Mill Creek Fisheries Monitoring Program
2009 Final Report

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Prepared By:

Rod McLeod
Project Coordinator
Chris Howard
Project Biologist

Mill Creek Fisheries Monitoring Program
255 North Fred Haight Drive
Crescent City, CA 95531

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ABSTRACT

The Mill Creek Fisheries Monitoring Program (MCFMP) collected the sixteenth consecutive year of fisheries data for Mill Creek, tributary to the Smith River, Del Norte County, California. The MCFMP began in 1994 to monitor the freshwater life history stages of returning salmonids and their varying life histories within two tributaries to Mill Creek, the West Branch and the East Fork. The California Department of Fish and Game (CDFG) Fisheries Restoration Grants Program has provided funding for this monitoring program since 2001. Natural runs of Chinook salmon (*Oncorhynchus tshawytscha*), Southern Oregon and Northern California Coast "threatened" coho salmon (*O. kisutch*), chum salmon (O. keta), steelhead (*O. mykiss irideus*) and coastal cutthroat trout (*O. clarki clarki*) occur in Mill Creek along with other important aquatic species of fish and wildlife. This final report under Contract Number P0610530 summaries results from three components of the Mill Creek Fisheries Monitoring Program: 2008 and 2009 Adult Escapement Surveys, 2007, 2008 and 2009 Summer Population Monitoring, and 2008 and 2009 Smolt Outmigration Trapping. The modified Hankin and Reeves (1988) single stream population estimate for juvenile coho salmon using the West Branch Mill Creek in the late summer of 2007, 2008 and 2009 was 13,826 fish in 2007; 15,569 fish in 2008, and 8,628 fish in 2009. For the East Fork Mill Creek the juvenile coho salmon estimates for 2007-2009 were 4,491 fish in 2007, 8,605 fish in 2008, and 9,934 fish in 2009. The population estimates for late summer juvenile steelhead on the West Branch 2007-2009 was 1,249 fish in 2007, 395 fish in 2008, and 622 fish in 2009. The population estimates for late summer juvenile steelhead on the East Fork 2007-2009 was 1,845 fish in 2007, 400 fish in 2008, and 1,061 fish in 2009. The population estimates for late summer juvenile coastal cutthroat trout on the West Branch 2007-2009 were 179 fish in 2007, 39 fish in 2008, and 63 fish in 2009. The population estimates for late summer juvenile coastal cutthroat trout on the East Fork 2007-2009 were 226 fish in 2007, 151 fish in 2008, and 470 fish in 2009. The population estimates for late summer juvenile Chinook salmon on the West Branch 2007-2009 were 1,298 fish in 2007, 28 fish in 2008, and 67 fish in 2009. The population estimates for late summer juvenile Chinook salmon on the East Fork 2007-2009 were 1,116 fish in 2007, 4 fish in 2008, and 40 fish in 2009.Adult escapement survey protocols described in Flossi et al. (1998), Waldvogel (1988) and CDFG (1988) were conducted during fall and winter water years (WY) 2008 and 2009 for a portion of Rock Creek and several reaches of Mill Creek. A total of 12.0 miles and 0.5 miles of stream where surveyed on a weekly basis as weather permitted in tributaries to Mill Creek and Rock Creek, respectively. In 2008, minimum escapement for Chinook salmon was estimated to be 147, 66, and 10 for the West Branch, East Fork and Rock Creek, respectively. In 2009, minimum escapement for Chinook salmon was estimated to be 263, 160, and 50 for the West Branch, East Fork and Rock Creek, respectively. Minimum escapement for coho salmon in 2008 was estimated to be 28, 6, and 0 on the West Branch, East Fork and Rock Creek, respectively. Minimum escapement for coho salmon in 2009 was estimated to be 12, 16, and 0 on the West Branch, East Fork and Rock Creek, respectively. A total of 553 Chinook, 39 coho and 214 unknown redds were observed in all reaches combined in 2008. In 2009 a total of 459 Chinook, 45 coho and 125 unknown redds were observed in all reaches combined. Juvenile and smolting salmonid emigration was monitored in the East Fork and WB using pipe traps from 29 Feb through 22 July 2008 (143 trapping days) and from 13 Mar through 30 Jun, 2009, (110 trapping days). During 2008, we captured 29,104 Chinook fry in the East Fork outmigrant pipe trap and 117,801 Chinook fry in

the West Branch outmigrant pipe trap. During 2009, we captured 3,950 Chinook fry in the East Fork outmigrant pipe trap and 22,175 Chinook fry in the West Branch outmigrant pipe trap Population estimates for coho salmon, steelhead, and coastal cutthroat trout smolts emigrating from the East Fork in 2008 were 1,234 (± 37), 541 (± 37) and 1,032(± 92), respectively. Population estimates for coho salmon, steelhead, and coastal cutthroat trout smolts emigrating from the East Fork in 2009 were 1,766 (± 164), 1,210 (± 346) and 1,010 (± 78), respectively. Estimates of coho salmon, steelhead, and coastal cutthroat trout smolts emigrating from the West Branch in 2008 were 3,731 (± 164), 1,514 (± 240), and 702 (± 59), respectively. Estimates of coho salmon, steelhead, and coastal cutthroat trout smolts emigrating from the West Branch in 2009 were 4,535 (± 452), 772 (± 103), and 1,005 (± 132), respectively. It appears that habitat restoration efforts on the East Fork Mill Creek are having a positive effect on the juvenile coho populations by increasing summer rearing habitat and winter high-flow velocity refugia. Salmonid populations in Mill Creek appear to be quite resilient and thus far have been able to maintain levels near the limit of the watersheds current carrying capacity.

This final report will complete the contractual obligations outlined in Grantee Agreement P0610530 Exhibit A Item 4B between Rowdy Creek Fish Hatchery and the California Department of Fish and Game (CDFG).

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1.0 INTRODUCTION

The Smith River is the last major coastal river in California protected from dams. Its surrounding watershed is considered critical refuge for declining native fish, where natural runs of Chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*O. kisutch*), chum salmon (O. keta), steelhead (*O. mykiss irideus*) and coastal cutthroat trout (*O. clarki clarki*) can be found in many of its tributaries. The Smith River headwaters are located in the western Klamath-Siskiyou Mountains and the total drainage covers 628 mi^2 of northwestern California and 91 mi^2 of Oregon. The major Smith River sub-basins include the North Fork (157 mi^2), Middle Fork (130 mi^2) and the South Fork (291 mi^2) (McCain et al. 1995).

Mill Creek is one of the most productive anadromous fish tributaries of the mainstem Smith River. Mill Creek originates in reforested land south of the Smith River and runs through several miles of protected redwood groves before meeting the Smith River 14.5 miles from the Pacific Ocean. All species of salmonids present in the Smith River basin can be found in the Mill Creek watershed. Problems facing anadromous salmonids in the Mill Creek HSA include poor LWD recruitment, barriers to fish passage, degraded riparian vegetation, and sediment input from the existing road network (CDFG 2004). The salmonid fisheries monitoring within Mill Creek includes annual estimation of adult spawner escapement, smolt emigration, and summertime populations of juvenile salmonids. This effort has continued with funding into its fifteenth and sixteenth years through the California Department of Fish and Games Fisheries Restoration Grant Program (Grantee Agreement No. P0610530).

This final report summarizes smolt outmigrant trapping, adult escapement surveys and juvenile summer population surveys conducted from Sept 1, 2007 through Oct 31, 2009. This report will fulfill the contractual obligations outlined in Grantee Agreement P0610530 between Rowdy Creek Fish Hatchery and the CDFG.

2.0 DESCRIPTION OF THE STUDY AREA

The study area includes the anadromous reaches of the East Fork (EF) and West Branch (WB) of Mill Creek (Fig. 1). The western border of the Mill Creek property is approximately 6 miles southeast from Crescent City in Del Norte County, California, and extends eastward 8 miles over the Mill Creek and Rock creek watersheds.

The Mill Creek watershed is steep and ranges from 200 feet above sea level to 2,400 feet at the top of Childs Hill. Mean annual rainfall ranges from 60-150 inches and mean monthly temperatures range from 41 to 67 F°. Lower reaches of Mill Creek are broad, flat valley bottoms with large amounts of stable sediment in terraces located above the active channel (Madej et al. 1986). Alluvial terrace and floodplain deposits of Pleistocene to Holocene age occur in valley bottoms along Mill Creek, EF Mill Creek, WB Mill Creek, and Rock Creek (Stillwater Sciences, 2002).

Mill Creek mimics the Smith River hydrograph though the Smith River has more run-off per unit area than Mill Creek (Madej et al. 1986). Mill Creek stream flow was monitored from 1974 to 1981 at a site 0.6 miles below the confluence of the EF and WB (USGS). The mean annual discharge of Mill Creek, monitored from 1974 to 1981 was 118 cubic feet per second (cfs) and the highest and lowest daily mean flows were 2.5 cfs and 2,980 cfs, respectively. The peak recorded flow for Mill Creek was 4,460 cfs in 1975. Stream morphologies in the study area vary from colluvial, boulder-cascade, step-pool, and bedrock channels in the upper basin positions to forced pool-riffle and plane-bed alluvial channels in the lower basin areas (Stillwater Sciences, 2003). For this report Smith River flows at the Jed Smith Park USGS gauging station (JED) and rainfall data from the Gasquet Ranger Station were used as surrogates for flow and precipitation conditions in the Mill Creek Watershed. Flows in the EF are roughly 2% and WB flows are roughly 1.25% of those recorded at JED. Precipitation in the Mill Creek Watershed has been found to closely mirror measurements taken at the Gasquet Ranger Station (Fiori, pers. com.)

Juvenile fish residing in both creeks are susceptible to drought. During critical periods of seasonally low flows, dissolved oxygen concentrations appear to remain above the 7 mg/L threshold as a specific water quality objective for streams in the Smith River hydrological unit (Winzler and Kelly 1980, NCRWQCB 1996 *in* Stillwater Sciences, 2002).

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Redwood accounts for most of the LWD (large woody debris) in the study area though short-term large wood recruitment is limited due to the past removal of large conifers in the riparian area and instream anadromous reaches and more recent dominance of these areas by hardwoods, predominately alder. The density of instream large woody debris (LWD) is greater in the WB than in the EF of Mill Creek (Howard 1995). The WB contains many highly complex LWD formed pools that consist of tree stems often greater than 5 feet in diameter and larger redwood rootwads. Alder plays a substantial role in LWD function in the WB and is often piled behind larger redwood crossings producing significant areas of complex habitat. In the past, CDFG has added a number of LWD structures to sections of both tributaries, which has helped increase shallow pool habitat. However, significant sections of the EF and small portions of the WB still lack LWD, particularly in the lower stream reaches. In 2006 Redwood National and State Parks began a large-scale instream habitat improvement project on the EF and to date, has constructed a total of 80 complex wood jams (CWJ's) within riffle and run habitats of that tributary (Fiori et al, 2009). These

CWJ's are much more complex that traditional LWD structures and provide a significant LWD and small woody debris cover component as well as creating pool habitat. Fiori et al, (2009) found that these structures have produced and maintained scour depths of 2 to 3.5 feet (shallow pools).

A small section of upper Rock Creek, which can only be accessed through the Mill Creek Acquisition, is also included in the study area. Spawning habitat, as a rule, is limited within Rock Creek due to its high gradient and boulder-dominated substrate. However, this small section is the longest consistent stretch of lower gradient, small substrate spawning habitat available in the entire anadromous length of this tributary. We only conduct spawning surveys in this section.

Anadromous species, such as the coho salmon are listed as a Threatened Species in the Southern Oregon Northern California Coast Evolutionary Significant Unit (Table 1). Other species of concern in Mill Creek are not warranted for listing under the Endangered Species Act. The Smith River is located to the north of more depressed southern populations of listed ESUs for steelhead and Chinook and coho salmon.

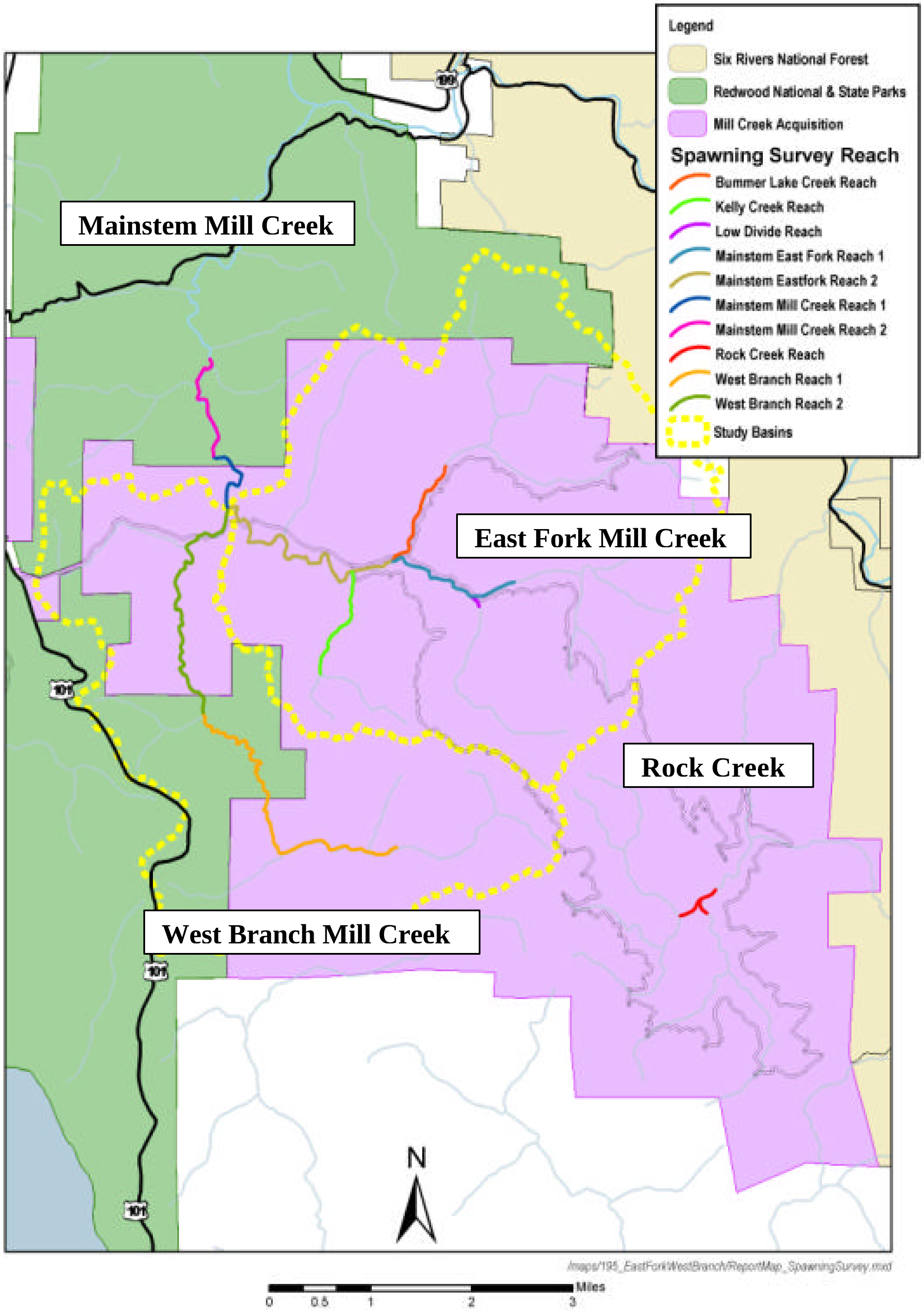

Figure 1. Anadromous reaches of the Mainstem, West Branch and East Fork Mill Creek and Rock Creek.

Table 1. Status of fish species occurring or potentially occurring in the Mill Creek watershed (Adapted from Stillwater Sciences, 2002).

SPECIES	ESU	STATUS[1]	
		Federal	State
Coho salmon *Oncorhynchus kisutch*	Southern Oregon/Northern California Coasts	T	T
Chinook salmon *Oncorhynchus tshawytscha*	Southern Oregon/Northern California Coasts	NW	CSC
Steelhead *Oncorhynchus mykiss irideus*	Klamath Mountains Province	NW	None
Coastal cutthroat trout Oncorhynchus clarki clarki	Southern Oregon/California Coastal	NW	CSC
Chum salmon *Oncorhynchus keta*	Pacific Coast	NW	None
Green sturgeon *Acipenser medirostris*	N/A	C2	None
River lamprey Lampetra ayresi	N/A	C2	CSC
Pacific Lamprey *Lampetra tridentata*	N/A	C2	None

1

T	Threatened
NW	Not warranted for listing
CSC	CDFG and/or California Board of Forestry Species of Concern
C2	Species formerly classified as Category 2 candidates by the USFWS; these species no longer have a legal federal status
CE	Candidate to be listed as endangered pursuant to the California Endangered Species Act.

3.0 METHODS

3.1 Juvenile Coho Population Estimates

Juvenile summer population surveys were conducted throughout the majority of anadromous habitat in the WB and EF (and major tributaries) using the Method of Bounded Counts (MBC)(Hankin and Reeves 1988, also see Dolloff et al. 1993). MBC is a two-phase regression estimation survey design based on repeated diver counts in addition to electrofishing. MBC is used to calibrate diver counts when the unit population size is small (N<25), substantially reducing electrofishing effort. MBC complements removal method estimates that often fail when fish density is low (N<25). With this method electrofishing is restricted to situations where fish abundance is high (N>25) or in riffles, which are too shallow to be snorkeled effectively and diver counts are likely inaccurate.

All juvenile summer population sampling took place in September and October of 2007, 2008 and 2009, when flows were the lowest. All units selected for Phase 1 sampling were dove or electrofished. Phase 2 calibration was performed either by diving or electrofishing (see above) and population estimates for coho salmon, Chinook salmon, steelhead and coastal cutthroat trout were calculated.

A. Habitat Mapping

Habitat unit delineation and Phase I unit selection took place simultaneously. Units were delineated according to biological breaks that did not allow fish to pass freely (i.e. riffles). Units were labeled as shallow pools (SP), deep pools (DP), runs (RU) or riffles (RF). Units deeper than 1 meter and/or difficult to wade for electrofishing were considered DP's. If fish movement between units was probable, units were lumped and classified by the dominant habitat type (SP, RU, DP, RF). Units with greater widths than lengths were lumped with the next unit upstream. A Hip-chain was used to measure unit lengths and a stadia rod was used to measure water depth and wetted channel width at the top and bottom of each unit. Mean widths were visually estimated and multiplied by the measured lengths to calculate the surface area of each unit. Habitat quality and percent cover were also visually estimated for each unit using the methods of Flosi et al. (1998). For 2009 the estimated areas of habitat units were used to generate population estimates rather than simply the number of units, as had been used previously. This method, described in Mohr and Hankin (2005), gives a more accurate estimate, with tighter confidence intervals when fish numbers are correlated with unit area.

Stratified sequential independent sampling was used to select the habitat units for Phase I. An algorithm was used to generate lists of "yes's" and "no's" according to desired sampling unit selection probability (Table 2). Phase I and Phase II lists were printed in columns on field paper. Columns were cut into strips and taped together to form a continuous strip that was coiled into a slotted dispensing container (35 mm film canister). This method allows a person to pull out a new answer ("yes" or "no") without advance knowledge of the answer.

Table 2. Probabilities of selecting habitat units for Phase I and Phase II sampling.

Habitat type	Phase I (first pass)	Phase II (Calibration)
Shallow Pool	0.333	0.25
Deep Pool	1.00	0.50*
Run	0.333	0.25
Riffle	0.10	1.00**

* All selected deep pools were surveyed by Method of Bounded Counts (4 dive passes).
**All selected riffles were surveyed by electrofishing.

Phase I units were selected while habitat typing. A strip was pulled after a habitat unit was delineated. If a "yes" was drawn, numbered flags were hung at the top and bottom of the unit to indicate where Phase I dives would occur.

B. Fish Counts

Habitat units selected for Phase I sampling were snorkeled in an upstream direction and all observed 0+ coho, 1+ steelhead and 1+ cutthroat trout were tallied. Divers used slates to record observed numbers of fish and the method chosen was used consistently among divers. At the end of the first pass, dive duration and numbers of fish were recorded and the Phase II strip was pulled to determine if calibration was necessary. If a "no" was drawn then the diver moved upstream to the next flagged dive unit. If a "yes" was drawn in a SP or RU unit where greater than 25 coho were counted, then the unit was flagged for Phase II calibration by electrofishing. If less than or equal to 25 coho were observed and habitat complexity (i.e. debris) did not affect seeing all the fish without risk of double counting, then the calibration was done through MBC; allowing for 4 total diver passes. All Phase II DP units were calibrated through method of bounded counts regardless of number of coho observed. During instances where riffles were drawn in Phase I ("yes"), unit flagging was hung for Phase II calibration using depletion methodology (electrofishing).

C. Electrofishing

One to two backpack electrofishing units were used to sample all Phase II riffles and other Phase II units that contained over 25 coho. Block nets were placed at the top and bottom of each unit and the three or four-pass depletion method was conducted. A jackknife estimator was used to estimate unit population size. A crew of up to six people was used for electrofishing. All species collected by electrofishing were counted, identified and released.

3.2 Adult spawning Escapement

Field protocols described in Flossi et al. (1998), Waldvogel (1988) and CDFG (1988) were conducted during fall and winter 2007/2008 and 2008/2009 for portions of Rock Creek and Mill Creek within the study area. All stream reaches previously monitored by Stimson Lumber Co. (Howard 1999) were surveyed once a week when possible (Table 3). In addition, during periods of low flows, additional reaches were surveyed on the Mainstem Mill Creek (Table 3).

Table 3. Stream reaches surveyed by the Mill Creek Fisheries Monitoring Program (2007-2009).

