers. Boat electrofishing gear for larger systems is not available. It is also unlikely that the services would permit the use of boat shockers.

<u>SAI-5 Smolt and Parr Outmigration Monitoring</u>

Summary: SAI-5 monitors parr and smolts leaving the Walla Walla Basin and addresses MIN 5.1-5.3 regarding their timing, abundance and survival, which were ranked 9, 10 and 9 respectively. High priority was placed on abundance estimates for total smolt abundance by species because it is a key life history stage. Once smolt production is know for each year, estimates of adult to egg, egg to smolt and smolt to adult survival can be calculated. These estimates can be used to develop a better understanding of limiting factors and how flow augmentation, passage facility operations and other factors influence salmonid survival at different life history stages. Salmonid production and life history modeling also requires this information and is frequently used to predict effects of proposed management action. This SAI is related to goals for adult returns and natural production. Understanding out-migration abundance, timing, and survival of parr and smolts from the headwaters to TMD and the lower Columbia River will assist managers in optimizing instream flow augmentation, passage facility operations and other management actions.

Consequences: Not evaluating smolt out-migrations would require managers to work with adult to adult survival and it would preclude the ability to separate the different life history stages to see where bottlenecks and other problems may exist. Multiple years are required for these types of evaluations because limiting factors can be variable from year to year in association with different flows, weather, management actions etc.

Summary of Past Efforts: CTUIR began collecting and PIT tagging out-migrants in 2001 (see Chapter 2).

Goal and General Approach for SAI-5: The goal is to estimate salmonid outmigration abundance for spring Chinook primarily and steelhead if conditions allow. The spring Chinook evaluation is related to the adult out-planting experiment.

Methods: Crews capture and PIT tag salmonids at smolt traps. Catch data and trap efficiency rates are used to estimate abundance, migration timing and relative survival of out-migrating parr and smolts. Crews PIT tag juvenile Chinook and steelhead greater-than 75 mm. Fish are anesthetized with MS222 (tricaine methane-sulfonate) and tagged by hand with sterile syringes. PIT tagged fish are measured, held for observation and released. The appropriate tagging and release files are submitted to PTAGIS according to the procedures detailed in the most recent PIT tag specification document. After the out-migration year is completed, staff extract detection data from the PTAGIS database and examine survival and arrival times to the different detection facilities for each tag group.

Abundance is estimated by multiplying total catch by the inverse of the trap efficiency estimate for relatively uniform time blocks and then combining the estimates for each sub-set for the over all abundance estimate.

Estimates for minimum smolt survival from tagging to detection at McNary, John Day, The Dalles and Bonneville Dam are based on PIT tag detections and overall detection rates at each dam. If adult returns are adequate, smolt to adult survival rate (SAR) of natural spring Chinook and steelhead will be estimated with the following formula:

$$SAR = \left[\frac{T}{\frac{R - 1}{C}} \right] (TRR)$$

Where
T = Number of PIT tagged individuals released.
R = Number of unique PIT tagged adults (Walla Walla origin) observed returning at either the Columbia River dams and at TMD.
C = Total number of tagged and untagged natural adults observed at TMD.

TRR = Mean tag retention rate.

We assume that most of the tags will be retained and function at the lower river detection sites even though only a small proportion may be detected. We will use a compilation of the most recent PIT tag retention studies as the assumed tag retention rate for adult salmon. For a functional estimate of smolt to adult survival, we need at least 20 adult detections but more detections would improve the estimate. If smolt to adult survival were 1%, we would need to tag at least 2000 smolts. During the 2002-2003 season we tagged over 3500 spring Chinook migrants. The installation and operation of adult detectors in the mainstem dams is a critical element for smolt to adult survival estimates. After we obtain initial results, we will determine the utility of this evaluation technique and make appropriate adjustments.

Reporting: Findings will be examined and discussed in relation to MIN-5.. Trends from multiple years will be examined in relation to adult spawners, relative abundance, climatic conditions, flow, temperatures, and physical habitat condition, and results of analysis for those efforts are discussed separately

Potential Problems, Probability of Success: It is difficult to meet standards required for quality mark recapture estimates more than half of the time. There are generally large uncertainties related to the outmigration estimates and estimates of confidence intervals. It is often difficult to recapture enough parr during both high and low flow events to produce reliable estimates for those times. This is also true at the beginning and end of the outmigration season. Problems also occur during icing, low flow, and floods when debris loads are heavy.

Man Days Needed: 380 man days/year for trapping and tagging in the Walla Walla River. 35 man day/year for data summarization and reporting.

Schedule: Trap from November through May. Digitize and summarize data within 10 days of collection. Submit data to PSMFC's PIT Tag Information System (PTAGIS) within 15 days of collection. Retrieve detection files and collate data by September. Complete results and discussion portions of the annual report by the following April.