MILL CREEK SURVEY REACHES						ROCK CREEK	
Mainstem		**East Fork**		**West Branch**		**Rock Creek**	
Reach	Miles	Reach	Miles	Reach	Miles	Reach	Miles
Upper	0.75	EF Reach 1	2.25	WB Reach 1	0.5	Rock	0.5
Lower	0.75	EF Reach 2	1.5	WB Reach 2	1.7		
		Kelly Creek	0.75-1	WB Reach 3	2.75		
		Bummer Lake Creek	0.5	Hamilton Creek	0.25		
		Low Divide Creek	0.25				
		First Gulch	0.5				

Surveyors donned waders and polarized glasses in order to ford high water and observe the presence and activities of adult anadromous fish in study reaches. Observations included redd counts, live fish counts, and carcass information. Redds were marked by attaching flagging to adjacent streamside locations. Test redds, or incomplete redds were not counted or flagged. Observed fish were counted and identified to species and sex when possible. Carcasses were identified to species and sex and measured to the nearest fork length in centimeters. Scale samples were taken from select carcasses and notable carcass observations were recorded (i.e. fin clips, scars, condition, percent spawned). Carcasses were marked by small pieces of flagging attached to the jaw or tail in order to avoid repeat counts.

Distinguishing sex or species of fish from the stream bank can be difficult during walking surveys. Before morphological changes occur in spawning salmonids (i.e. color, shape), when they are “fresh”, the identification of sex and sometimes species is more difficult to determine especially just after a freshet and/or during turbid conditions. When the water begins to recede and fish begin to hold in larger pools or begin spawning, fish and redd identification is usually more accurate.

During spawning, scales and skin are removed from the tail and caudal peduncle region of females from intense digging, resulting in easy identification. Males are often larger, have a prominent dorsal region, and a longer snout. Polarized glasses are a must in Mill Creek and surveys are most effective during the peak daylight hours. Special care is taken in Mill Creek to avoid any disturbance of redds caused by walking and attempts are made to not spook fish or interfere with spawning.

Spawner surveys are not as effective as counting weirs for accurately estimating the number of anadromous fish that reach a particular region of habitat. However, surveys do provide a general estimate of spawner abundance during a particular season. They also provide age, sex, length, and redd data and document spawning activity in the system that can be used to compare annual, intra and inter-basin escapement.

Early in the spawner survey season and prior to large storm events, redds are clearly visible in Mill and Rock Creeks and evidenced by overturned cobble cleaned of the summer’s algal growth, with an apparent “pot” or “pit” and a “mound”. After a few high water events that are capable of rolling cobble, redds are often indistinguishable from natural bedload movement and carcasses are often carried well away from the main channel and are found in bank-full locations and even trees.

Scavengers such as bears and other mammals around the project area commonly drag a significant number of carcasses away from the channel.

3.3 Juvenile Outmigration Trapping

A. West Branch Trap Description

The WB trap site was located 250 feet above the confluence of the WB and EF, known as the "pump house pool" (Figs. 2 and 3). A combination of panels as describe by Haden and Gale (1999) were ripped lengthways and ½ inch holes were drilled in the corners and webbing was used to tie panels end-to-end (Fig. 4). Approximately 70, 7-ft. T-posts were driven several feet into the substrate in a manner that allowed several pallets and panels to be used in concert to form the weir. Use of a more incised "V" design reduced the potential stranding of young-of-the-year (YOY) salmonids that may become impinged on hardware cloth panels used in this application. Regular cleaning of the panels was needed through most of the trapping period to allow water movement through the hardware cloth. Cleaning was reduced during periods of low flow to help concentrate flows towards the two 8" PVC inlets at the vertex of the weir. A "double-barrel" pipe set up was used to increase flow to boxes in this low gradient section of stream. Screw jacks were used to adjust the outlet pipe height, allowing for trapping at various water levels. Water exited the pipes onto a McBain Ramp; an effective, fish-friendly trapping device used for passing fish and dissipating large amounts of water before entering the attached live-boxes. Within the live boxes, wooden baffles further dissipate flow energy. Steel grates (3/8"-mesh) separated two live boxes and helped prevent the predation of YOY by larger fish.

B. East Fork Trap Description

The EF trap site was located 100 feet downstream from the Hamilton Road Bridge (Fig. 2). The entire trap consisted of a rock weir, several sections of 8" PVC pipe, a McBain Ramp and live-trap boxes (Fig. 4). Local cobble and boulder substrate was positioned so that the vertex of the weir pointed downstream in the thalweg. Divers filled the interstitial spaces with substrate in order to increase capture efficiency. The pipe inlet is buried at the weir vertex, creating a vacuum, where downstream migrants approaching the weir vertex are drawn into the pipe and funneled downstream to the live-trap boxes. The drop in elevation, from the pipe inlet to the outlet, creates strong water draw to the pipe and the resulting suction is inescapable to small fish near the pipe inlet. Varying numbers of twenty foot by 8" PVC pipe sections are used depending on flow conditions. Pipes are held in place with large cobble and boulders. Again, screw jacks were used to adjust the outlet pipe height, a McBain ramp was used to dissipate flow and one or two live-boxes separated by steel grates (3/8") were used to separate YOY from larger fish.

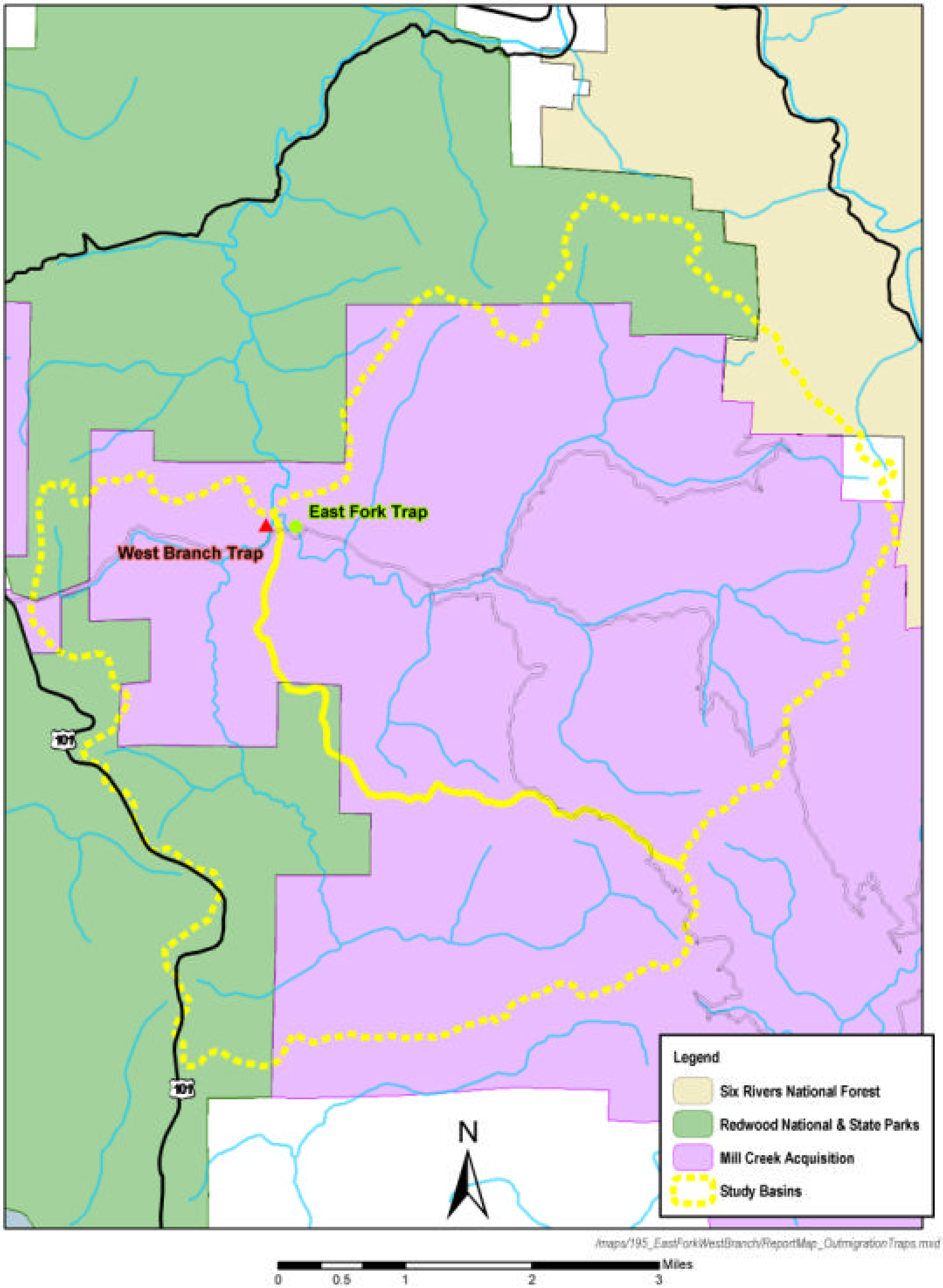

Figure 2. West Branch and East Fork Mill Creek smolt outmigration trap locations.

Figure 3. The West Branch location and design, implemented in 2008 and 2009.

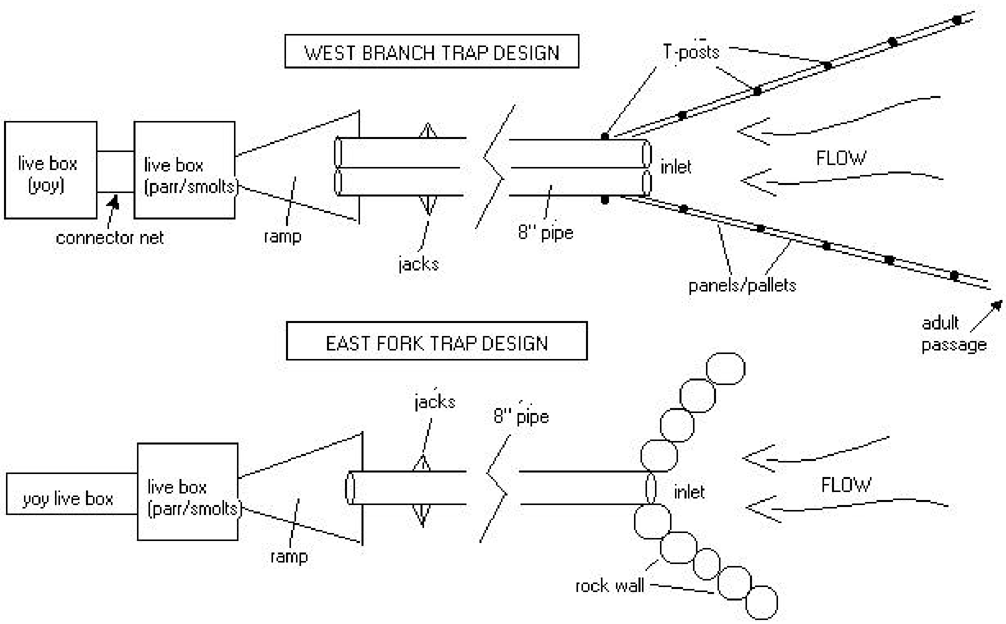

Figure 4. Mill Creek Tributary Pipe Trap Designs, 2008 and 2009.

C. Trap Operation

Traps were checked in the morning hours and maintenance was performed, if necessary, after all fish had been released. All fish were counted and identified to species and life stage when possible. Stage of development was estimated for all salmonid parr and smolts. Each day a sub sample of young-of-the-year salmonids was measured to fork length. Similarly, a sub sample of 1+ salmonids and non-salmonids were measured. Scale samples were obtained from select steelhead and cutthroat smolts. Steelhead kelt length, sex, and hatchery fin clips, if any, were recorded upon capture. On several occasions when we had many thousands of YOY to process on the WB, we used a volumetric method to estimate some of the YOY numbers. First, several 100ml sub-samples of YOY were taken and the mean numbers of each species/100ml were calculated. Then these means were applied to a larger volume of YOYs to estimate the total number of each species.

D. Trap Efficiency and Smolt Population Estimates

Weekly trap efficiencies and smolt populations were estimated using the Darroch Analysis (DARR2.0) (Bjorkstedt 2005) of mark-recapture data. Each day a sub-sample of captured coho, steelhead and cutthroat smolts were anesthetized, marked and held upstream, at least one habitat break away, for potential recapture in the traps. These fish were released after dark using a timer activated release device similar to that used by Miller et al. (2000). Four types of fin clips were used; upper caudal clip (UC), lower caudal clip (LC), upper vertical caudal clip (UVC) and lower vertical caudal clip (LVC). Clip types were changed every seven days allowing for at least a three-week separation between clips. The assumption was made that smolting species were actively emigrating to the ocean and therefore will not attempt to redistribute upstream of the weir once re-released for trap efficiency tests.

4.0 RESULTS

4.1 Juvenile Summer Population Estimates

Sampling in 2007 was unfortunately cut short due to a number of rain events that began in late September and continued through October 2007. Because of the high flows 5 riffles (3 WB, 2EF) selected for phase I sampling were not electrofished; 6 additional habitat units (4 shallow pools, 1 deep pool and 1 run) on the EF selected for phase I sampling were not dove; and one entire EF tributary (Chewie Creek) was not sampled at all. In addition, prior to the rains, one isolated shallow pool in the WB selected for phase I sampling completely dried up before it could be sampled. In 2008 and 2009 all phase I and phase II sampling was completed.

A. Summer Habitat Availability

Habitat type delineation during Phase 1 selection was conducted for the WB and EF in 2007-2009. Primary channel length represents available anadromous habitat during summer low flows. Tables 4 and 5 summarize total lengths of the four primary habitat data types collected for the WB and EF from 1994-2009.

In 2007, a 6.2-mile reach on the WB composed of 468 habitat units was mapped and selected for Phase 1 sampling (Table 4). In 2008, 5.9 miles and 468 habitat units were mapped on the WB; and in 2009 5.9 miles and 444 habitat units were mapped on the WB (Table 4). In 2007 the EF of Mill Creek and its major tributaries (except Chewie Creek) were selected and mapped for Phase 1 sampling, collectively accounting for 5.3 miles and 414 units (Table 5). In 2008, 6.0 mi and 579 habitat units were mapped in the EF; and in 2009, 6.2 mi and 525 habitat units were mapped (Table 5). Chewie Creek was included in the 2008 and 2009 sampling.

Pools and Deep Pools have consistently made up the largest percentage of habitat types and overall primary channel length within the WB from 1995 through 2009. Riffle habitat types and associated primary channel length are generally the second most frequently encountered habitat type in the WB. Riffle habitat is the most frequently encountered habitat type in the EF since surveys began in 1995, while pools and deep pools have made up the second most frequently encountered habitat types in the EF (Table 5).

B. Population Estimates

Coho salmon juvenile population estimates for the WB were 13,826 in 2007, 15,569 in 2008, and 8,628 in 2009 (Table 6). Coho salmon juvenile population estimates for the EF were 4,491 in 2007, 8,605 in 2008 (excluding Chewie Creek), and 9,934 in 2009 (Table 7).

Table 4. Total length of habitat types for the West Branch Mill Creek, 1994 – 2009.

West Branch Mill Creek	Primary Channel	Habitat Types					
Year	**Total (ft)**	**Dry**	**Pool**	**Deep Pool**	**Run**	**Riffle**	**Cascade**
1994	2,228		945	NA*	662	620	-
1995	33,614	1,503	12,770	6,438	6,207	9,702	-
1996	36,426	456	12,439	5,439	3,987	14,940	77.10
1997	23,940	2,540	6,599	4,335	6,197	6,806	-
1998	30,081	2,896	8,064	6,843	8,025	7,149	-
1999	28,881	3,575	9,138	2,842	6,215	7,111	-
2000	28,505	3,137	8,730	4,390	5,307	6,941	-
2001	26,904	1,968	10,456	7,394	0	7,084	-
2002	26,895	5,218	7,957	4,592	3,619	5,509	-
2003	33,195	4,612	10,331	6,280	4,211	7,761	-
2004	29,770	4,357	10,778	2,182	5,885	6,568	-
2005	30,549	3,954	7,931	6,067	6,213	6,384	-
2006	30,082	4,148	10,976	4,548	4,381	6,029	-
2007	**32,880**	**4,765**	**10,834**	**6,270**	**5,006**	**6,005**	**-**
2008	**31,109**	**4,621**	**9,018**	**5,285**	**5,201**	**6,984**	-
2009	**31,332**	**4,936**	**7,629**	**6,692**	**6,683**	**5,392**	-

*A deep pool habitat type was not used in Scriven's (1994) survey methodology.

Table 5. Total primary channel length of habitat types for the East Fork Mill Creek (which include Bummer Lake Creek, 1995 and 1996 Phase 1 Sampling, and Bummer Lake, Chewie, and Low Divide reaches, 2004 through 2009).

East Fork Mill Creek	Primary Channel	Habitat Types (ft)					
Year	**Total (ft)**	**Dry**	**Pool**	**Deep Pool**	**Run**	**Riffle**	**Cascade**
1995	25,493	0	6,976	4,975	4,171	10,126	30
1996	25,014	0	5,872	4,125	5,660	9,550	59
2004	26,586	0	9,698	4,369	1,445	11,074	-
2005	33,375	0	7,756	6,236	5,264	14,119	-
2006	32,442	0	6,590	5,123	7,357	13,307	
2007*	**27,767**	**0**	**6,018**	**5,061**	**5,487**	**11,201**	-
2008	**31,792**	**0**	**8,346**	**4,739**	**5,572**	**13,135**	-
2009	**32,874**	**116**	**7,814**	**5,636**	**6,262**	**13,046**	-

* Does not include Chewie Creek.

Table 6. Juvenile coho salmon population estimates for the West Branch, 2007-2009.

West Branch Mill Creek 2007							
Species	Habitat	Population Estimate	Sampling Variance	Standard Error	95% Confidence interval	Total Population Estimate	95% Confidence interval
Coho	DP	**2970**	855.18	29.24	58.49	2970	58
Coho	SP	**10235**	413864.53	643.32	1286.65	10856	1297
Coho	Run	**514**	2623.65	51.22	102.44		
Coho	Riffle	**106**	3864.60	62.17	124.33		
			Total Coho Salmon Population Estimate			**13,826**	

West Branch Mill Creek 2008							
Species	Habitat	Population Estimate	Sampling Variance	Standard Error	95% Confidence interval	Total Population Estimate	95% Confidence interval
Coho	DP	**5322**	7441.50	86.26	172.53	5322	173
Coho	SP	**7788**	90428.19	300.71	601.43	10247	823
Coho	Run	**1794**	20872.15	144.47	288.94		
Coho	Riffle	**665**	58135.75	241.11	482.23		
			Total Coho Salmon Population Estimate			**15,569**	

West Branch Mill Creek 2009							
Species	Habitat	Population Estimate	Sampling Variance	Standard Error	95% Confidence interval	Total Population Estimate	95% Confidence interval
Coho	DP	**3435**	609.00	24.68	49.36	3435	49
Coho	SP	**3925**	224368.57	473.68	947.35	5193	987
Coho	Run	**1241**	19247.09	138.73	277.47		
Coho	Riffle	**27**	0.71	665.54	25.80		
			Total Coho Salmon Population Estimate			**8,628**	

Diver observations were also made for juvenile steelhead, juvenile coastal cutthroat trout and young-of-the-year Chinook salmon. Only juvenile 1+ (trout appearing over 100 millimeters in length) steelhead and coastal cutthroat trout were observed and recorded for estimating population size. All Chinook salmon young-of-the-year (YOY) observed during dives were included in counts.

Table 7. Juvenile coho salmon population estimates for the East Fork, 2007-2009 (Chewie Creek excluded in 2007).

East Fork Mill Creek 2007							
Species	**Habitat**	**Population Estimate**	**Sampling Variance**	**Standard Error**	**95% Confidence interval**	**Total Population Estimate**	**95% Confidence interval**
Coho	DP	**1449**	9573.26	97.84	195.69	1449	196
Coho	SP	**2797**	264346.98	514.15	1028.29	3042	1035
Coho	Run	**198**	2889.93	53.76	107.52		
Coho	Riffle	**47**	669.95	25.88	51.77		
			Total Coho Salmon Population Estimate			**4,491**	

East Fork Mill Creek 2008							
Species	**Habitat**	**Population Estimate**	**Sampling Variance**	**Standard Error**	**95% Confidence interval**	**Total Population Estimate**	**95% Confidence interval**
Coho	DP	**2927**	19663.05	140.22	280.45	2927	280
Coho	SP	**4176**	79239.58	281.50	562.99	5679	856
Coho	Run	**845**	40714.75	201.78	403.56		
Coho	Riffle	**657**	63129.67	251.26	502.51		
			Total Coho Salmon Population Estimate			**8,605**	

East Fork Mill Creek 2009							
Species	**Habitat**	**Population Estimate**	**Sampling Variance**	**Standard Error**	**95% Confidence interval**	**Total Population Estimate**	**95% Confidence interval**
Coho	DP	**3138**	1290.00	35.92	71.83	3138	72
Coho	SP	**5408**	273117.34	522.61	1045.21	6797	1051
Coho	Run	**1151**	3122.77	55.88	111.76		
Coho	Riffle	**238**	22.15	41064.62	202.64		
			Total Coho Salmon Population Estimate			**9,934**	

Steelhead trout juvenile population estimates for the WB were 1,249 in 2007, 395 in 2008, and 622 in 2009 (Table 8). Cutthroat trout juvenile population estimates for the WB were 179 in 2007, 39 in 2008, and 63 in 2009 (Table 9). Chinook salmon juvenile population estimates for the WB were 1,298 in 2007, 28 in 2008, and 67 in 2009 (Table 10).

Steelhead trout juvenile population estimates for the EF were 1,845 in 2007, 400 in 2008 (excluding Chewie Creek), and 1,061 in 2009 (Table 11). Cutthroat trout juvenile population estimates for the EF were 226 in 2007, 151 in 2008 (excluding Chewie Creek), and 470 in 2009 (Table 12). Chinook salmon juvenile population estimates for the EF were 1,116 in 2007, 4 in 2008 (excluding Chewie Creek), and 40 in 2009 (Table13).

Tables 8-13 summarize the 2007 estimates for these species in the WB and EF, respectively.

Table 8. Population estimates for 1+ steelhead trout for the West Branch Mill Creek, 2007-2009.

West Branch Mill Creek 2007							
Species	Habitat	Population Estimate	Sampling Variance	Standard Error	95% Confidence interval	Total Population Estimate	95% Confidence interval
Steelhead	DP	**435**	533.85	23.11	46.21	435	46
Steelhead	SP	**715**	38994.49	197.47	394.94		
Steelhead	Run	**76**	949.66	30.82	61.63		
Steelhead	Riffle	**24**	239.43	15.47	30.95		
			Total Steelhead Population Estimate			**1,249**	

West Branch Mill Creek 2008							
Species	Habitat	Population Estimate	Sampling Variance	Standard Error	95% Confidence interval	Total Population Estimate	95% Confidence interval
Steelhead	DP	**299**	106.97	10.34	20.69	299	21
Steelhead	SP	**50***	0.00	0.00	0.00	96	36
Steelhead	Run	**59**	39.98	6.32	12.65		
Steelhead	Riffle	**38**	290.22	17.04	34.07		
			Total Steelhead Population Estimate			**395**	

West Branch Mill Creek 2009							
Species	Habitat	Population Estimate	Sampling Variance	Standard Error	95% Confidence interval	Total Population Estimate	95% Confidence interval
Steelhead	DP	**300**	10.41	3.23	6.45	300	6
Steelhead	SP	**257**	1299.49	36.05	72.10	323	72
Steelhead	Run	**3**	1.46	1.21	2.42		
Steelhead	Riffle	**63**	0.00	0.00	0.00		
			Total Steelhead Population Estimate			**622**	

*-Estimates are hard counts

Table 9. Population estimates for 1+ coastal cutthroat trout for the West Branch Mill Creek, 2007-2009.

West Branch Mill Creek 2007							
Species	**Habitat**	**Population Estimate**	**Sampling Variance**	**Standard Error**	**95% Confidence interval**	**Total Population Estimate**	**95% Confidence interval**
Cutthroat	DP	**74**	376.04	19.39	38.78	74	39
Cutthroat	SP	**105**	757.09	27.52	55.03	105	55
Cutthroat	Run	**0**	0.00	0.00	0.00		
Cutthroat	Riffle	**0**	0.00	0.00	0.00		
		Total Cutthroat Trout Population Estimate				**179**	

West Branch Mill Creek 2008							
Species	**Habitat**	**Population Estimate**	**Sampling Variance**	**Standard Error**	**95% Confidence interval**	**Total Population Estimate**	**95% Confidence interval**
Cutthroat	DP	**32**	15.96	4.00	7.99	32	8
Cutthroat	SP	**0***	0.00	0.00	0.00	8	14
Cutthroat	Run	**0***	0.00	0.00	0.00		
Cutthroat	Riffle	**8**	49.37	7.03	14.05		
		Total Cutthroat Trout Population Estimate				**39**	

West Branch Mill Creek 2009							
Species	**Habitat**	**Population Estimate**	**Sampling Variance**	**Standard Error**	**95% Confidence interval**	**Total Population Estimate**	**95% Confidence interval**
Cutthroat	DP	**26**	29.01	5.39	10.77	26	11
Cutthroat	SP	**36**	134.62	11.60	23.21	36	23
Cutthroat	Run	**1***	0.00	0.00	0.00		
Cutthroat	Riffle	**0***	0.00	0.00	0.00		
		Total Cutthroat Trout Population Estimate				**63**	

*-Estimates are hard counts

Table 10. Population estimates for YOY Chinook salmon for the West Branch Mill Creek, 2007-2009.

West Branch Mill Creek 2007

Species	Habitat	Population Estimate	Sampling Variance	Standard Error	95% Confidence interval	Total Population Estimate	95% Confidence interval
Chinook	DP	**276**	615.54	24.81	49.62	276	50
Chinook	SP	**972**	170516.63	412.94	825.87		
Chinook	Run	**50**	383.81	19.59	39.18		
Chinook	Riffle	**0**	0.00	0.00	0.00		
				Total Chinook Population Estimate		**1,298**	

West Branch Mill Creek 2008

Species	Habitat	Population Estimate	Sampling Variance	Standard Error	95% Confidence interval	Total Population Estimate	95% Confidence interval
Chinook	DP	**28**	3.76	1.94	3.88	28	4
Chinook	SP	**4***	0.00	0.00	0.00	0	0
Chinook	Run	**2***	0.00	0.00	0.00		
Chinook	Riffle	**0**	0.00	0.00	0.00		
				Total Chinook Population Estimate		**28**	

West Branch Mill Creek 2009

Species	Habitat	Population Estimate	Sampling Variance	Standard Error	95% Confidence interval	Total Population Estimate	95% Confidence interval
Chinook	DP	**51**	195.46	13.98	27.96	51	28
Chinook	SP	**16**	15.21	3.90	7.80	16	8
Chinook	Run	**0***	0.00	0.00	0.00		
Chinook	Riffle	**0***	0.00	0.00	0.00		
				Total Chinook Population Estimate		**67**	

*-Estimates are hard counts

Table 11. Population estimates for 1+ steelhead trout for the East Fork Mill Creek, 2007-2009.

East Fork Mill Creek 2007

Species	Habitat	Population Estimate	Sampling Variance	Standard Error	95% Confidence interval	Total Population Estimate	95% Confidence interval
Steelhead	DP	**566**	9397.06	96.94	193.88	566	194
Steelhead	SP	**687**	16893.87	129.98	259.95	1279	598
Steelhead	Run	**173**	4301.39	65.59	131.17		
Steelhead	Riffle	**419**	68353.70	261.45	522.89		
					Total Steelhead Population Estimate	**1,845**	

East Fork Mill Creek 2008

Species	Habitat	Population Estimate	Sampling Variance	Standard Error	95% Confidence interval	Total Population Estimate	95% Confidence interval
Steelhead	DP	**99**	130.38	11.42	22.84	99	23
Steelhead	SP	**162**	63.90	7.99	15.99	301	110
Steelhead	Run	**21**	103.97	10.20	20.39		
Steelhead	Riffle	**117**	2868.90	53.56	107.12		
					Total Steelhead Population Estimate	**400**	

East Fork Mill Creek 2009

Species	Habitat	Population Estimate	Sampling Variance	Standard Error	95% Confidence interval	Total Population Estimate	95% Confidence interval
Steelhead	DP	**378**	838.70	28.96	57.92	378	58
Steelhead	SP	**466**	3115.62	55.82	111.64	684	112
Steelhead	Run	**4***	0.00	0.00	0.00		
Steelhead	Riffle	**218**	0.00	0.00	0.00		
					Total Steelhead Population Estimate	**1,061**	

*-Estimates are hard counts

Table 12. Population estimates for 1+ coastal cutthroat trout for the East Fork Mill Creek, 2007-2009.

East Fork Mill Creek 2007

Species	Habitat	Population Estimate	Sampling Variance	Standard Error	95% Confidence interval	Total Population Estimate	95% Confidence interval
Cutthroat	DP	**76**	145.61	12.07	24.13	76	24
Cutthroat	SP	**108**	858.10	29.29	58.59	149	76
Cutthroat	Run	**18**	80.46	8.97	17.94		
Cutthroat	Riffle	**23**	501.10	22.39	44.77		
					Total Cutthroat Trout Population Estimate	**226**	

East Fork Mill Creek 2008

Species	Habitat	Population Estimate	Sampling Variance	Standard Error	95% Confidence interval	Total Population Estimate	95% Confidence interval
Cutthroat	DP	**43**	429.87	20.73	41.47	43	41
Cutthroat	SP	**58**	20.87	4.57	9.14	108	52
Cutthroat	Run	**15**	53.05	7.28	14.57		
Cutthroat	Riffle	**35**	612.03	24.74	49.48		
					Total Cutthroat Trout Population Estimate	**151**	

East Fork Mill Creek 2009

Species	Habitat	Population Estimate	Sampling Variance	Standard Error	95% Confidence interval	Total Population Estimate	95% Confidence interval
Cutthroat	DP	**78**	785.41	28.03	56.05	78	56
Cutthroat	SP	**392**	16645.67	129.02	258.04	392	258
Cutthroat	Run	**1***	0.00	0.00	0.00		
Cutthroat	Riffle	**0***	0.12	220.21	14.84		
					Total Cutthroat Trout Population Estimate	**470**	

*-Estimates are hard counts

C. Summary of Population Estimates 1994 through 2009

Summary data from previous summer coho population estimates for the WB are shown in Table 14. Population estimates made in 1994 were made by Joe Scriven as part of Masters Thesis work conducted in 1994. Surveys conducted in 1999 and 2000 contained sampling errors that lead to underestimates in population size. Juvenile estimates in 1999 did not include deep pools and in 2000, estimates could not be expanded for shallow pools, due to the limited number of units that were calibrated.

Table 13. Population estimates for YOY Chinook salmon for the East Fork Mill Creek, 2007-2009.

East Fork Mill Creek 2007							
Species	Habitat	Population Estimate	Sampling Variance	Standard Error	95% Confidence interval	Total Population Estimate	95% Confidence interval
Chinook	DP	**185**	1472.47	38.37	76.75	185	77
Chinook	SP	**827**	163697.94	404.60	809.19	931	809
Chinook	Run	**104**	80.46	8.97	17.94		
Chinook	Riffle	**0**	0.00	0.00	0.00		
					Total Chinook Population Estimate	**1,116**	

East Fork Mill Creek 2008							
Species	Habitat	Population Estimate	Sampling Variance	Standard Error	95% Confidence interval	Total Population Estimate	95% Confidence interval
Chinook	DP	**4***	0.00	0.00	0.00	4	0
Chinook	SP	**0**	0.00	0.00	0.00	0	0
Chinook	Run	**0**	0.00	0.00	0.00		
Chinook	Riffle	**0**	0.00	0.00	0.00		
					Total Chinook Population Estimate	**4**	

East Fork Mill Creek 2009							
Species	Habitat	Population Estimate	Sampling Variance	Standard Error	95% Confidence interval	Total Population Estimate	95% Confidence interval
Species	Habitat	Population Estimate	Sampling Variance	Standard Error	95% Confidence interval	Total Population Estimate	95% Confidence interval
Chinook	DP	**40**	249.20	15.79	31.57	40	32
Chinook	SP	**0***	0.00	0.00	0.00	0	0
Chinook	Run	**0***	0.00	0.00	0.00		
Chinook	Riffle	**0**	0.00	0.00	0.00		
					Total Chinook Population Estimate	**40**	

-*Estimates are hard counts

Table 14. Summary of juvenile coho salmon summer population estimates for the West Branch Mill Creek, 1994 – 2009.

Year	Population Estimate	Length of Primary Channel (mi)
1994	*7,811	0.42
1995	*5,208	6.35
1996	10,316	6.88
1997	10,911	4.53
1998	3,817	5.69
1999	1,789	5.46
2000	6,472	5.44
2001	6,511	5.10
2002	13,444	5.10
2003	22,542	6.20
2004	8,336	5.20
2005	24,527	5.79
2006	23,999	5.69
2007	**13,826**	**6.23**
2008	**15,569**	**5.89**
2009	**8,628**	**5.93**

* Deep pool habitat type was not used in Scriven's (1994) and Moyer 1995-survey methodology

Summary data are presented for EF summer coho population estimates in Table 15. Dive surveys for juvenile coho salmon were only conducted on the EF in 1995, 1996 and 2004-2009. Dive counts made for coho salmon in 1995 and, 1996 do not include any EF tributaries. From 2004 - 2009, surveys were expanded to capture the majority of anadromous habitat in the EF, which includes Bummer Lake Creek, Chewie Creek and Low Divide Creek. In 2007, Chewie Creek was not sampled.

Table 15. Summary of juvenile coho salmon population estimates for the East Fork Mill Creek, 1995, 1996 and 2004 through 2009.

Year	Population Estimate	Length of Primary Channel (mi)
1995	*1,968	4.13
1996	2,963	4.04
2004	3,957	5.04
2005	12,067	6.32
2006	9,418	5.12
2007	**†4,491**	**5.23**
2008	**8,605**	**6.02**
2009	**9,934**	**6.23**

* Deep pool habitat type was not used Moyer (1995) survey methodology.

† Chewie Creek was not sampled in 2007.

4.2 Adult Spawning Surveys

For purposes of presenting spawning survey information, Mill Creek was divided into three main study sections; West Branch (WB), East Fork (EF) and Mainstem. The WB consists of four survey reaches totaling 4.75 miles (Table 3, Fig. 1), however only the WB Reach 2 and WB Reach 3 were surveyed on a weekly basis. The EF consists of five survey reaches (including Bummer Lake Creek and Chewie Creek) totaling 5.4 miles, however First Gulch is only spot checked during peak flows. The Mainstem Mill Creek consists of two reaches totaling 1.5 miles (Table 3, Fig. 1), which are surveyed sporadically during lower flows. One additional study section includes Rock Creek, tributary to the South Fork Smith River. This survey reach is 0.5 miles in length (Table 3, Fig. 1). Data is summarized by study section. Appendices A-D contain detailed weekly surveys and escapement by reach for the 2007/08, and 2008/09 survey periods.

A. Survey Duration and Specifics

Survey year 2007/08 (WY 2008) was initiated on 23 October after a significant storm event allowed Chinook to migrate into Mill Creek and tributaries (Fig. 5). Most reaches were first surveyed by the end of the first week of November 2007, and with few exceptions, continued on a weekly basis for all reaches until 08 Feb 2008. Eighty-nine spawner surveys were performed during the 2007/08-survey period. Most Chinook were observed throughout the system from early November 07 through early January 08. Most coho were observed in January 08 and steelhead in January and February 08. Weekly counts for individual reaches are listed in Appendix A.

The first 2008/09 (WY 2009) spawner surveys were conducted on 25 October, although the first significant rains of the season were not until early November (Fig. 6). After this early November rain event, Mill Creek flows increased significantly and Chinook salmon moved into the system. Thus, we commenced with our weekly surveys and most reaches had been surveyed at least once by the end of the second week of November 2008. With few exceptions, surveys continued on a weekly basis for all reaches until 18 Feb 2008. Ninety-two spawner surveys were performed during the 2008/09-survey period. Most Chinook were observed throughout the system from early November 08 through early January 09. Most coho were observed in January 09 and steelhead in January and February 09. Weekly counts for individual reaches are listed in Appendix B.

B. Minimum Chinook and coho salmon Escapement Estimates - Mill Creek

Stimson Lumber Company (since WY 1994) and the University of California Cooperative Extension (since WY 1981) have monitored Chinook and coho salmon escapement on the WB. Table 16 shows the combined minimum escapement estimates from the two study reaches on the WB reported since 1993. Surveys of WB Reach 2 by the University of California Cooperative Extension were taken over by the MCFMP in 2004. Minimum escapement estimates for WB Chinook salmon in WY 2008, and WY 2009 were 147 and 263 respectively. Minimum escapement estimates for WB coho salmon in WY 2008, and WY 2009 were 28 and 12 respectively (Table 16).

Chinook and coho salmon have been monitored on the EF since WY 1994. Table 17 shows the combined minimum escapement estimates from the five study reaches for Chinook and coho salmon on the EF since WY 1994. Minimum escapement estimates for EF Chinook salmon in WY 2008, and WY 2009 were 66 and 160 respectively. Minimum escapement estimates for EF coho salmon in WY 2008, and WY 2009 were 6 and 16 respectively (Table 17).

The Mill Creek Fisheries Monitoring Program has monitored Chinook and coho salmon on the Mainstem Mill Creek since WY 2003. Table 18 shows the combined minimum escapement estimates from the two reaches for Chinook and coho salmon on the Mainstem Mill Creek. Minimum escapement estimates for Mainstem Mill Creek Chinook and coho salmon in 2008 were 22 and 2 respectively (Table 18). Minimum escapement estimates for Mainstem Mill Creek Chinook and coho salmon in 2009 were 55 and 2 respectively (Table 18). These surveys are conducted on an opportunistic basis when flows are conducive for viewing.

Table 16. West Branch Mill Creek Chinook and coho salmon minimum escapement estimates (WY 1994 - 2009).

Water Year	Chinook Salmon Observed	Coho Salmon Observed
1994	113	114
1995	203	36
1996	245	51
1997	206	45
1998	183	6
1999	219	3
2000	183	10
2001	356	18
2002	444	35
2003	371	85
2004	*214	*20
2005	*323	*175
2006	*189	*22
2007	*194	*11
2008	***147**	***28**
2009	***263**	***12**

*Count includes the West Branch Reach 1.

C. Minimum Chinook and coho salmon Escapement Estimates Rock Creek

Spawning habitat is limited within Rock Creek due to its high gradient and boulder-dominated substrate. The short reach where annual spawning surveys have been conducted since WY 1995 does not typically yield large numbers of Chinook salmon, and coho salmon have never been observed reproducing in the drainage. Chinook may primarily spawn lower in the watershed, taking advantage of patchily distributed spawning habitat that occurs below the study section. However, this section of Rock Creek, discovered during 1994 Flosi and Reynolds habitat surveys, is the longest consistent stretch of lower gradient, small substrate spawning habitat available in the entire anadromous length of this tributary. The minimum escapement estimate for Rock Creek Chinook in WY 2008 and 2009 was 10 and 50 respectively (Table 19). As usual, no coho salmon were observed in Rock Creek during WY 2008 or 2009.

Table 17. East Fork Mill Creek Chinook and coho salmon minimum escapement estimates (WY 1994 - 2009).

Water Year	Chinook Salmon Observed	Coho Salmon Observed
1994	*20	*29
1995	114	45
1996	106	29
1997	150	26
1998	156	10
1999	141	1
2000	156	2
2001	315	10
2002	333	19
2003	261	35
2004	227	9
2005	170	55
2006	129	27
2007	97	7
2008	**66**	**6**
2009	**160**	**16**

* Count does not include Bummer Lake, Low Divide or Kelly Creek reaches.

Table 18. Mainstem Mill Creek Chinook and coho salmon minimum escapement estimates (WY 2003 - 2009).

Water Year	Chinook Salmon Observed	Coho Salmon Observed
2003	87	1
2004	47	0
2005	98	7
2006	26	0
2007	18	0
2008	**22**	**2**
2009	**55**	**2**

Table 19. Rock Creek Chinook and coho salmon minimum escapement estimates (WY 1995 - 2009).

Year	Chinook Salmon Observed	Coho Salmon Observed
1995	12	0
1996	29	0
1997	35	0
1998	22	0
1999	11	0
2000	59	0
2001	21	0
2002	77	0
2003	16	0
2004	17	0
2005	6	0
2006	10	0
2007	15	0
2008	**10**	**0**
2009	**50**	**0**

D. Chinook and Coho Salmon Redd Counts

In WY 2008, a total of 340 Chinook, 23 coho and 106 unknown redds were observed on the two combined WB reaches. In WY 2009, 193 Chinook, 24 coho, and 64 unknown redds were observed on the WB (Table 20). For the five combined EF reaches, a total of 143 Chinook, 12 coho and 100 unknown redds were observed in WY 2008. For these same five reach, a total of 188 Chinook, 21 coho and 61 unknown redds were observed in WY 2009 (Table 21). For the two Mainstem Mill Creek reaches, a total of 51 Chinook, 4 coho, and 7 unknown redds were observed in 2007. These same reaches had a total of 40 Chinook, 0 coho, and 4 unknown redds (Table 22). For Rock Creek a total of 19 Chinook and 1 unknown redds were observed in WY 2008, and 38 Chinook redds were observed in WY 2009 (Table 23). No known coho redds were observed in Rock Creek during WY 2008 or 2009.

E. Steelhead and Coastal Cutthroat Trout Spawner Data

Steelhead and coastal cutthroat trout were observed incidentally during spawning surveys in WY 2008 and 2009. However, due to the difficulties of observing these species with any consistency, minimum escapements were not determined and these numbers should not be considered estimations of run size. In WY 2008, a total of 92 cutthroat, 36 steelhead and 280 steelhead redds were observed in all survey reaches combined. In WY 2009 a total of 109 cutthroat, 34 steelhead and 330 steelhead redds were observed in all reaches combined (Table 24).

Table 20. West Branch Mill Creek salmon redd data, WY 1995 - 2009.

	Chinook Salmon			**Coho Salmon**			**Unknown**
Water Year	Known Redds	Unknown Redds	**Total Redds**	Known Redds	Unknown Redds	**Total Redds**	**Unknown Redds**
1995	145	52	197	17	27	44	0
1996	186	23	209	17	8	25	0
1997	239	9	248	31	37	68	0
1998	164	8	172	6	4	10	0
1999	158	0	158	1	2	3	0
2000	82	0	82	2	0	2	0
2001	63	0	63	2	0	2	0
2002	116	NA	116	24	NA	24	72
2003	74	NA	74	108	NA	108	46
2004	291	NA	291	33	NA	33	63
2005	447	NA	447	414	NA	414	324
2006	537	N/A	537	35	N/A	35	335
2007	376	N/A	376	14	N/A	14	111
2008	**340**	**N/A**	**340**	**23**	**N/A**	**23**	**106**
2009	**193**	**N/A**	**193**	**24**	**N/A**	**24**	**64**

Table 21. East Fork Mill Creek salmon redd data, WY 1995 - 2009.