Special Equipment Needed: The project has the necessary equipment, including smolt traps, PIT tagging equipment and detectors, laptop computer, PTAGIS software, internet service and PIT tags.

SAI-6 Fish Habitat Inventories

Fish habitat inventories were ranked 5. There may be greater interest if habitat surveys are combined with the stratified random juvenile monitoring surveys. However, there does not appear to be much support for the traditional intensive habitat surveys conducted in Elbow Creek 93. Managers recognize the importance of quality aquatic habitat for salmonids and have a fairly good understanding about the condition of aquatic habitats throughout the Walla Walla Basin. This SAI was not developed because of its low ranking. IF this SAI is developed CTUIR will employ regional standards and protocols if developed. Work would likely follow that described by Moore (et al 1993) and include consideration of methods and protocol in the habitat monitoring methods synthesis and review put together by Johnson (et al 2001).

SAI-7 Water Temperature Monitoring
This is a basic monitoring activity and it addresses MIN-7.1 and 7.2 which were ranked 8 and 5 respectively. Managers expressed more interest in water temperature monitoring if directly related to specific actions. This SAI was not developed as CTUIR RM&E will no longer monitor water temperatures in the Walla Walla Basin after 2002. Current water temperature monitoring in the Walla Walla Bain is conducted by ODEQ, WDFW, WDEQ, WWWC, USFWS, USFS and others. This SAI is already developed in other documents.

SAI-8, Harvest Monitoring
Harvest monitoring addresses MIN-8.1-8.3 which were each ranked 9. Harvest opportunities have always been important management goals for CTUIR, WDFW and ODFW for salmonids in the Basin. WDFW currently conducts harvest monitoring on the LSRCP steelhead hatchery program. There is an established study plan associated with that SAI.

SAI-9 Adult Salmon and Steelhead Straying
Associated MIN ranked 8 and 8, WDFW and LSRCP address this SAI for their steelhead project through the hatchery M&E project. CTUIR will address this issue in regard to the spring Chinook salmon hatchery.

SAI-10 Hatchery Program Monitoring
The associated MIN 10.1-10.7 all ranked 9. WDFW and LSRCP address these SAI through the hatchery M&E project for summer steelhead. CTUIR will address this issue in regard to the spring Chinook salmon hatchery.

Evaluation SAI
SAI-11 Adult Migration Evaluations
The associated MIN-11.1-11.6 received high ranks primarily because fish passage issues are directly impacting bull trout and steelhead in the Walla Walla River. CTUIR is currently conducting an intensive passage evaluation for steelhead and working cooperatively with ODFW on their bull trout study (see Chapter Six of this reports). ODFW tags the bull trout and CTUIR crews monitor their progress (Mahoney 2002). Critical questions remain about the new passage facilities at Nursery Bridge Ladder and in the Mill Creek -Yellowhawk Creek complex.

SAI-12 Juvenile Salmonid Passage Evaluations
The associated MIN ranked low. ODFW completed a project in the neighboring Umatilla Basin and found current screen designs were adequate for the most part (Knapp et al. 1996). Recent installation of juvenile fish passage facilities in the Walla Walla basin are

of the same design and function as the Umatilla facilities. CTUIR RM&E plans to examine reach survival rates to determine if there are significant problems on a larger scale before spending millions of dollars on detailed studies of each part of the juvenile passage facilities.

SAI-13 Salmonid Productivity, Fitness and Survival Rates
The associate MIN 13.1-13.6 ranked 9,9,9,9,9and 6 respectively. This SAI has not been adequately addressed or developed. CTUIR will work with ODFW and WDFW to purse this SAI.

SAI-14 Interactions between Fish and Habitat
The associate MIN 14.1-14.5 ranked 8,8,8,6 and 6 respectively. This SAI has not been adequately addressed or developed. However it was ranked moderately high. CTUIR has conducted some habitat restoration efficacy evaluations (Childs 2001) but a unified basin-wide approach is needed.

SAI-15 Determine Optimal Hatchery Practices
The associated MIN 15.1-15.10 ranked from 4 to 9. WDFW and LSRCP will address these issue through their hatchery M&E project for steelhead. CTUIR will address this issues in regard to the proposed spring Chinook salmon hatchery.

SAI-16 Evaluating Similarities and Differences between Hatchery and Natural Fish
The associated MIN 16.1-16.4 ranked fairly high, 8, 8, 8 and 6 respectively. WDFW and LSRCP will address this SAI through the hatchery M&E project. CTUIR will address this issues in regard to the proposed spring Chinook salmon hatchery.

SAI-17 Harvest Related Evaluations
The associated MIN 17.1 -17.2 ranked low, 7 and 6, respectively. This SAI has not been addressed or developed on the Oregon side. WDFW has an ongoing harvest monitoring program for their steelhead hatchery program.