	Chinook Salmon			**Coho Salmon**			**Unknown**
Water Year	Known Redds	Unknown Redds	**Total Redds**	Known Redds	Unknown Redds	**Total Redds**	**Unknown Redds**
1995	170	58	228	15	24	39	0
1996	124	22	146	33	6	39	0
1997	205	32	237	26	37	63	0
1998	205	8	213	3	1	4	0
1999	128	0	128	1	0	1	0
2000	198	0	198	2	0	2	0
2001	242	0	242	10	0	10	0
2002	464	NA	464	36	NA	36	95
2003	435	NA	435	132	NA	132	111
2004	301	NA	301	14	NA	14	89
2005	290	NA	290	136	NA	136	205
2006	281	N/A	281	35	N/A	35	181
2007	253	N/A	253	8	N/A	8	86
2008	**143**	**N/A**	**143**	**12**	**N/A**	**12**	**100**
2009	**188**	**N/A**	**188**	**21**	**N/A**	**21**	**61**

Table 22. Mainstem Mill Creek salmon redd data, WY 2003 - 2009.

	Chinook Salmon			**Coho Salmon**			**Unknown**
Water Year	Known Redds	Unknown Redds	**Total Redds**	Known Redds	Unknown Redds	**Total Redds**	**Unknown Redds**
2003	118	N/A	118	1	N/A	1	6
2004	51	N/A	51	0	N/A	0	13
2005	104	N/A	104	0	N/A	0	53
2006	6	N/A	6	0	N/A	0	0
2007	24	N/A	24	0	N/A	0	4
2008	**51**	**N/A**	**51**	**4**	**N/A**	**4**	**7**
2009	**40**	**N/A**	**40**	**0**	**N/A**	**0**	**4**

Table 23. Rock Creek salmon redd data, WY 1995 - 2009.

	Chinook Salmon			**Coho Salmon**			**Unknown**
Water Year	Known Redds	Unknown Redds	**Total Redds**	Known Redds	Unknown Redds	**Total Redds**	**Unknown Redds**
1995	NA	NA	NA	NA	NA	NA	NA
1996	46	3	49	0	0	0	0
1997	33	2	35	0	0	0	0
1998	32	0	32	0	0	0	0
1999	13	0	13	0	0	0	0
2000	63	4	67	0	0	0	0
2001	39	3	42	0	0	0	0
2002	121	NA	121	0	NA	0	4
2003	31	NA	31	0	NA	0	9
2004	33	NA	33	0	NA	0	9
2005	8	NA	8	0	NA	0	17
2006	46	NA	46	0	NA	0	4
2007	57	N/A	57	0	N/A	0	1
2008	**19**	**N/A**	**19**	**0**	**N/A**	**0**	**1**
2009	**38**	**N/A**	**38**	**0**	**N/A**	**0**	**0**

Table 24. Steelhead, steelhead redds and coastal cutthroat trout observed during spawner surveys, WY 2008 and 2009 (Totals are bolded).

Stream Reach	2008			2009		
	Cutthroat	Steelhead	Steelhead Redds	Cutthroat	Steelhead	Steelhead Redds
WEST BRANCH						
Upper West	40	10	114	42	2	114
WB Reach 2	31	9	4	44	7	58
WB Reach 1	0	0	0	1	3	4
Total	**71**	**19**	**118**	**87**	**12**	**176**
EAST FORK MILL CREEK						
EF Reach 2	2	1	56	4	5	72
EF Reach 1	1	6	26	3	7	56
Kelly/Chewie	4	5	20	0	0	4
Bummer Lake	2	3	2	1	0	14
Low Divide	0	0	4	2	0	8
Total	**9**	**15**	**108**	**10**	**12**	**154**
MAINSTEM						
Upper	0	0	6	1	5	0
Lower	5	0	10	0	4	0
Total	**5**	**0**	**16**	**1**	**9**	**0**
ROCK CREEK	7	2	38	11	1	0
Totals	**92**	**36**	**280**	**109**	**34**	**330**

4.3 Juvenile Outmigration Trapping

In 2008, juvenile outmigration traps were operated on the WB and EF from 29 Feb through 22 Jul, a period of 143 days. During this period, traps did not operate for a total of 2 days on each tributary due to high flows (see Fig. 7).

In 2009, juvenile outmigration traps were operated on the WB and EF from 13 Mar through 30 Jun, a period of 110 days. During this period, traps did not operate for a total of 18 days on the WB and 20 days on the EF due to high flows (See Fig. 8).

During non-operation periods, traps and ramps were either inundated so as to allow fish to escape, or the traps were pulled completely out of the water until flows subsided. In some cases excessive debris loads clogged a pipe, ramp or trap box, preventing proper trap operation or causing water to back up the ramp, allowing fish to escape. In some of these latter cases fish were captured and processed, but as far as trapping effort is concerned those days were grouped with the no-effort days and are referred to as days where we were not effectively trapping.

A. Species Composition

Ten fish, four amphibian, and one crustacean species were captured during juvenile outmigration trapping on the WB and EF during the 2008 and 2009 trapping seasons (Table 25). The majority of fish captured were in the genus *Oncorhynchus*, however, several incidental captures included species of lamprey, stickleback, sucker, and sculpin (Table 25).

Table 25. Species captured during outmigration trapping in the Mill Creek drainage, 2008, and 2009.

Common Name	Scientific Name
Coastal Cutthroat Trout	*Oncorhynchus clarki clarki*
Steelhead Trout	*Oncorhynchus mykiss*
Coho Salmon	*Oncorhynchus kisutch*
Chinook Salmon	*Oncorhynchus tshawytscha*
Pacific Lamprey	*Lampetra tridentata*
Western Brook Lamprey	*Lampetra richardsoni*
Lamprey Ammocetes	*Lampetra Sp.*
Prickly Sculpin	*Cottus asper*
Coastrange Sculpin	*Cottus aleuticus*
Three-spined Stickleback	*Gasterosteus aculeatus*
Klamath Small-scale Sucker	*Catostomus rimiculus*
Coastal Giant Salamander	*Dicamptodon tenebrosus*
Foothill Yellow –legged frog	*Rana boylii*
Northern Red-legged frog	*Rana aurora aurora*
Tailed Frog	*Ascaphus truei*
Crayfish	*Pacifastacus spp*

B. Species Abundance

Species abundance within the WB and EF drainage has fluctuated yearly since trap installation in 1994. Abundance figures reflect the total number of each species captured and handled at each trap site. Observed variability in abundance can be an expression of trap efficiency, adult escapement and overall freshwater survival, and should not be considered an indicator of species population size. The total numbers of fish caught in 2008 and 2009 and for the previous fourteen years of trapping are listed in Tables 26 and 27.

C. Population Estimates

Tables 28 and 29 show the WB and EF coho, steelhead and coastal cutthroat trout smolt population estimates from 1994 through 2009. Estimates for 2001 through 2009 were derived using DARR 2.0, which provides an output graph showing the estimated number of smolts (N), capture periods, and estimated capture efficiencies (x) (Figs 9-20). The yellow highlighted areas on the figures indicate where strata were pooled to estimate population size for weeks where limited numbers of smolts were recaptured. Although 1994 –2000 population estimates were derived using other methods (primarily the Bootstrap Trap Efficiency Program), they are included in Tables 28 and 29 for comparison. Estimates of coho salmon, steelhead, and coastal cutthroat trout smolts emigrating from the WB in 2008 were 3,731 (± 164), 1514 (± 240), and 702 (± 59) smolts, respectively. Estimates of coho salmon, steelhead, and coastal cutthroat trout smolts emigrating from the WB in 2009 were 4,535 (± 452), 772 (± 103), and 1005 (± 132) smolts, respectively.

Population estimates for coho salmon, steelhead, and coastal cutthroat trout smolts emigrating from the EF in 2008 were 1,234 (± 37), 541 (± 37) and 1,032 (± 92) smolts, respectively.
Population estimates for coho salmon, steelhead, and coastal cutthroat trout smolts emigrating from the EF in 2009 were 1,766 (± 164), 1210 (± 346) and 1,010 (± 78) smolts, respectively.

D. Smolt Size and Condition

Tables 30-32 depict the size range and mean length for smolting coho salmon, steelhead and coastal cutthroat trout, captured in the WB and EF from 1994 - 2009. Mean lengths of smolts captured in 2008 and 2009 fell within the ranges observed for each species in previous years (Tables 30-32).

Table 33 shows the size range and mean lengths for all non-smolting salmonids captured in the WB and EF in 2008 and 2009. YOY coho salmon, Chinook salmon and trout are considered to be age 0+. Trout YOY are assumed to be primarily steelhead, however a small percentage may be cutthroat, therefore they are placed in the general "trout" classification.

Trout "parr" are considered 1+ (at least one year but less than 2-year old) fish. For identification purposes, we grouped almost all trout parr under 100mm in length into the trout category because it is often difficult to distinguish between steelhead and cutthroat in this size range. It is believed, however that the majority of "trout parr" are steelhead. In 2008, trout parr ranged in size from 47 to 99mm, with a mean length of 85mm on both the WB and EF (Table 33). In 2009, trout parr ranged in size from 55 to 99mm, with a mean length of 86mm on the WB and 85mm on the EF (Table 33). Pre-smolting steelhead and cutthroat trout are those fish that have not lost their parr marks, but are easily identifiable as either species. These pre-smolting steelhead and cutthroat trout show no indication of smoltification at time of capture and are assumed to be fish that are two to three years in age, under-going a general redistribution within the watershed. This behavior has been observed annually within pre-smolting steelhead and cutthroat life histories within Mill Creek. Pre-smolting steelhead and cutthroat trout can be of similar size to smolting fish, however their mean size is generally smaller. In 2008, steelhead pre-smolts ranged from 100-161mm with mean lengths of 113mm and 114mm on the WB and EF respectively. In 2009, steelhead pre-smolts ranged from 100-152mm with mean lengths of 114mm and 115mm on the WB and EF respectively (Table 33). In 2008, pre-smolt cutthroat ranged in size from 66-138mm, with mean lengths of 106mm and 111mm on the WB and EF respectively. In 2009, pre-smolt cutthroat ranged in size from 77-135mm, with mean lengths of 108mm and 109mm on the WB and EF respectively (Table 33).

Table 26. West Branch Mill Creek seasonal trap totals by species and life history stage, 1994-2009.

Species	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	**2008**	**2009**	**Yearly Avg.**
Coho Salmon																	
YOY (0+)	4580	84	539	1067	36	0	93	198	2784	1799	203	6076	6008	991	**2942**	**318**	1732
Smolt (1+)	462	1470	195	626	1394	677	817	3682	1209	1151	901	234	2567	1163	**2435**	**2453**	1340
Chinook Salmon																	
Adult (Spawners)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	**0**	**0**	0
Smolt (1+)	0	0	0	0	0	0	0	0	0	0	0	1	2	0	**26**	**0**	2
YOY Smolt (0+)	7589	8198	14236	48917	19743	18757	21401	89991	80541	36842	37787	35644	46844	141136	**117801**	**22175**	46725
Chum Salmon																	
Smolt (0+)	0	0	100	0	0	5	4	0	621	0	0	0	0	0	**0**	**0**	46
Steelhead Trout																	
Adult	33	8	61	82	60	38	44	71	49	25	90	30	32	29	**32**	**24**	44
Smolt (2 - 3+)	252	57	328	823	439	374	1112	606	312	63	221	168	171	246	**310**	**260**	359
Pre-smolt (1 - 3+)	*	869	427	645	477	725	746	1149	519	709	162	194	1038	384	**958**	**600**	640
Coastal Cutthroat Trout																	
Adults	11	15	20	44	35	30	28	4	4	18	7	3	29	10	**18**	**10**	18
Smolt (2 - 3+)	40	18	205	601	391	289	496	297	283	292	205	97	541	166	**277**	**298**	281
Pre-smolt (1 - 3+)	252	498	35	175	436	95	381	296	217	92	52	35	118	55	**90**	**144**	186
Trout (Cutthroat/Steelhead)																	
YOY (0+)	5908	12874	3321	12581	17403	9859	3652	5903	3644	10941	6809	7714	33861	15800	**17030**	**3442**	10671
Parr (1+)	1531	981	612	1114	3216	2034	4368	3533	977	917	798	345	759	951	**2589**	**1867**	1662
Pacific Lamprey	100	15	23	51	32	50	131	56	1	39	26	57	110	26	**98**	**131**	59
Brook Lamprey	0	0	32	5	6	0	45	138	49	2	2	4	11	2	**51**	**8**	22
Prickly Sculpin	30	110	36	142	181	101	131	81	53	118	63	77	103	26	**95**	**78**	89
Coastrange Sculpin											101	103	311	315	**581**	**543**	326
Three-spined Stickleback	214	11	22	25	11	6	27	84	44	42	30	84	19	19	**17**	**14**	42
Klamath Small-scale Sucker	6	14	154	8	135	836	86	557	40	7	68	40	58	248	**193**	**93**	159

Table 27. East Fork Mill Creek seasonal trap totals by species and life history stage, 1994-2009.

Species	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	**2008**	**2009**	**Yearly Avg.**
Coho Salmon																	
YOY (0+)	1513	41	377	632	34	0	175	66	260	1220	76	123	285	230	**1859**	**46**	434
Smolt (1+)	457	411	75	176	1020	194	203	1921	899	552	722	200	945	1384	**971**	**666**	675
Chinook Salmon (0+)																	
Adult (Spawners)	0	0	0	0	0	0	0	0	0	0	0	0	1	0	**0**	**0**	0
Smolt (1+)	0	0	0	0	0	0	0	0	0	0	0	0	3	0	**0**	**0**	0
YOY Smolt (0+)	13340	2778	5831	14420	6330	13816	9102	26748	46600	9750	10231	2819	5534	33462	**29104**	**3950**	14613
Chum Salmon																	
Smolt (0+)	0	0	3	0	0	0	0	0	45	0	0	0	0	0	**0**	**0**	3
Steelhead Trout																	
Adult (Spawners)	67	30	39	103	56	25	77	74	56	28	143	66	10	56	**57**	**32**	57
Smolt (2 - 3+)	495	43	191	580	297	66	606	626	382	54	228	206	64	129	**289**	**196**	278
Pre-smolt (1 - 2+)	656	433	17	518	404	404	644	1518	1378	725	330	238	387	926	**668**	**269**	595
Coastal Cutthroat Trout																	
Adult (Spawners)	13	13	17	46	30	16	40	33	55	24	36	29	36	96	**64**	**33**	36
Smolt (2 - 3+)	117	25	239	528	373	446	560	585	1013	572	519	188	667	705	**569**	**355**	466
Pre-smolt (1 – 2+)	656	433	9	123	301	179	272	331	381	61	65	42	68	26	**51**	**71**	192
Trout (Cutthroat/Steelhead)																	
YOY (0+)	7359	4785	1634	9664	5867	8647	2364	4906	9114	10156	4441	714	7695	7039	**7642**	**280**	5769
Parr (1+)	2879	341	325	587	1611	1097	1814	2317	1441	798	514	270	510	1856	**943**	**659**	1123
Pacific Lamprey	224	16	26	80	40	47	68	21	3	11	16	29	15	28	**56**	**38**	45
Western Brook Lamprey	0	1	12	3	1	0	2	58	120	3	1	2	3	0	**1**	**1**	13
Prickly Sculpin	66	75	83	160	68	52	125	65	56	187	228	122	68	40	**70**	**78**	96
Coastrange Sculpin											199	55	98	145	**134**	**195**	138
Three-spined Stickleback	144	22	26	14	8	5	14	71	59	36	14	15	8	7	**7**	**10**	29
Klamath Small-scale Sucker	12	1	47	4	53	126	21	230	26	2	37	21	17	56	**11**	**18**	43

Table 28. DARR mean population estimates for smolting species of coho salmon, steelhead and coastal cutthroat trout on the West Branch Mill Creek 1994-2009.

West Branch Mill Creek DARR Mean Population Estimate

Species	1994*	1995*	1996*	1997*	1998*	1999*	2000*	2001	2002	2003	2004	2005	2006	2007	2008	2009	Mean
Coho Smolts	832	2717	1117	1261	4327 (±266)	1580	2265	10821 (±1160)	5004 (±585)	2931 (±253)	3832 (±469)	763 (±128)	**3981 (±226)**	**3129 (±226)**	**3731 (±164)**	**4535 (±452)**	**3302**
Steelhead Smolts	483	2252	1674	2961	2223	2375	4066	3980 (±951)	1893 (±311)	545 (±242)	1525 (±293)	550 (±121)	**1135 (±333)**	**1142 (±160)**	**1514 (±240)**	**772 (±103)**	**1818**
Cutthroat Smolts	469	1026	1772	1607	1065	672	1761	1841 (±492)	1364 (±192)	1565 (±352)	1099 (±165)	700 (±241)	**2178 (±554)**	**803 (±167)**	**702 (±59)**	**1005 (±132)**	**1227**

* Population estimates from 1995 through 2000 were calculated using the Bootstrap Trap Efficiency Program.

Table 29. DARR mean population estimates for smolting species of coho salmon, steelhead and coastal cutthroat trout on the East Fork Mill Creek 1994-2009.

East Fork Mill Creek DARR Mean Population Estimate

Species	1994*	1995*	1996*	1997*	1998*	1999*	2000*	2001	2002	2003	2004	2005	2006	2007	2008	2009	Mean
Coho Smolts	1224	932	1131	350	2332	259	2000	3184 (±183)	1631 (±128)	771 (±59)	1507 (±154)	496 (±109)	**1404 (±76)**	**3018 (±152)**	**1234 (±37)**	**1766 (±164)**	**1452**
Steelhead Smolts	1280	1965	1519	1129	795	227	1998	1555 (±114)	874 (±61)	392 (±161)	480 (±69)	539 (±96)	**300 (±109)**	**443 (±92)**	**541 (±37)**	**1210 (±346)**	**953**
Cutthroat Smolts	314	1457	1863	1405	832	1019	1280	1414 (±109)	1708 (±78)	1373 (±135)	1867 (±441)	1305 (±311)	**1092 (±111)**	**1464 (±76)**	**1032 (±92)**	**1010 (±78)**	**1277**

* Population estimates from 1995 through 2000 were calculated using the Bootstrap Trap Efficiency Program

Table 30. Mean size and size range of coho salmon smolts captured in two tributaries of the Mill Creek drainage, 1994 - 2009 (FL in mm).

West Branch Mill Creek	Size Range (mm)	Mean (mm)		**East Fork Mill Creek**	Size Range (mm)	Mean (mm)
1994	62-148	114		1994	62-148	115
1995	61-141	102		1995	62-145	107
1996	61-150	95		1996	61-136	100
1997	61-141	105		1997	61-133	104
1998	60-147	103		1998	75-150	106
1999	90-139	115		1999	95-145	116
2000	73-130	106		2000	75-131	108
2001	65-150	100		2001	76-143	105
2002	71-165	110		2002	68-148	110
2003	70-135	106		2003	73-134	108
2004	58-134	97		2004	68-141	104
2005	68-134	101		2005	82-127	109
2006	62-135	105		2006	83-131	106
2007	60-137	96		2007	80-129	104
2008	60-135	102		2008	71-135	108
2009	58-145	99		2009	78-135	103

Table 31. Mean size and size range of steelhead trout smolts captured in two tributaries of the Mill Creek drainage, 1994 - 2009 (FL in mm).

West Branch Mill Creek	Size Range (mm)	Mean (mm)		**East Fork Mill Creek**	Size Range (mm)	Mean (mm)
1994	140-220	172		1994	125-225	168
1995	139-195	159		1995	141-199	163
1996	102-232	175		1996	111-233	176
1997	102-234	174		1997	122-228	171
1998	105-221	165		1998	100-220	168
1999	130-221	164		1999	140-221	165
2000	120-260	165		2000	108-245	167
2001	120-260	165		2001	108-245	167
2002	128-226	168		2002	110-260	170
2003	126-213	162		2003	128-200	165
2004	129-218	163		2004	128-232	171
2005	109-221	172		2005	119-302	176
2006	130-217	167		2006	122-208	162
2007	111-230	169		2007	142-277	171
2008	130-227	164		2008	136-247	170
2009	134-202	158		2009	127-205	161

Table 32. Mean size and size range of coastal cutthroat trout smolts captured in two tributaries of the Mill Creek drainage, 1994 - 2009 (FL in mm).

West Branch Mill Creek	Size Range (mm)	Mean (mm)		East Fork Mill Creek	Size Range (mm)	Mean (mm)
1994	122-220	150		1994	113-205	150
1995	129-191	166		1995	119-198	165
1996	98-237	145		1996	106-213	148
1997	99-250	143		1997	100-232	145
1998	106-215	145		1998	105-196	149
1999	114-215	157		1999	122-204	155
2000	84-195	136		2000	89-215	147
2001	114-215	157		2001	122-204	154
2002	87-214	138		2002	91-233	147
2003	97-173	140		2003	105-191	147
2004	103-198	145		2004	98-210	146
2005	108-215	139		2005	113-198	142
2006	109-191	144		2006	113-206	147
2007	107-201	152		2007	101-205	153
2008	100-200	147		2008	104-200	149
2009	106-193	139		2009	118-199	145

Table 33. Mean size and size range of Young-of-Year (YOY), parr, pre-smolt and adult salmonids captured in the West Branch and East Fork Mill Creek, 2008 and 2009 (FL in mm).

	West Branch					East Fork			
	2008		2009			2008		2009	
	Size Range (mm)	Mean (mm)	Size Range (mm)	Mean (mm		Size Range (mm)	Mean (mm)	Size Range (mm)	Mean (mm)
Coho Salmon									
YOY (0+)	32-121	44	31-70	42		30-67	45	35-62	44
Chinook Salmon									
YOY Smolt (0+)	31-83	48	32-87	53		34-97	52	36-83	56
Smolt (1+)	69-115	90	--	--		--	--	--	--
Adult (2+)	--	--	--	--		--	--	--	--
Steelhead Trout									
Pre-smolt (2 - 3+)	100-161	113	100-148	114		100-150	114	100-152	115
Adults	470-840	663	480-795	645		330-790	621	430-775	594
Cutthroat Trout									
Pre-smolts (1+)	66-128	106	77-131	108		90-138	111	87-135	109
Adult (3+)	132-320	207	108-347	229		171-430	214	160-350	224
Trout									
YOY (0+)	25-71	42	23-79	46		26-84	44	27-71	44
Parr (1+)	57-99	85	61-99	86		47-99	85	55-99	85

As in previous years, steelhead adults captured in the traps all appeared to have been "kelts" or "runbacks" (fish that had spawned and were heading back downstream to the ocean). In 2008, runbacks range in size from 330-840mm, with mean lengths of 663mm and 621mm on the WB and EF respectively (Table 33). Of the 89 adult steelhead captured in 2008, 8.9% (7 males and 3 females) had clipped adipose fins indicating hatchery origin. In 2009, runbacks range in size from 430-795mm, with mean lengths of 645mm and 594mm on the WB and EF respectively (Table 33). Of the 56 adult steelhead captured in 2009, 21.4% (9 males and 3 females) were of hatchery origin. Cutthroat trout adults were identified as those fish that showed neither parr marks nor evidence of smoltification. Adult cutthroat can have several different looks, which may indicate residency or "sea run" life histories. We attempt to distinguish between the life histories, however for the purposes of this report and describing size range, both life histories are grouped under cutthroat adults. In 2008, adult cutthroat ranged in size from 132 to 430mm, with mean lengths of 207 and 214mm on the WB and EF respectively. In 2009, adult cutthroat ranged in size from 108 to 350mm, with mean lengths of 229 and 224mm on the WB and EF respectively (Table 33).

E. Trap Mortality

Trap design and construction was effective in reducing mortality below threshold levels prescribed by the California Department of Fish and Game. Mortality levels exceeding 5% of the population trapped during a given day or over the trapping season will initiate permit review. Because Southern Oregon/Northern California Coast Coho Salmon are a State and Federally listed species, their mortality is of particular concern and is therefore displayed separately. Mortality levels are presented in Table 34 as a percent of the total population trapped over the entire trapping season. Total mortality of all salmonid species and life stages combined in 2008 was 0.69% for the WB trap and 0.27% for the EF trap (Table 34). Total mortality of coho salmon alone in 2008 was 0.32% for the WB trap and 0.16% for the EF trap (Table 34). Total mortality of all salmonid species and life stages combined in 2009 was 1.42% for the WB trap and 0.49% for the EF trap (Table 34). Total mortality of coho salmon alone in 2009 was again 0.32% for the WB trap and 0.42% for the EF trap (Table 34).

Table 34. Percent of salmonid population lost from trap mortality in two tributaries of the Mill Creek drainage, 2008-2009.

2008	**Percent Mortality**	
Trap Location	**All Salmonids**	**Coho only**
West Branch Mill Creek	0.69%	0.32%
East Fork Mill Creek	0.27%	0.16%

2009	**Percent Mortality**	
Trap Location	**All Salmonids**	**Coho only**
West Branch Mill Creek	1.42%	0.32%
East Fork Mill Creek	0.49%	0.42%

4.4 Overwinter Survival

Estimated overwinter survival rates for coho smolt populations of the WB and EF since 1995 are shown in Tables 35 & 36. On the WB over-winter survival of coho appears to have varied considerably over the years (Table 35). Omitting the 1994 and 1998-2000 data (see footnotes of Table 35) the average coho overwinter survival on has been 27% on the WB. Since 2007 coho overwinter survival on the WB has been about average (Table 35). Overwinter survival on the EF has not varied as much as on the WB and has averaged 19% since 1996-97 (1995-96 0+ estimates did not include EF tributaries) (Table 36). Since 2006 coho overwinter survival on the EF has been above average (Table 35).

Table 35. Over-winter survival estimates for coho salmon smolts in the West Branch of Mill Creek, WY 1995 –2009.

WB Mill Creek	0+ Population	Smolt Population	Over-winter Survival (%)
1994 - 95	7,811[1]	2,717	**35%**
1995 - 96	5,208	1,117	**21%**
1996 - 97	10,316	1,392	**12%**
1997 - 98	10,911	4,327	**40%**
1998 - 99	3,817	1,580	**41%**
1999 - 00	*1,789	2,265	**127%**
2000 - 01	*6,472	10,821	**167%**
2001 - 02	6,511	5,004	**77%**
2002 - 03	13,444	2,931	**22%**
2003 - 04	22,542	3,832	**17%**
2004 - 05	8,336	763	**9%**
2005 - 06	24,527	3,981	**16%**
2006 - 07	23,999	3,129	**13%**
2007 - 08	13,826	3,731	**27%**
2008 - 09	15,569	4,535	**29%**

[1] The young-of-the-year population shown for 1994 is not a population estimate, rather an estimate of relative abundance (Scriven 1997).

*As noted in Section 4.1(C), deep pool habitat units were not surveyed, drastically underestimating 0+ coho population.

Table 36. Over-winter survival rates for coho salmon smolts in the East Fork of Mill Creek, WY1995 through 2007.

EF Mill Creek	0+Population	Smolt Population	Over-winter Survival (%)
1995 - 96	*1,968	1,131	**57%**
1996 - 97	2,963	350	**12%**
2004 - 05	3,957	496	**12%**
2005 - 06	12,067	1,404	**12%**
2006 - 07	9,418	3,018	**32%**
2007 - 08	4,491	1,234	**27%**
2008 - 09	8,605	1,766	**21%**

*As noted in Section 4.1(C), Bummer Lake, Low Divide and Chewie Creeks were not surveyed for the 0+ coho population estimate.

5.0 DISCUSSION

5.1 Juvenile Summer Population Estimate

Shortly after emerging, young-of-the-year (0+) coho salmon establish territories within suitable rearing habitat, characterized by the presence of low velocity waters. In any given year, young of the year coho survival will be dependent on factors such as adult escapement and redd survival, but will ultimately be limited by the quantity and quality of summer slow water habitat. Typically, the maximum number of juvenile (0+) coho salmon that can be supported by very good summer habitat is small relative to the number of fry a few successful redds can produce. Because of this, spawning gravel availability and egg mortality are rarely important in coho population dynamics, as observed in Mill Creek (Stillwater Sciences 2006). Any density dependent mortality that might result from redd superimposition or density independent mortality (redd scour or poor gravel) are usually irrelevant, because far more fry are typically produced than can be supported by the available habitat (Stillwater 2006).

Population estimates for 0+ coho salmon in 2007 on both the WB and EF were substantially lower than the previous two years. This is indicative of the low escapement observed in the winter of 2006/07. Adult Coho escapement was substantially lower than the previous two years. The relatively low numbers of emigrating 0+ coho captured in the WB during the 2007 trapping season indicate that few fish were being forced out of the system due to overcrowding and competition for territories, which also can be seen in 1998, 1999, 2000, 2001, and 2004. This trend is similar, but not as apparent in the EF data.

In 2008, 0+ coho population estimates increased in both tributaries, but the EF showed a more dramatic increase than the WB, nearly doubling from the previous year (Tables 14 and 15, Fig. 21). The 2008 WB 0+ coho population estimate only increased by about 10% from the previous year (Table 14, Fig. 21).

In 2009 the WB coho population showed a substantial drop while the EF population increased slightly. In 2009, for the first time since we have been collecting summer population data on both tributaries, the EF appeared to have a higher summer coho population than the WB. Traditionally, the EF summer coho population has been at least half that of the WB (Tables 14 and 15, Fig. 21).

Most of the differences in the summer coho population trends between the two Mill Creek tributaries appear to be found in the pool habitats, particularly shallow pools. From 2007 to 2009, the 0+ coho population estimate for shallow pools has steadily decreased in the WB while steadily increasing in the EF (Fig. 22). We believe this is likely a result of an increase in both the quantity and quality of shallow pool habitat in the EF. Beginning in 2006 Redwood National and State Parks has constructed a total of 80 complex wood jams (CWJ's) within riffle and run habitats of the EF (Fiori et al. 2009). These CWJ's have produced and maintained scour depths of 2 to 3.5 feet (shallow pools) and also provide an abundance of LWD cover for juvenile coho. Habitat data does show an increasing trend in total length of pool habitat since 2006 (Table 5), but total habitat lengths seem to fluctuate quite a bit, even when adjusted for yearly variation in total length of primary channel sampled. This is due not only to natural stream dynamics, but also to varying flows at the time of the surveys. Slight changes in flow due to a recent rain or prolonged dry spells can knock some habitat units into an adjacent category. Thus surveys done during dry sampling periods will show more shallow water habitats, as opposed to surveys done during wet sampling periods. Never-the-less, CWJ sites have created pool habitat where run or riffle habitat once was, and it is likely that the total length of pool habitat would have been less if the CWJ's had not been constructed.

It appears that the increased pool habitat created by the recent addition of CWJ's in the EF is supporting a larger number of 0+ coho than would have been the case under the previous habitat conditions.

In 2006 Stillwater Sciences developed models from Mill Creek data that predicted that 0+ coho salmon capacity was reached at about 25,000 fish on the WB, and about 12,000 fish on the EF (Stillwater 2006). Although 12,000 fish has not been reached on the EF for the past several years, it is approaching the predicted carrying capacity.

When the number of coho exceed carrying capacity, 0+ coho are forced to migrate through the watershed. The large numbers of 0+ coho captured in outmigrant traps in 1994, 1997, 2002, 2003, 2005, 2006, and 2008 indicate that this was occurring on the WB (Table 26). Conversely, the relatively low catches of WB 0+ coho in 1996, 1998-2001, 2004 and 2009 indicate that summer rearing capacity was not reached. These observations are further supported by the relatively high summer 0+ coho population estimates for 2003, 2005, 2006 and 2008, and the relatively low summer population estimates for 1998-2001, 2004 and 2009 (Table 14).

The quantity and quality of available summer rearing habitat plays an important role for increasing the number of 0+ coho in Mill Creek. In the West Branch, the amount of slow water habitat (pool habitat) cannot easily be increased unless stream length is added through the removal of anadromous barriers or by reclaiming significant sections of dry channel (see Table 12). It appears the West Branch has reached a bottleneck associated with available summer rearing habitat as predicted by Stillwater Sciences (2006); Models developed for the WB indicate 0+ coho salmon capacity on the WB is reached at 25,000 fish.

On the EF, modeling has predicted carrying capacity will be reached at 12,000 juvenile coho (Stillwater 2006). The length of anadromous stream miles on the EF is roughly equivalent to the WB; however, 0+ coho populations remain approximately half that of the WB on a year-to-year basis. It appears that both habitat quantity, with regard to velocity refuge (pool availability), and habitat quality (complex units that can support increased numbers of fish) are currently limiting the expansion of the 0+ coho population within this tributary. As can be seen in Table 23, significant 0+ coho emigration can occur even when the preceding winters adult escapement is relatively low, supporting the hypothesis that summer rearing habitat may be fully seeded and is only capable of supporting about 12,000 0+ coho. By increasing the amount of available summer rearing habitat, we should have a significant response in overall summer populations of 0+ coho, provided that adequate adult escapement is achieved.

Steelhead juveniles (1+) are present in consistently low numbers compared to coho 0+. Steelhead juveniles often move out of the EF and WB in the spring and summer, possibly following young-of-the-year salmonid population movements into the mainstem or estuary of the Smith River. These larger movements of pre-smolting juvenile steelhead that do not take on the appearance of smoltification can be observed during spring and early summer smolt trapping, where they are consistently captured in large numbers (Tables 26 and 27). This movement can potentially account for the limited number of juvenile steelhead observed in the WB and EF during late summer dive counts.

Similar to juvenile steelhead, coastal cutthroat trout (1+) also follow this pattern of movement, leaving the tributaries in spring and early summer prior to smoltification. This accounts for the limited number of 1+ cutthroat trout captured and observed during late summer dive counts. Given their elusive nature, cutthroat trout are rather difficult to survey through dive counts; however, even during depletion surveys, cutthroat are not commonly removed through electrofishing from habitat units.

Chinook salmon young-of-the-year (YOY) are typically all-but-absent from both tributaries during late summer dive counts. However, 2007 was an exception. Many of the non-riffle habitat units surveyed in 2007 contained a few YOY Chinook. These fish were typically found in the faster water at the head of the units where 0+ coho numbers were relatively sparse. These fish normally emigrate from the system during the spring, however, there was very little rainfall after April 2007 and consequently, stream flows dropped and remained unusually low during this period (Howard and McLeod 2007). Thus, potentially late emigrating YOY Chinook never saw a freshet to trigger emigration, and were ultimately forced to remain in the system as extremely low summer flows approached. There may also have been less incentive to emigrate due to the relatively low numbers of 0+ coho salmon in the system in 2007. Young-of-the-year Chinook counts dropped back down to low levels in 2008 and 2009 (Tables 10 and 13).

5.2 Adult Spawning Surveys

Chinook and coho salmon minimum escapement counts have been generated for the Mill Creek tributaries and for a small reach of Rock Creek for the last sixteen years (Figs 23 and 24). Adult escapement counts for coho salmon on both the WB and EF show a general trend toward increasing abundance from WY 1999 to 2005, then decreasing abundance from WY 2005 to 2007, where numbers have remained low through 2009 (Fig. 23). As noted in Howard and McLeod (2007), shifts in ocean productivity may be the most likely contributor to the observed fluctuations in coho escapement. Changes in freshwater smolt production on each tributary have increased moderately, but not enough to account for the massive swings in adult escapement (Howard and McLeod 2007).

The WY 2005 adult coho salmon escapement counts were the highest on record for both tributaries (Tables 12 and 13, Fig. 23). The large drop in observed 2006 and 2007 adult coho escapement may be reflective of poor ocean conditions for smolts that emigrated in 2004 and 2005. However, the low 2006 and 2007 adult counts may be more an artifact of the more numerous high-flow events during those years. This precluded surveying during many of the periods in which we would expect to see coho, and also inhibited our ability to see adult fish when we were able to survey. This observation is supported by data from the 2006 and 2007 juvenile summer population estimates, which show that both years had some of the largest 0+ coho population estimates since counts began (Tables 14 and 15). It seems unlikely that such strong 0+ coho populations were derived from such low adult escapement.

Stillwater (2006) indicated that even very small escapements may provide enough females to fully seed the available summer rearing habitat with 0+ coho. This is supported by 0+ coho population estimates for 2005 and 2006 which were similar in magnitude (Tables 14 and 15) despite the huge difference in adult escapements those preceding winters, respectively (Tables 16 and 17). The extremely low 2007 coho escapement, however, resulted in a concomitant drop in the 2007 0+ coho population estimates (Tables 14 and 15). This indicates that a minimum coho salmon escapement of 20 to 30 fish (10-15 females) is needed on each tributary to fully seed the available summer rearing habitat.

Chinook salmon escapement has been variable over the life of the monitoring program. Moderately sized decreases in adult Chinook escapement have been observed in the East Fork yearly since WY 2002. The 2009 Chinook escapement showed a marked increase over the previous few years (Fig. 24) and preliminary data collected for 2010 indicate record high numbers of Chinook returning to Mill Creek and the Smith River as a whole (Van Scoyk, pers. com.). These fluctuations can be the result of several factors and are assumed to have more to do with fluctuations in ocean productivity.

As with coho salmon, it appears even moderate Chinook escapement provides adequate egg to fry emergence. An excellent example of this has occurred in the West Branch were the largest young-of-the-year counts on record occurred in 2007 and 2008, despite low to moderate adult returns the preceding winters, respectively (Tables 16 and 26).

As with 2006 and 2007, the 2008 spawning survey effort was complicated by large winter freshets that limited the number of surveys. The last 2 weeks of December and the first two weeks of January 2008 saw very few periods where flows were low enough to conduct accurate surveys in the Mill Creek drainage (see Fig. 5 and Appendix A). Consequently, redd data has been found to be a reliable indicator of escapement after large freshets have occurred, unless flows were extremely high. Often, as in 2007 and 2008, the limited windows of opportunity force surveyors to concentrate more effort than usual on headwater reaches, and escapement estimates are likely to be very conservative.

5.3 Juvenile Outmigration Trapping

A. Smolt Population Estimates

Obtaining population estimates of salmonid smolts leaving the Mill Creek tributaries is the most significant data gathered during juvenile outmigration trapping. Smolting salmonids are the last life history stage to live in freshwater before emigration to the Pacific Ocean. Therefore, increasing or decreasing trends in smolt production reflect the streams ability to support and sustain viable populations. Population estimates of smolting coho, steelhead, and cutthroat have been calculated for Mill Creek since trapping began in 1994. In conjunction with the escapement and summer population data, smolt production estimates have proven to be invaluable for assessing limiting factors within the watershed, identifying potential areas for restoration, and now as a tool for gauging the effectiveness of restoration efforts.

Coho smolt production fluctuates annually in both tributaries, however annual production in the WB is generally two to three times higher than in the EF (Fig. 25). As discussed in Howard and McLeod (2007), the similar smolt population estimates for the WB and EF in 2007 was thought to be a result of improved winter rearing habitat, where CWJ placement occurred on the EF tributary during the summer of 2006. Despite further CWJ construction in 2007 and 2008, subsequent 2008 and 2009 EF coho smolt population estimates have were less than half that of the WB (Fig. 25). It will likely take a few more years to see the full effects of the CWJ installations.

As with coho salmon smolt production, steelhead smolt population estimates in the WB are generally about twice that of the EF. This was not evidence by the 2009 EF steelhead smolt estimate, which was actually higher than for the WB (Fig. 26).

Steelhead smolt population estimates have varied significantly in both tributaries. Significant decreases were observed from 2001 to 2005, but now appear to be rebuilding in size, although estimates have been below average since 2002 (except for EF 2009) (Tables 28 and 29).

Why steelhead smolt production is generally so much higher in the WB is not clear at this time, but may reflect a response to differences in habitat quality and quantity or a response to environmental conditions such as peak flows, as seen with coho salmon smolts.

Unlike coho and steelhead, cutthroat trout smolt production within the WB and the EF has been relatively stable over the last sixteen years of monitoring (Fig. 27). The differences in smolt population estimates between the two tributaries are relatively small and one tributary seems just as likely as the other to produce the larger cutthroat smolt population estimate for any particular year (Fig. 27).

The data suggests that the WB and the EF are about equally suited for cutthroat trout production. The reasonably stable trends observed in cutthroat populations reflects the opportunistic behavior of this species, and its ability to fill niche type habitats or even hybridize with resident populations of steelhead (Voight 2006).

B. Relative Abundance of Non-smolting Fish

Smolt population estimates generated through efficiency tests are not performed for anything other than salmonids known to be leaving the system. Catches of other salmonid life stages and non-salmonid species are based on their true abundance.

Catches of YOY salmonids was higher than average on both tributaries in 2008 and lower than average in 2009 (Tables 26 and 27). Chinook YOY counts in particular were considerably higher than average on the WB in 2008 (Fig. 28). A higher than usual catch of Chinook 1+ was also observed on the WB in 2008. This is likely due to the higher number of Chinook YOY observed during 2007 dive surveys. Although YOY Chinook were also observed on the EF during the summer surveys, no 1+ Chinook were recorded on the EF. Because Chinook 1+ generally emigrate when coho smolt runs are peaking, and they can look very similar to coho smolts. It is possible that some Chinook overwintered in the EF, but escaped detection during outmigration trapping.

In 2008 and 2009 steelhead 2+ and trout par catches were higher than average on the WB, but lower than average on the EF (Tables 26 and 27). Late season adult steelhead captures were below average for both tributaries in 2008 and 2009 (Tables 26 and 27).

Coastal cutthroat parr catches were lower than average on both tributaries during 2008 and 2009. Coastal cutthroat adult catches were at or above average on both tributaries (Tables 26 and 27).

Observed productivity of non-salmonid species was higher than average on the WB in 2008. Sculpin catches were the highest ever, and almost four times higher than average (Table 26). The 2009 sculpin catch was also extremely high. Catches of non-salmonid species on the EF in 2008 were generally lower than average; however, coastrange sculpin and pacific lamprey were slightly higher than average (Table 27).

In 2009 twice the average number of Pacific lamprey were captured on the WB while less than one half the average number of American brook lamprey were caught (Table 27). Pacific lamprey catches were about average on the EF in 2008 and 2009, but only one American brook lamprey was captured on the EF during each of those years (Table 26).

Although great effort goes toward keeping trapping effort equal among years, trap efficiencies vary daily depending on flows, debris loads, scour under weir panels. YOY in particular can literally slip through the cracks. Continuous effort has been directed towards preventative maintenance of the weirs.

5.4 Density Dependence and Overwinter Survival

As stated in previous reports (Stillwater 2006, Howard and McLeod 2007, McLeod and Howard 2009) density dependent competition likely plays a significant role in Mill Creek when coho populations are at capacity. In most years, coho 0+ populations reach a bottleneck in the amount of available overwintering habitat that provides velocity refuge. Review of the last 16 years of data consistently point to overwinter carrying capacity as the primary limiting factor to the production of coho smolts within Mill Creek.

In review of the available data, 0+ coho cohorts were plotted against subsequent production years to see if there was any density dependent mechanism regulating coho smolt production (Fig. 29). The relationship is not strong, which leads us to conclude the primary limiting factor is some variable or group of variables that affect the juvenile coho between the late summer and spring outmigration.