Research SAI
SAI-18 Genetic Studies
The Genetic studies related to MIN-18 ranked high in priority. CTUIR conducted a steelhead genetics study in the Walla Walla basin from 1999-2002 (see Chapter 5). Bull trout genetic characteristics are still poorly understood and there are additional questions regarding steelhead genetics research.

Summary of Past Efforts: Narum (et al. 2003) examined genetic composition and characteristics of rainbow trout and steelhead from throughout the Walla Walla basin and steelhead from the Umatilla and Snake Rivers. Genetic characteristics indicate some uniqueness of Walla Walla steelhead and some minor separation between resident and anadromous stocks. Remaining genetic related questions for steelhead relate to the variation of these genetic characteristics through time between and within subpopulations (MIN-18.2-18.5).

Goal and General Approach: The primary goal is to collect bull trout tissues samples from throughout the Walla Walla and adjacent basins. The second goal is to assemble a genetic data archive for the Walla Walla Basin steelhead and bull trout. The concept is to collect samples annually with standardized sample designs and protocols. The tissue archive will be used to provide materials for current evaluations as well as future genetic research questions that have not yet been identified or formally developed. Annual steelhead samples will be taken from 1) all adult steelhead broodstock used in the LSRCP program, 2) 100 naturally produced smolts, and 3) 100 adult steelhead returning to the upper Walla Walla River, the Touchet River and Mill Creek. However, Mill Creek does not currently have 100 adult returns. Samples will include date, location, age, sex, length, origin and distinctive features. Bull trout samples will be taken only when bull trout are captured incidentally until formal studies are developed and approved through USFWS.

Coordination, Reporting and Project Assessment

RM&E Coordination Framework

Coordination at multiple scales requires willingness and cooperation of many agencies and groups. We plan to incorporate as many willing partners in to the RM&E planning process as possible through the Walla Walla Technical Work Group (TWG). The coordination framework at the Province and Regional Scales will come through mandates of both funding (BPA) and regulatory agencies (USFWS, NMFS). CTUIR hopes to blend the provincial and regional management information needs with the needs of local managers. We plan to adapt our standard monitoring methods, protocols, data management formats and reporting standards to the recommendations developed through the ongoing CBFWA, NMFS, USFWS and ISRP processes.

CTUIR cannot guarantee the cooperation of other agencies and groups in the RM&E plan development. For example, working with CBFWA will require us to wait until their regional RM&E project is further developed. A similar condition existed with ODFW when they declined to collaborate with us on this plan until they had completed other processes. They may want to develop their own RM&E plan rather than integrate their needs and perspectives into this plan. WDFW may wish to take a similar approach. These types of provincial ownership issues have been common in the region due to differences in personalities, perceptions and management philosophies. For example, CTUIR developed a Basin Fisheries Restoration Plan in 1984. Rather than working through a coordinated framework, ODFW wrote their own plan in 1986 (ODFW 1986). Cleary the differences were important from their perspective. Therefore, while we remain hopeful, we recognize the possibility that coordination and development of an RM&E plan by CTUIR could be ignored by key agencies and groups. Part of the difficulty stems from directives given by State and Tribal leadership to management and RM&E staff. Differences occasionally escalate until legal action is taken. While these obstacles represent less than ideal situations, we feel that effective and worthwhile

RM&E plans can be developed and implemented through WDFW, ODFW and CTUIR RM&E projects in the Walla Walla River Basin.

Data Management and Reporting
Until regional formats are developed, we will manage existing data bases with our current formats and develop reports using Microsoft Word. We post data and reports on the CTUIR website and forward electronic copies of the reports to BPA annually. We will use regional reporting and data management formats and standards once they are developed and adopted (provided they are reasonable and prudent).

Summary of Project Assessments
In an effort to improve program deliverables and to utilize staff more effectively CTUIR routinely evaluates project efficiency and productivity. These self evaluations exposed a number of areas where improvements were needed. Local managers and project personnel have made significant changes. For example, CTUIR and BPA recently split the UBNPME project and created the Walla Walla Natural Production Monitoring and Evaluation Project (WWNPME, Project Number 200003900). CTUIR established a field station in the Walla Walla Basin to improve logistical efficiency. Recently CTUIR RM&E project personnel have made significant changes in the amount of field work planned in relation to staffing levels. In the past, CTUIR RM&E projects tried to do too much field work given existing personnel, especially when vacancies occurred and when processes and deliverables escalated exponentially (HGMPs, Subbasin Plans, ESA processes, expanded proposal processes etc.). CTUIR RM&E projects now concentrate on the highest priority MIN, but with fewer SAI. This strategy reduces the number of questions examined but improves timeliness and quality of deliverables.

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