Stillwater (2006) found that in Mill Creek peak winter flows showed a negative correlation with production of 1+ coho smolts. Since Stillwater's analysis we have now added four more years of data, recalculated the correlations with updated flow values, and found that peak winter flow has remained a fairly good predictor of smolt production on the WB, with an R^2 of 0.66 (Fig. 30). The relationship is not as strong for the EF; using pre-2007 EF data the correlation has an R^2 of 0.50 (Fig. 30). Post-2006 data was omitted from the EF calculation because the recent additions of CWJ's has likely increased the number of pools on the EF and may have caused a shift in the relationship (Howard and McLeod 2007). Indeed, the 2007 and 2009 EF smolt estimates were higher than predicted by the pre-2007 correlation, but the 2008 smolt estimate was very close to that predicted by the pre-2007 correlation (Fig. 30). Because peak flows were similar in 2007 and 2008, the difference in EF smolt estimates for those years further suggests that factors other than peak flows are limiting coho smolt production.

If peak winter flows are indeed a limiting factor for juvenile coho, it follows that the number and duration, as well as the magnitude of high flow events above some threshold level would also likely be affecting the fish. Similarly, extremely low fall or winter flow periods (such as what occurred in 2001 and 2008) could have a negative effect on juvenile fish; and of course the summer population of 0+ coho would be a factor below some threshold level.

Whatever all the limiting factors are, it appears that in most years, even when poor adult returns occur, or other factors result in less than saturated summer habitat, winter carrying capacity may still be exceeded. Winter carrying capacity may well be the one of the most important limiting factors to not only coho survival, but perhaps also cutthroat and steelhead.

It is likely that winter carrying capacity for Mill Creek salmonids was historically higher than it is today. Habitat disturbance in the Mill Creek watershed through a long history of anthropogenic activities has likely altered many natural processes. Others have shown that riparian logging can alter chemical, biological and physical process and features that shape stream ecosystems and determine population densities and community structure of salmonids (Gregory et al. 1987; Reeves et al. 1993). Because these processes and habitat features operate at different temporal scales, the recovery of fish populations following riparian logging represents an integrated response to multiple habitat attributes that change through time (Gregory et al. 1987).

In Mill Creek, differences in harvest history, harvest method and time of entry within the two tributaries reflect the observed variation in many habitat attributes (e.g. pool frequency and LWD created habitat types), which we believe are correlated to winter carrying capacity, population size and production levels of salmonids within the watershed.

Large woody debris dominated pools, as well as wide floodplains and associated backwaters and side channels, and are the primary forms of velocity refugia sought out by juvenile salmonids during high flow events. The WB has an extensive floodplain but the EF channel is primarily entrenched and confined along much of its length by both the geology and manmade diversions along the old mill site. Both channels have a deficit of LWD as compared to historic levels, but it is more apparent on the EF. Poor floodplain connectivity, decreased spawning gravel retention, depleted pool cover and formative elements, have likely been limiting to all salmonid populations within the EF (Fiori 2004, Fiori 2005, and Stillwater Sciences 2006).

Because floodplain area is limited, recruitment of LWD to create pools is the primary means by which velocity refugia can be created on the EF. Presently, natural wood recruitment on the EF is primarily from riparian alders, which provide habitat of limited quality and short duration (<6 years) (Fiori 2004). Instream recruitment from riparian conifer planting efforts on the EF is anticipated to take at least 40 years. This rate of LWD recruitment is far removed from the pre-logging days. However, the placement of CWJ's, in shallow flatwater and riffle habitat has proven to be an effective method to promote the formation of complex pool habitat in the EF. The first few years data since CWJ placement began has been encouraging, but more data will be needed to fully evaluate the success of the habitat improvement work.

Overall, the data shows that the salmonid populations in Mill Creek may be affected by many factors within and outside the watershed, and can fluctuate dramatically from year to year. However, these populations appear to be quite resilient and thus far have been able to maintain levels near the limit of the watersheds current carrying capacity.

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7.0 FIGURES

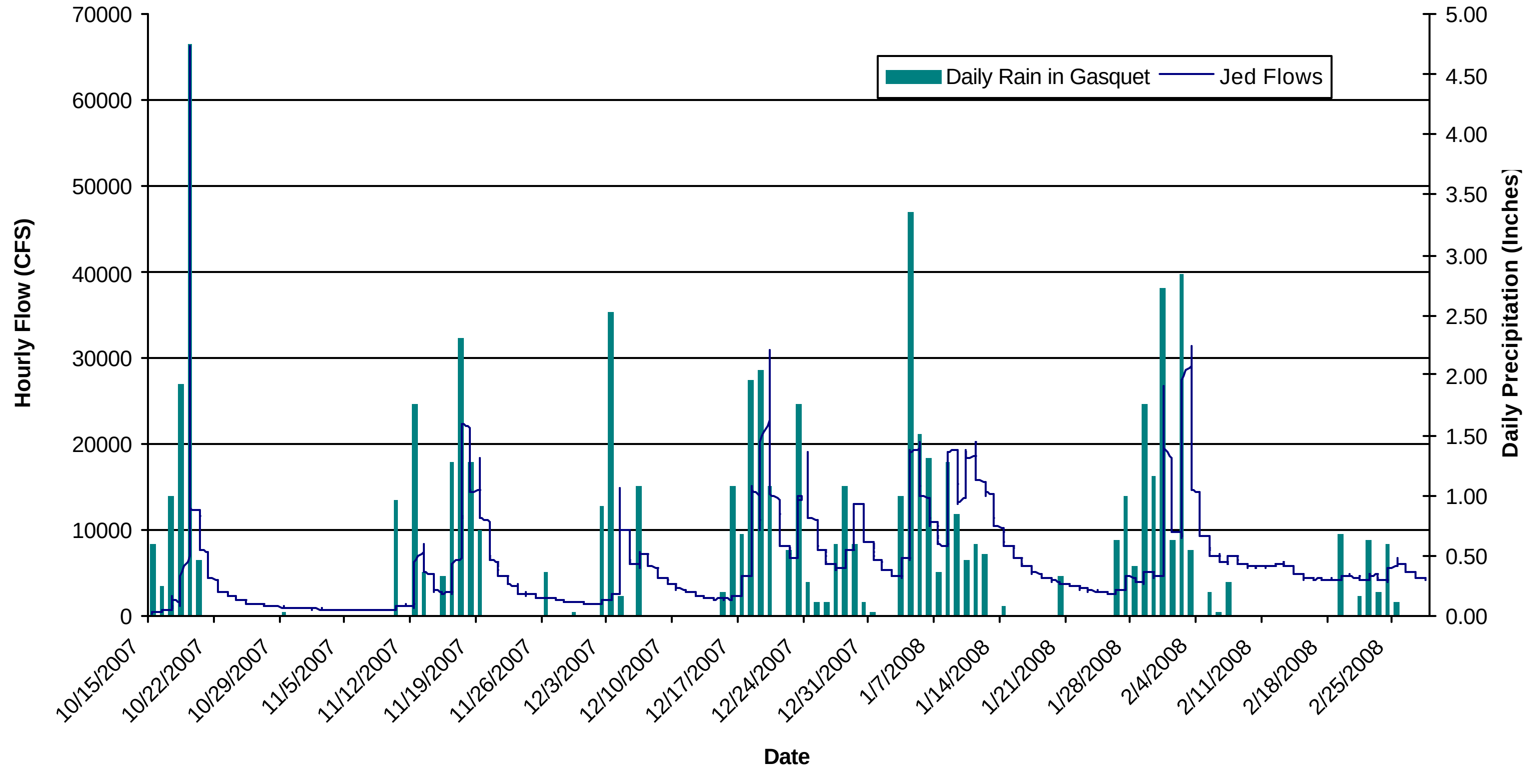


Figure 5. Hourly Smith River flows at Jed Smith Gauging station and daily precipitation in Gasquet during the 2007/08 spawner survey season.

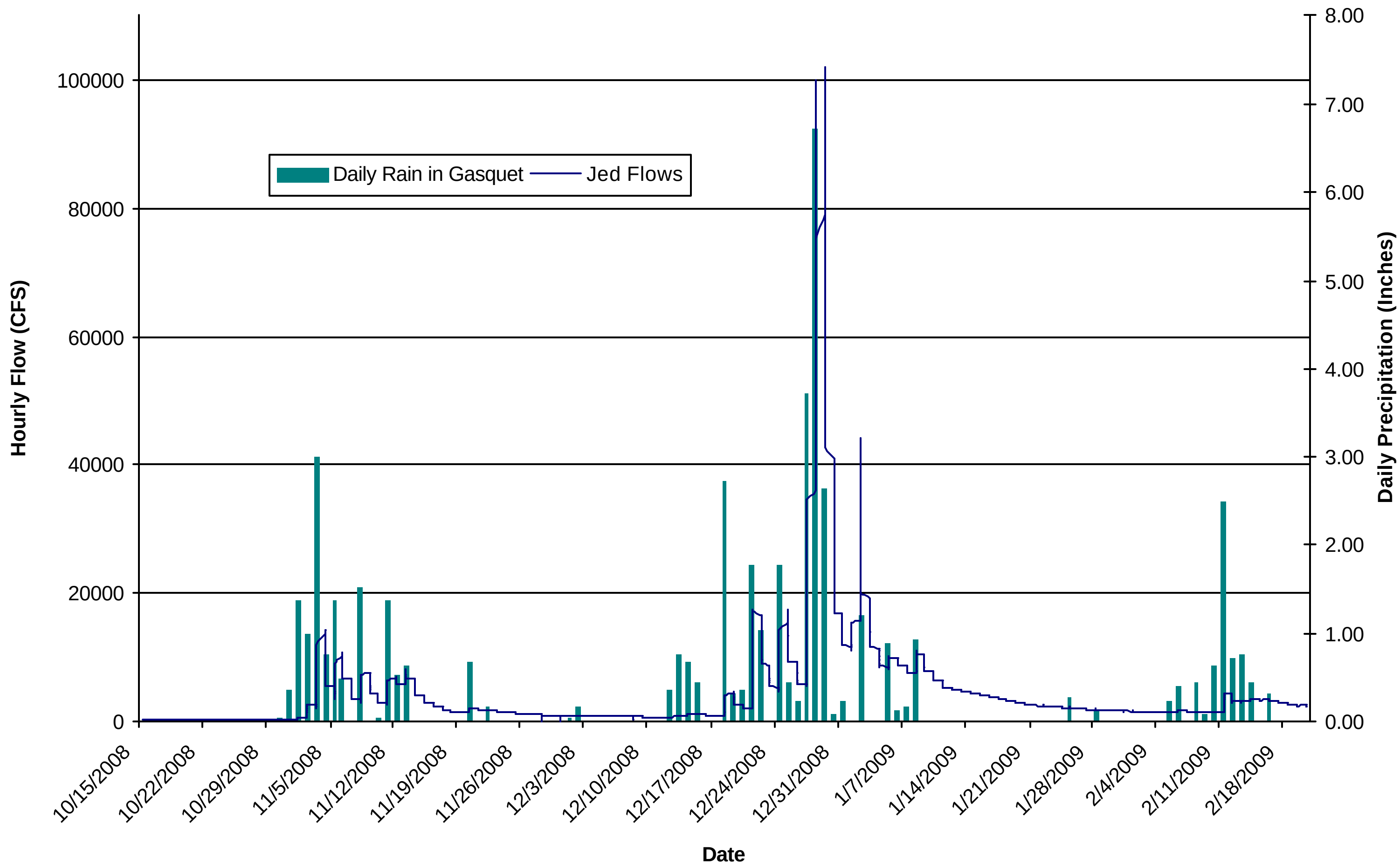


Figure 6. Hourly Smith River flows at Jed Smith Gauging station and daily precipitation in Gasquet during the 2008/09 spawner survey season.

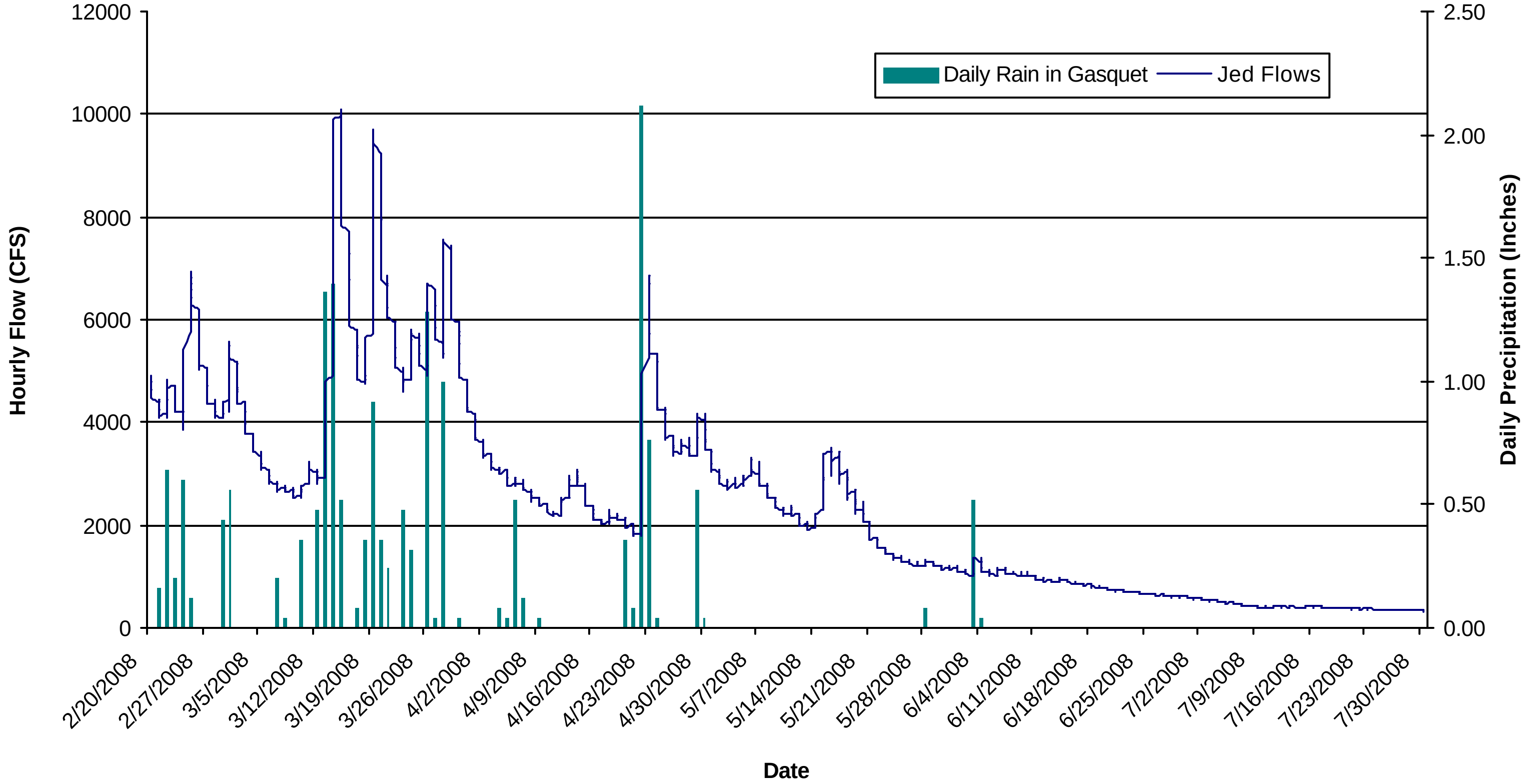


Figure 7. Hourly Smith River flows at Jed Smith Gauging station and daily precipitation in Gasquet during the 2008 trapping season.

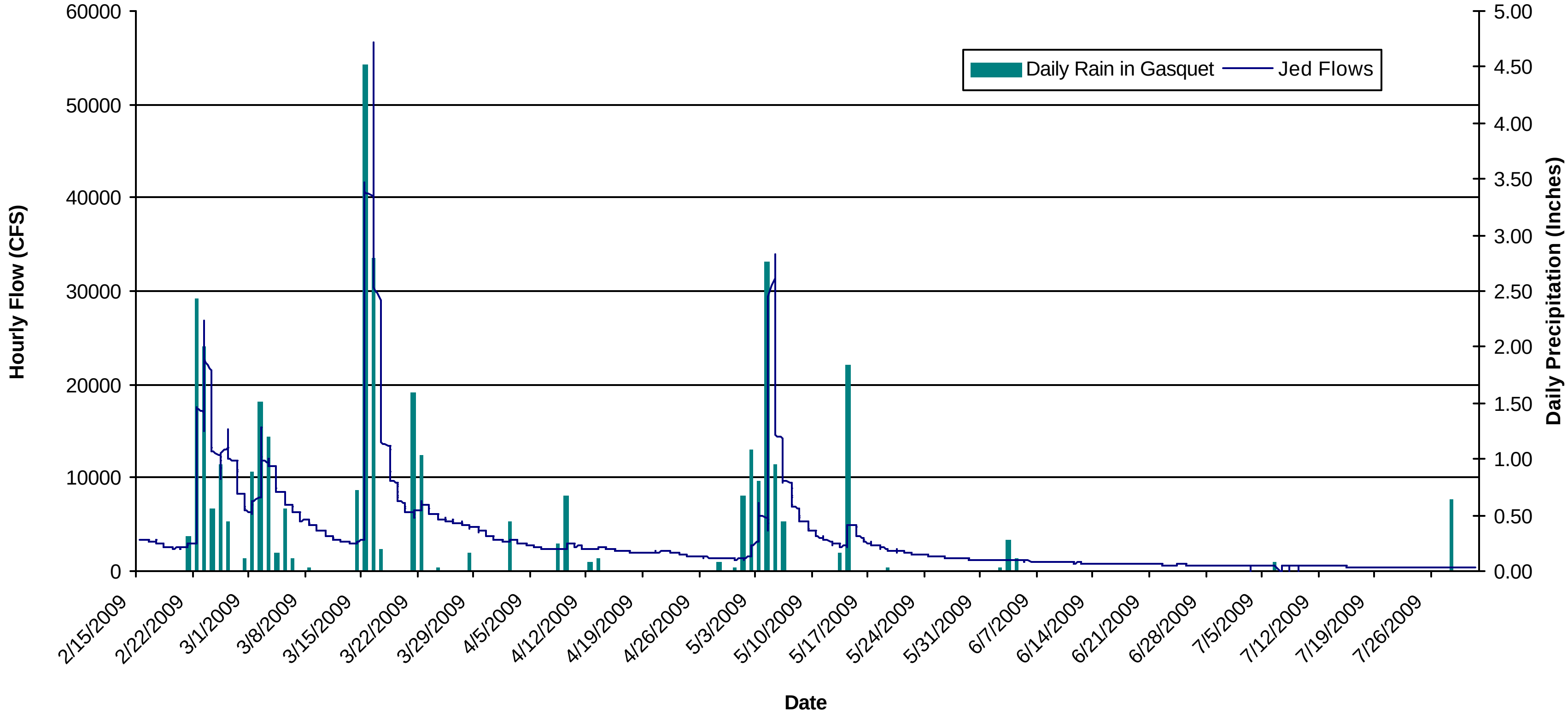


Figure 8. Hourly Smith River flows at Jed Smith Gauging station and daily precipitation in Gasquet during the 2009 trapping season.

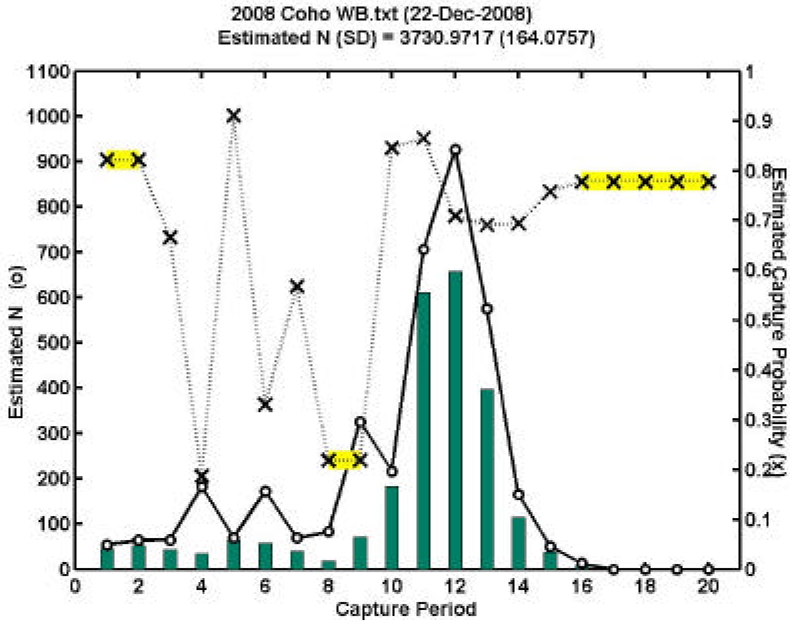


Figure 9. DARR output graph showing weekly estimated N and capture probabilities for smolting coho salmon on the West Branch Mill Creek, 2008.

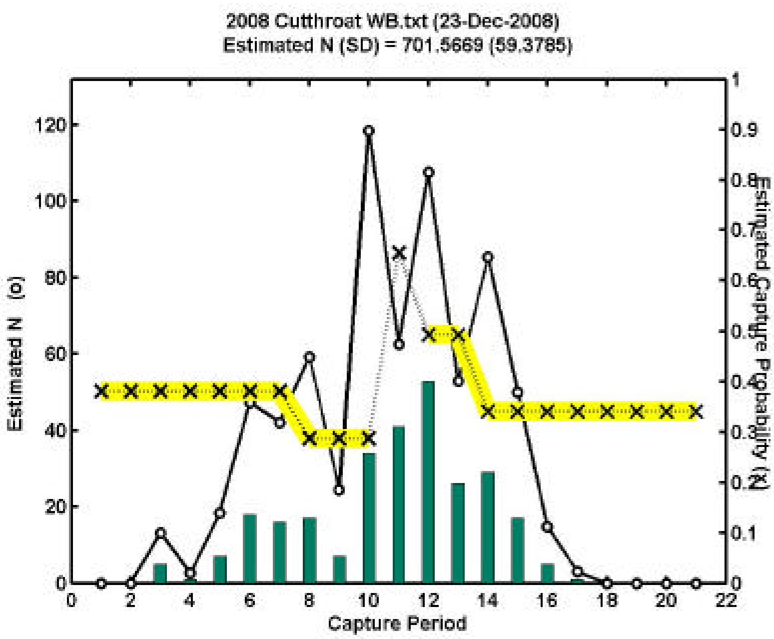


Figure 10. DARR output graph showing weekly estimated N and capture probabilities for smolting coastal cutthroat trout on the West Branch Mill Creek, 2008.

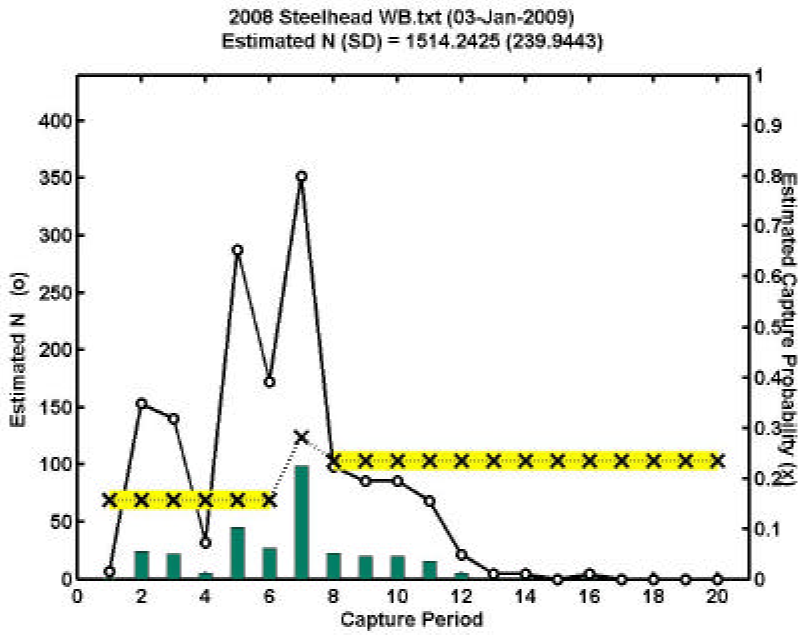


Figure 11. DARR output graph showing weekly estimated N and capture probabilities for smolting steelhead on the West Branch Mill Creek, 2008.

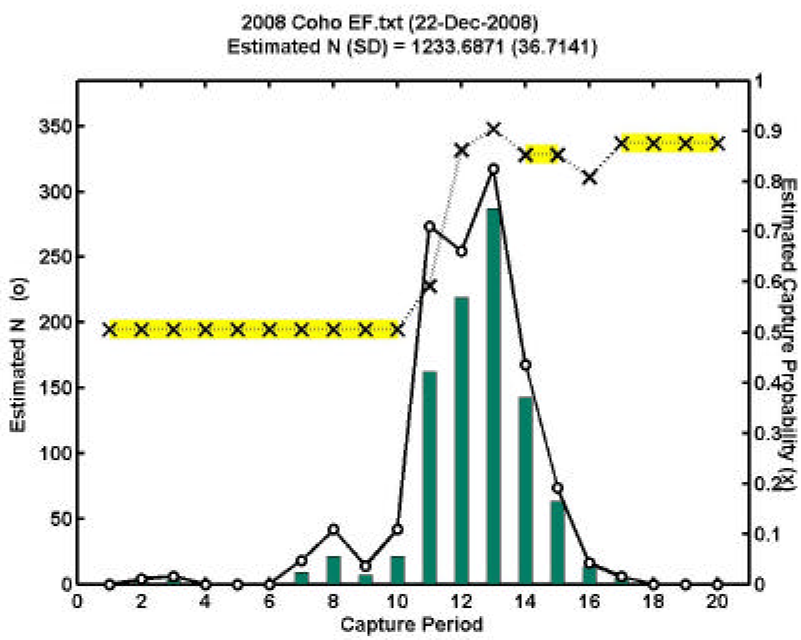


Figure12. DARR output graph showing weekly estimated N and capture probabilities for smolting coho salmon on the East Fork Mill Creek, 2008.

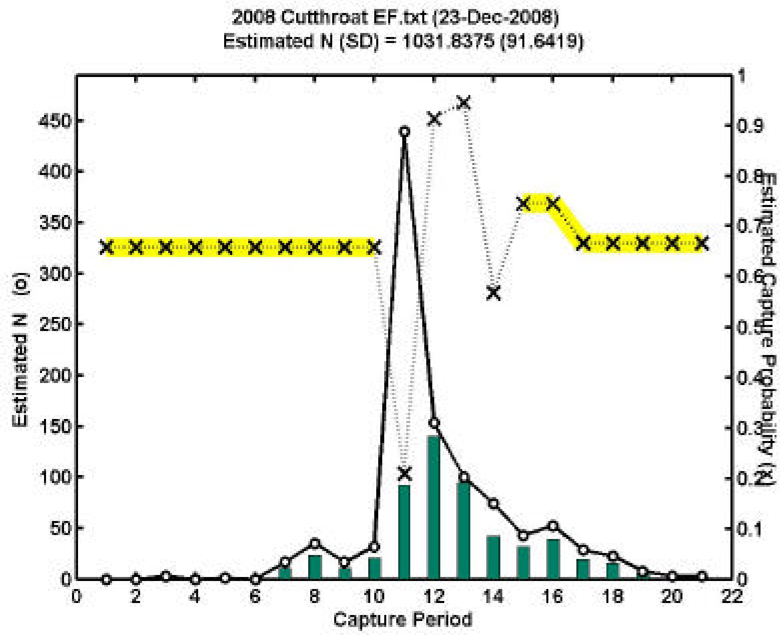


Figure 13. DARR output graph showing weekly estimated N and capture probabilities for smolting coastal cutthroat trout on the East Fork Mill Creek, 2008.

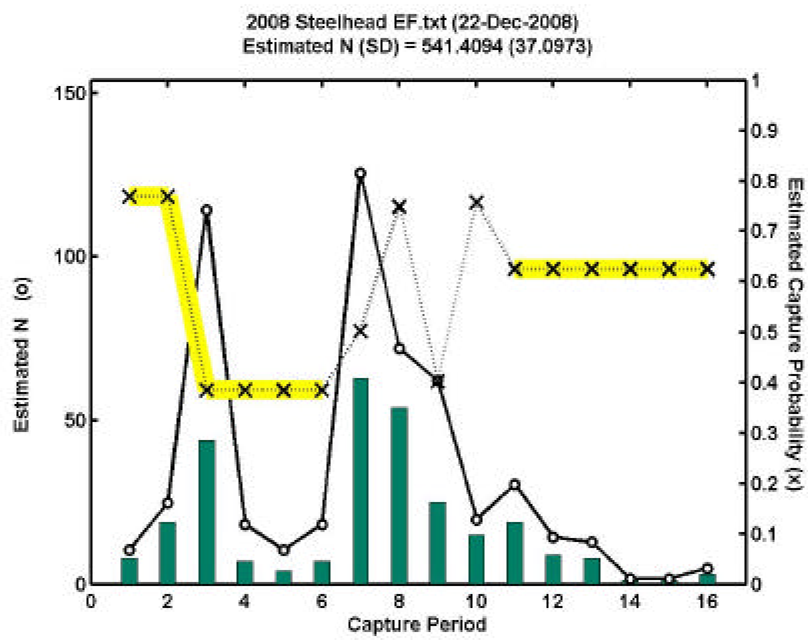


Figure 14. DARR output graph showing weekly estimated N and capture probabilities for smolting steelhead on the East Fork Mill Creek, 2008.

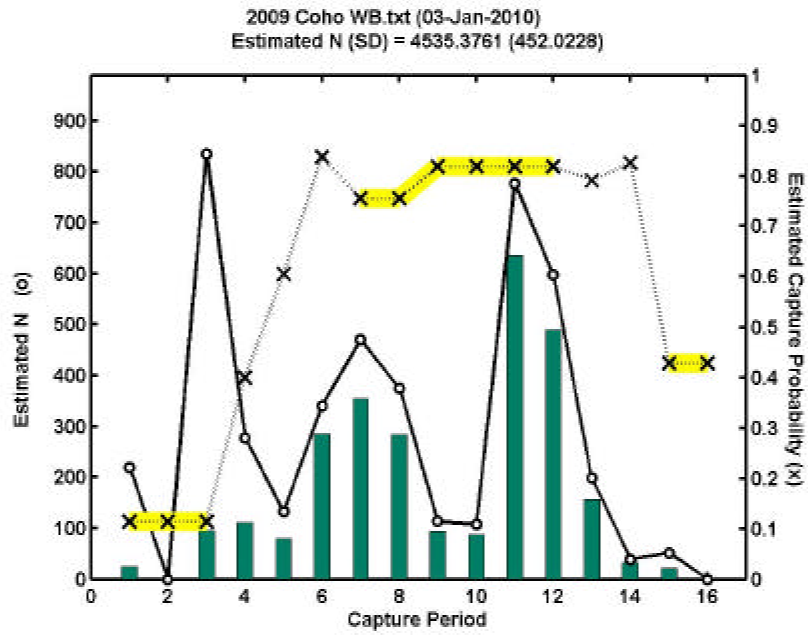


Figure 15. DARR output graph showing weekly estimated N and capture probabilities for smolting coho salmon on the West Branch Mill Creek, 2009.

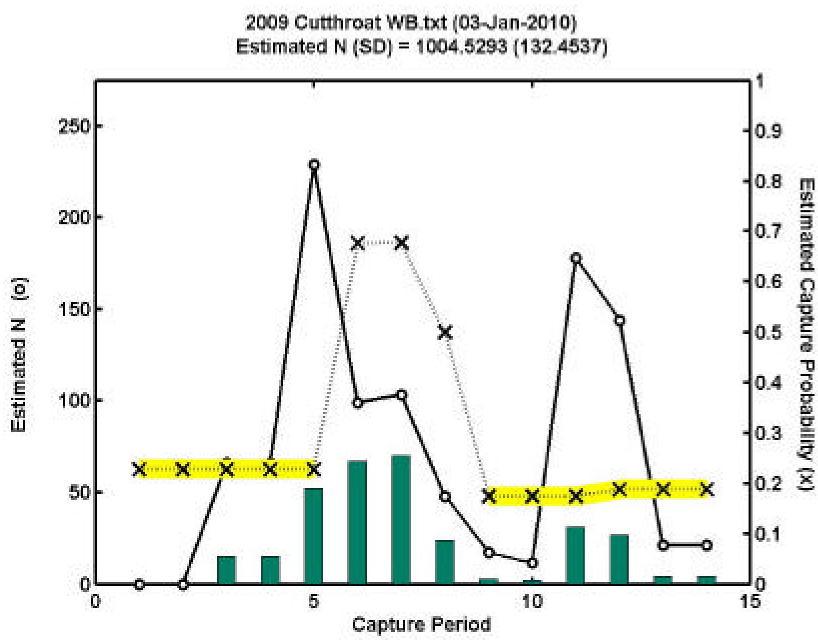


Figure 16. DARR output graph showing weekly estimated N and capture probabilities for smolting coastal cutthroat trout on the West Branch Mill Creek, 2009.

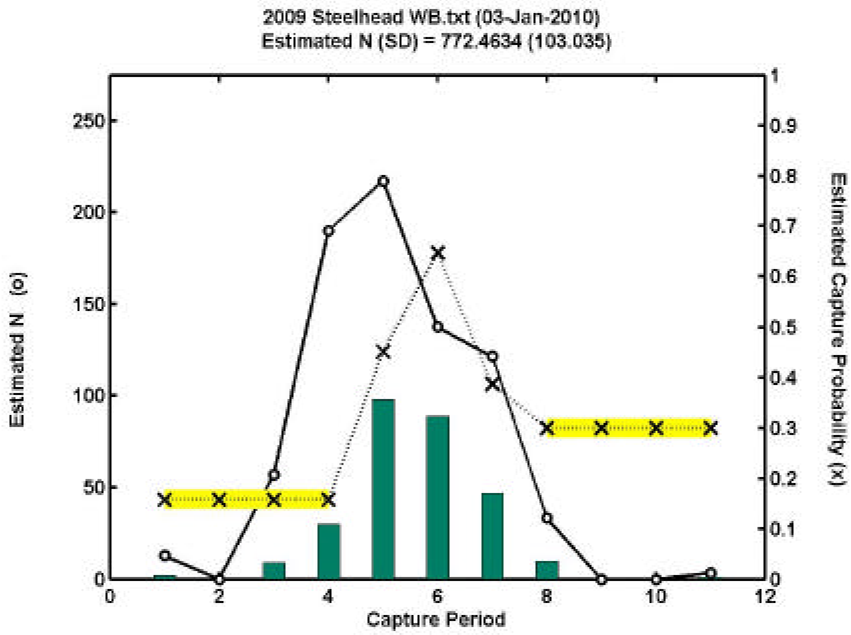


Figure 17. DARR output graph showing weekly estimated N and capture probabilities for smolting steelhead on the West Branch Mill Creek, 2009.

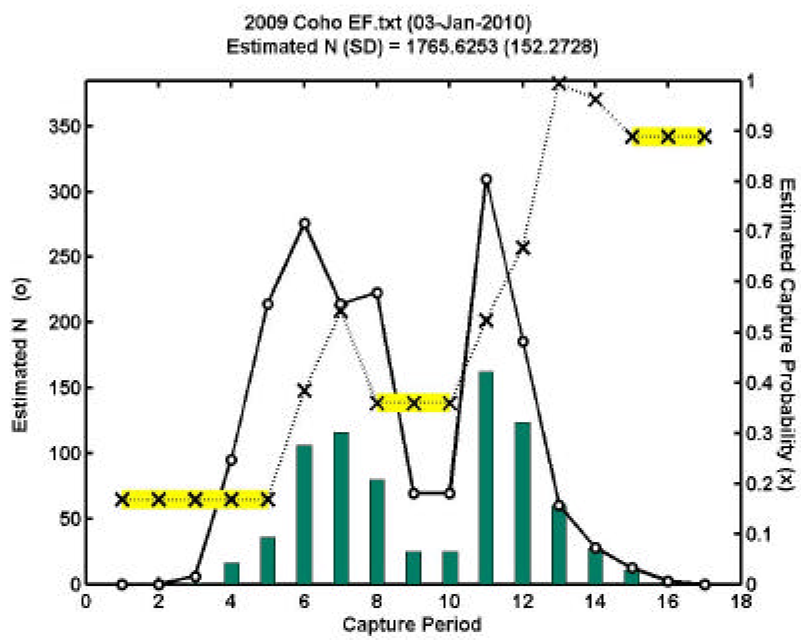


Figure 18. DARR output graph showing weekly estimated N and capture probabilities for smolting coho salmon on the East Fork Mill Creek, 2009.

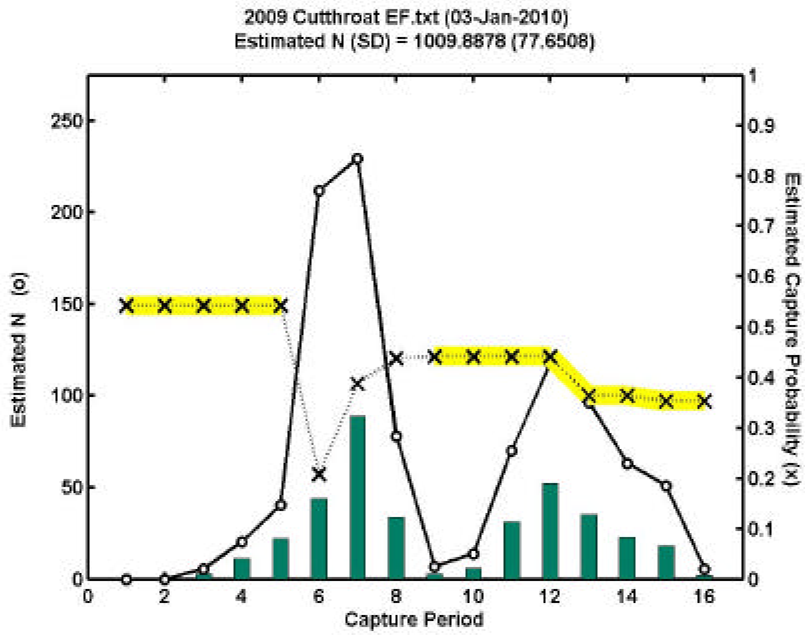


Figure 19. DARR output graph showing weekly estimated N and capture probabilities for smolting coastal cutthroat trout on the East Fork Mill Creek, 2009.

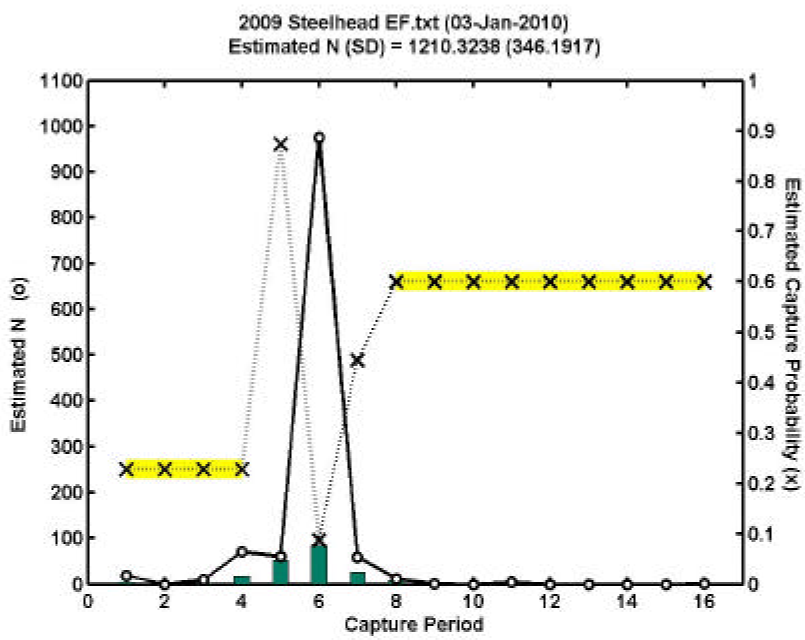


Figure 20. DARR output graph showing weekly estimated N and capture probabilities for smolting steelhead on the East Fork Mill Creek, 2009.

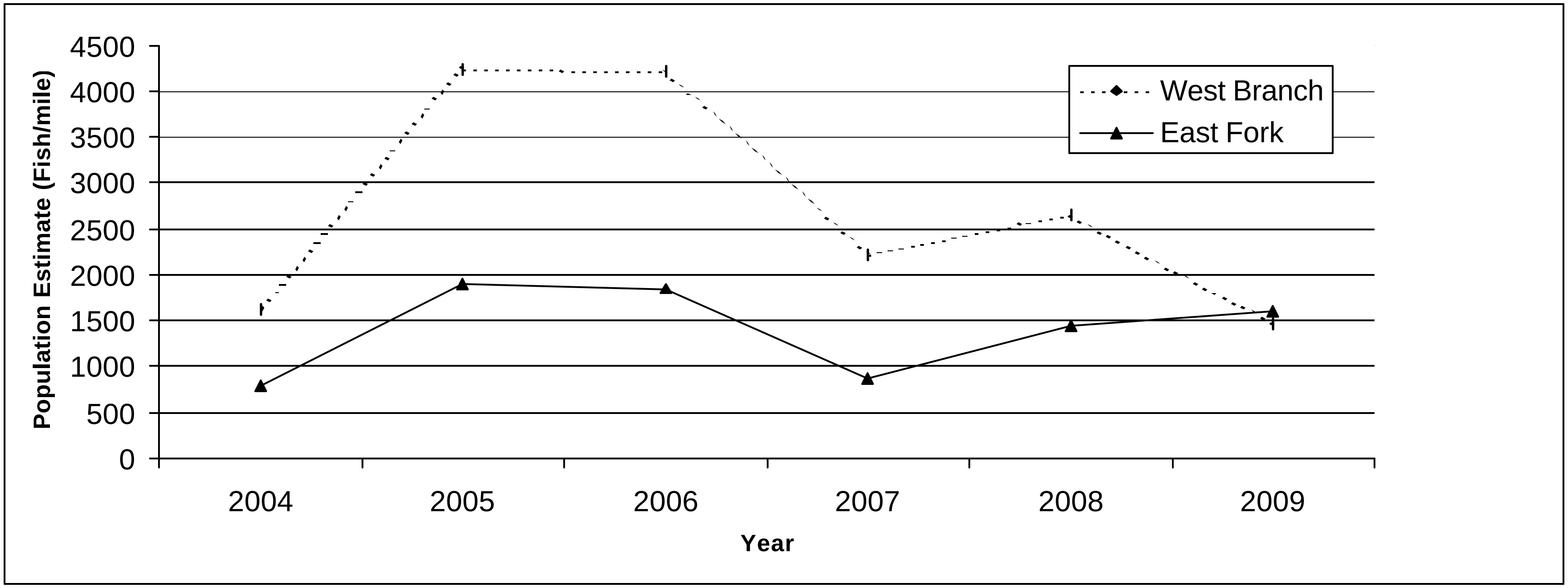
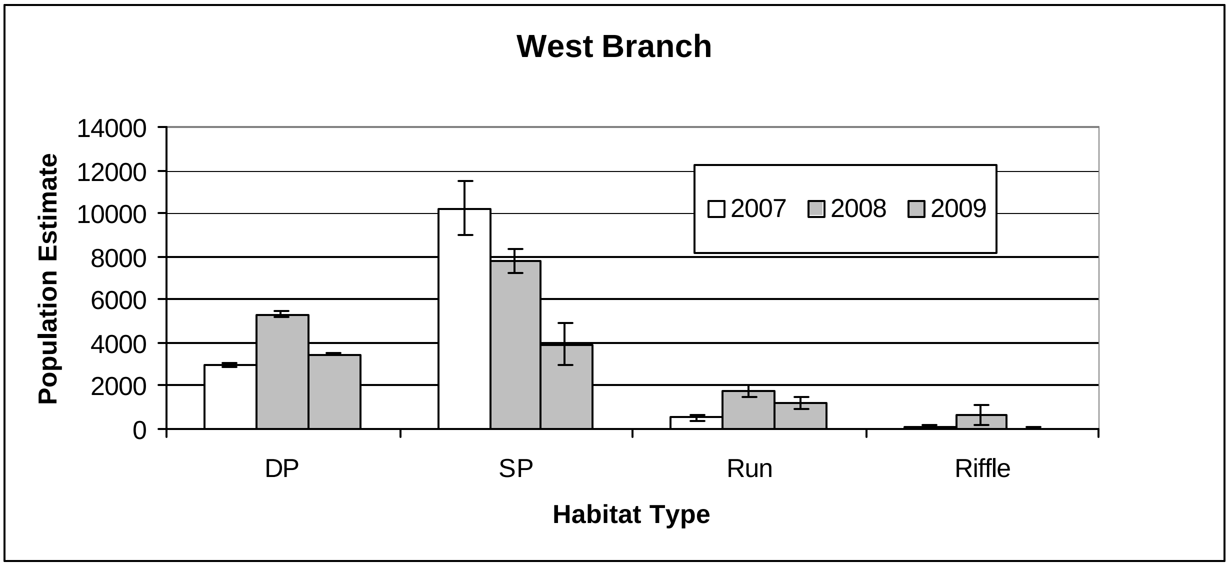


Figure 21. Juvenile coho salmon summer population estimates (fish/mile) for the East Fork and West Branch Mill Creek 2004-2009



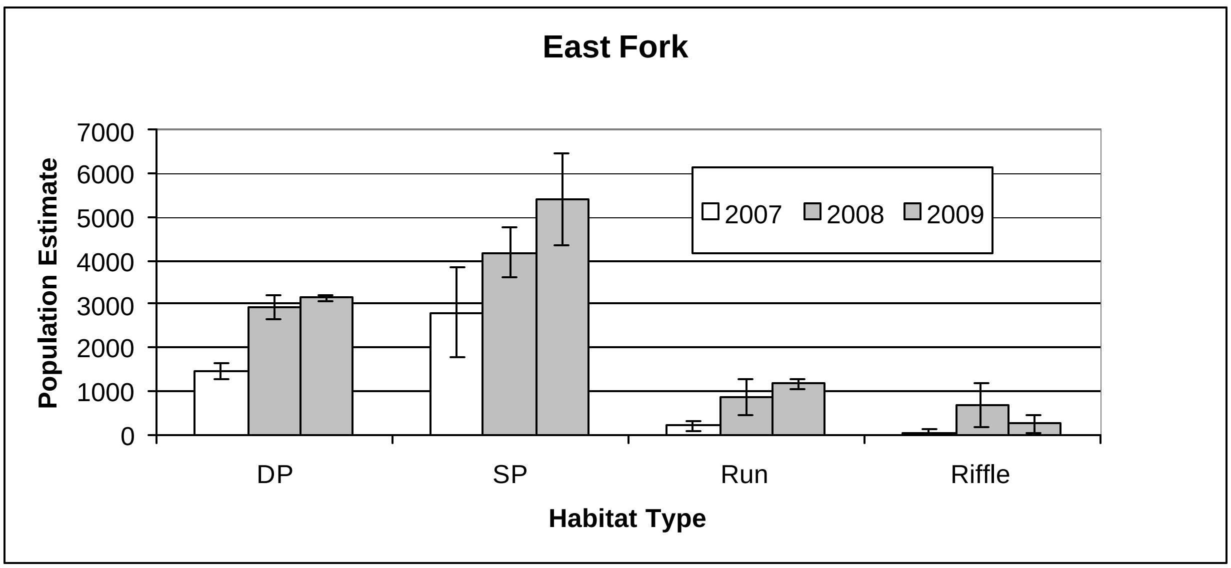


Figure 22. Juvenile coho salmon summer population estimates by habitat type for the West Branch and East Fork Mill Creek 2007-2009.

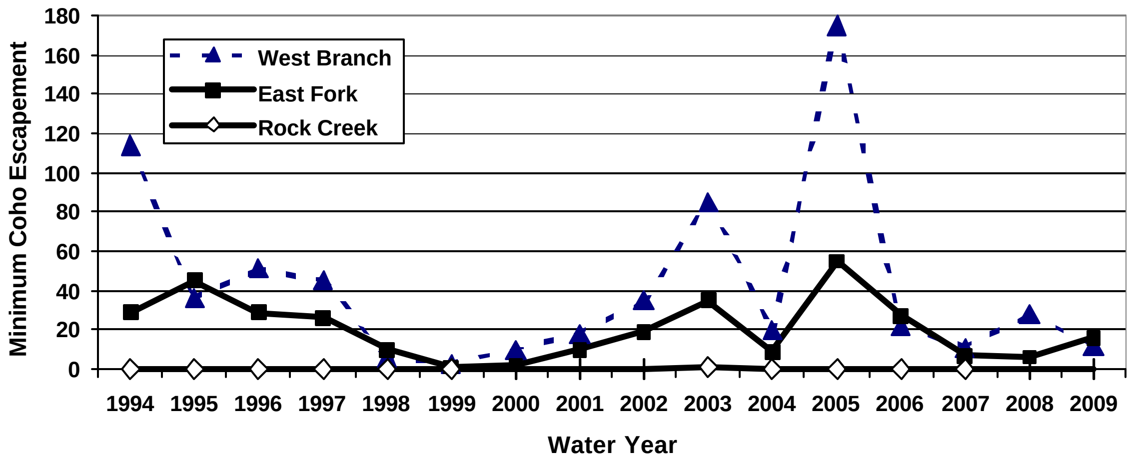


Figure 23. Coho salmon minimum escapement estimates for West Branch and East Fork Mill Creek and Rock Creek from WY 1994 to 2009.

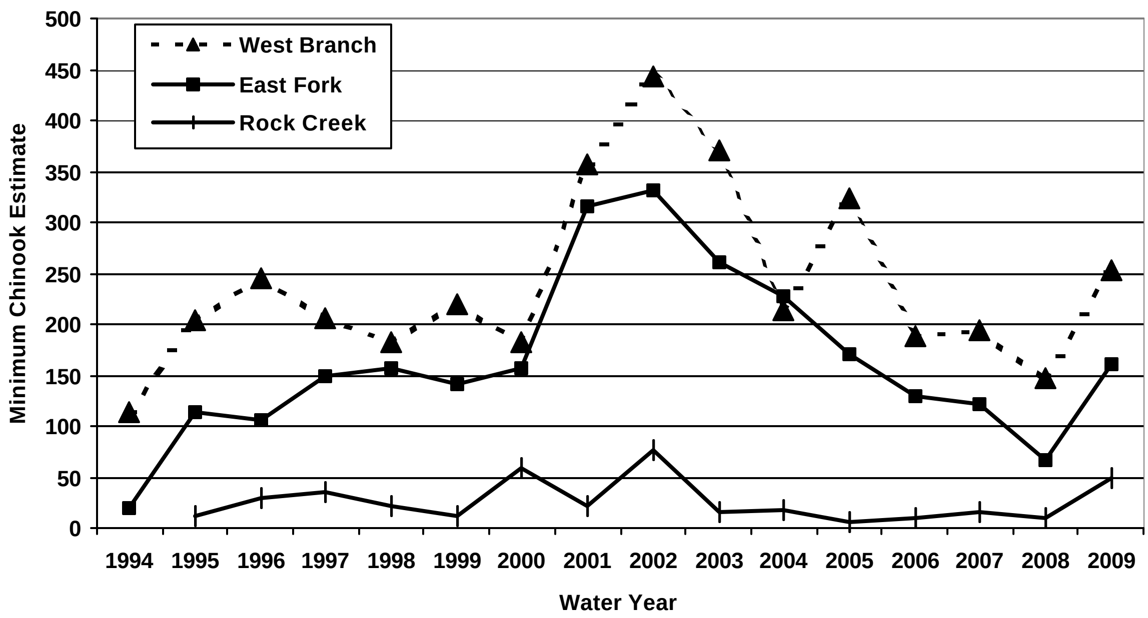


Figure 24. Chinook salmon minimum escapement estimates for West Branch and East Fork Mill Creek and Rock Creek from WY 1994 to 2009

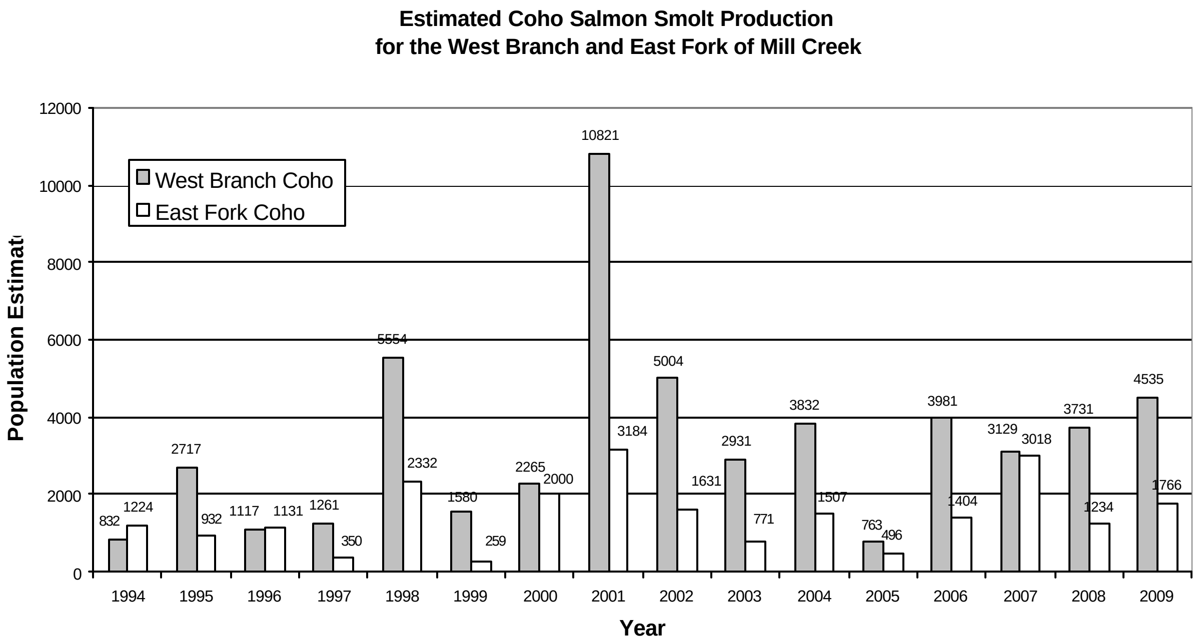


Figure 25. Coho salmon smolt population estimates for the West Branch and East Fork of Mill Creek, 1994 through 2009.

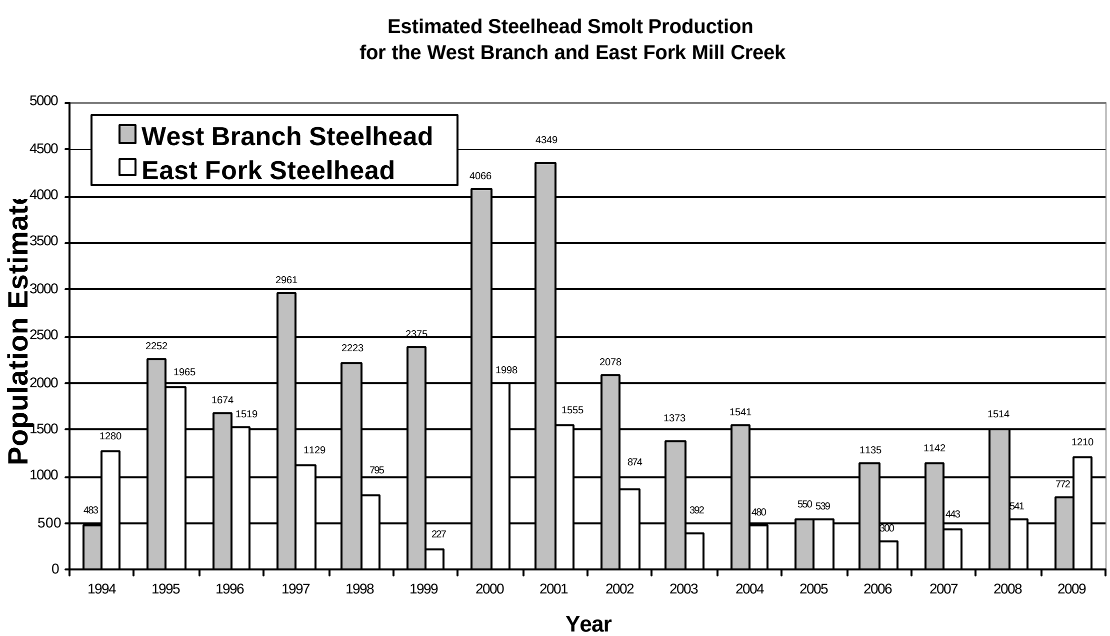


Figure 26. Steelhead smolt population estimates for the West Branch and East Fork of Mill Creek, 1994 through 2009.

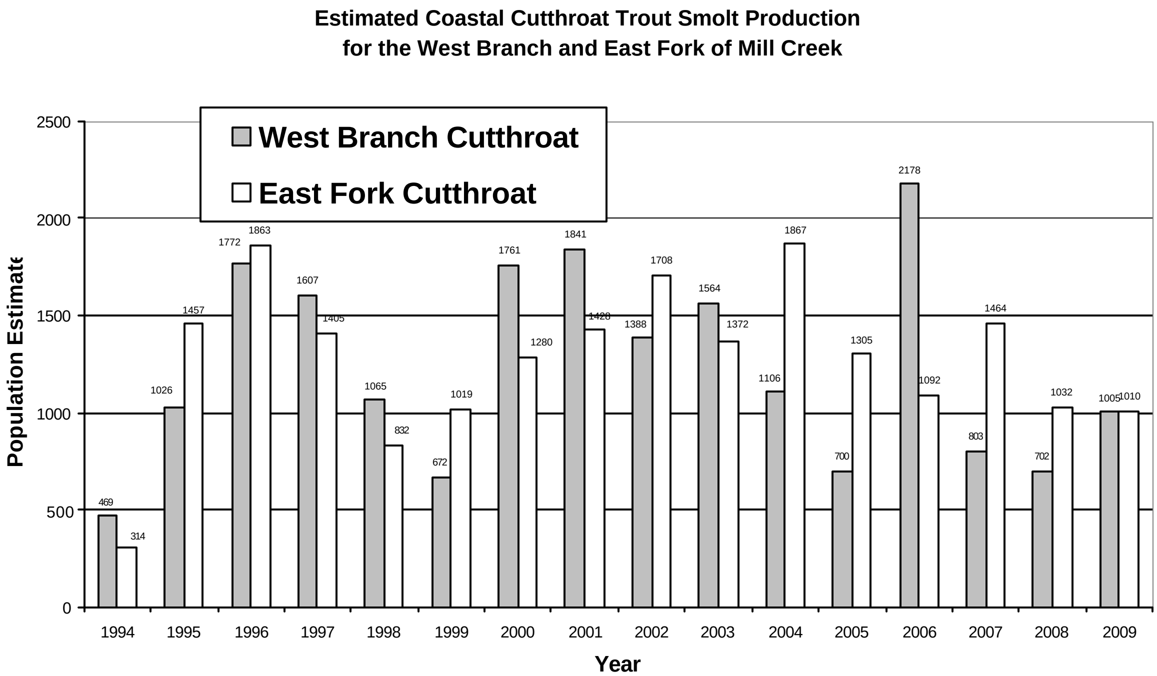


Figure 27. Coastal Cutthroat trout smolt population estimates for the West Branch and East Fork of Mill Creek, 1994 through 2009.

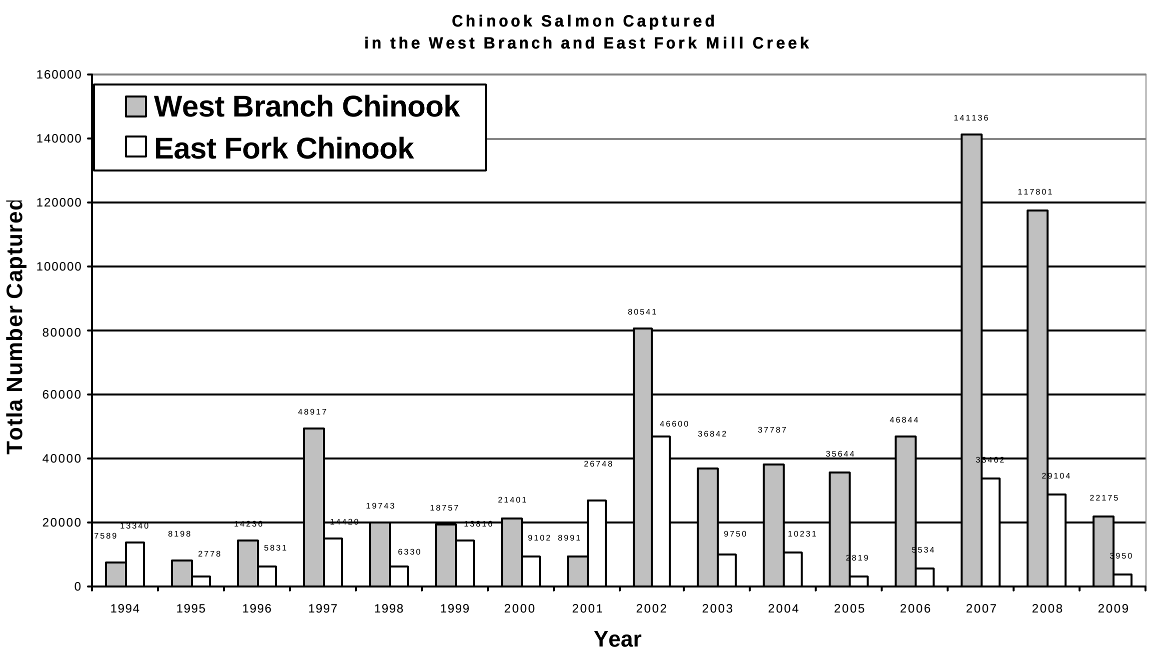


Figure 28. Chinook salmon young-of-the-year captured in the West Branch and East Fork of Mill Creek, 1994 through 2009.

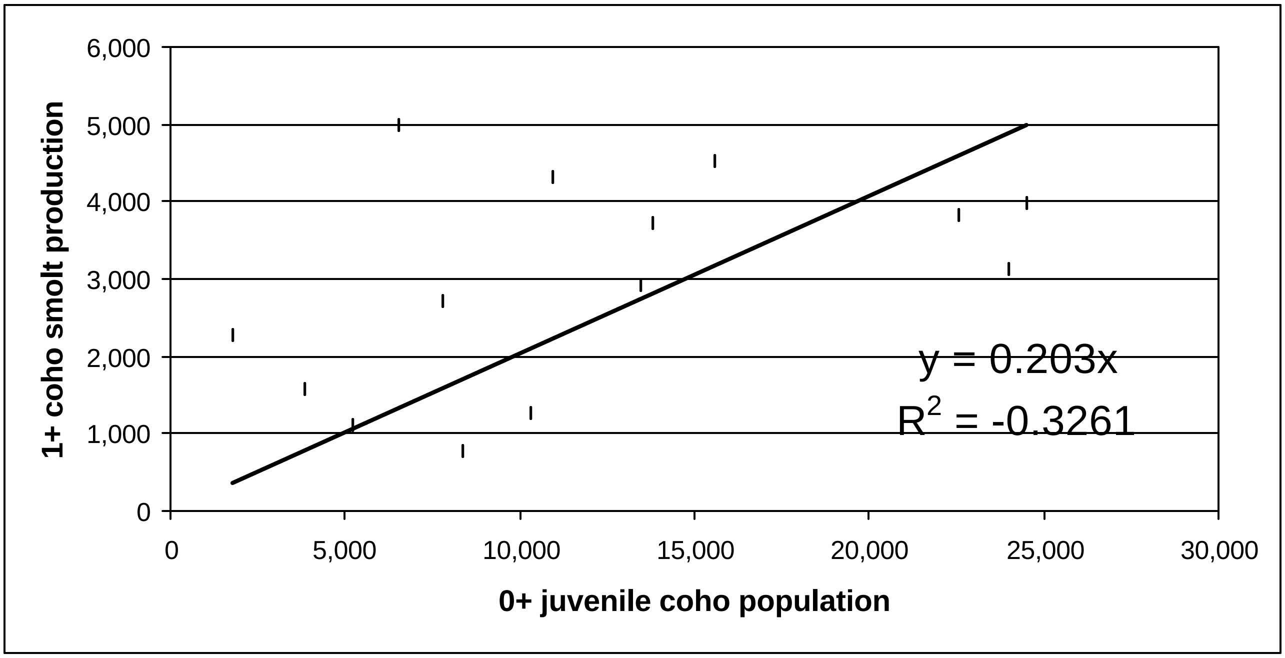


Figure 29. Estimated numbers of 1+ coho salmon smolts versus estimated 0+ juvenile coho from the preceding summer, West Branch Mill Creek, WY 1995 to 2008.

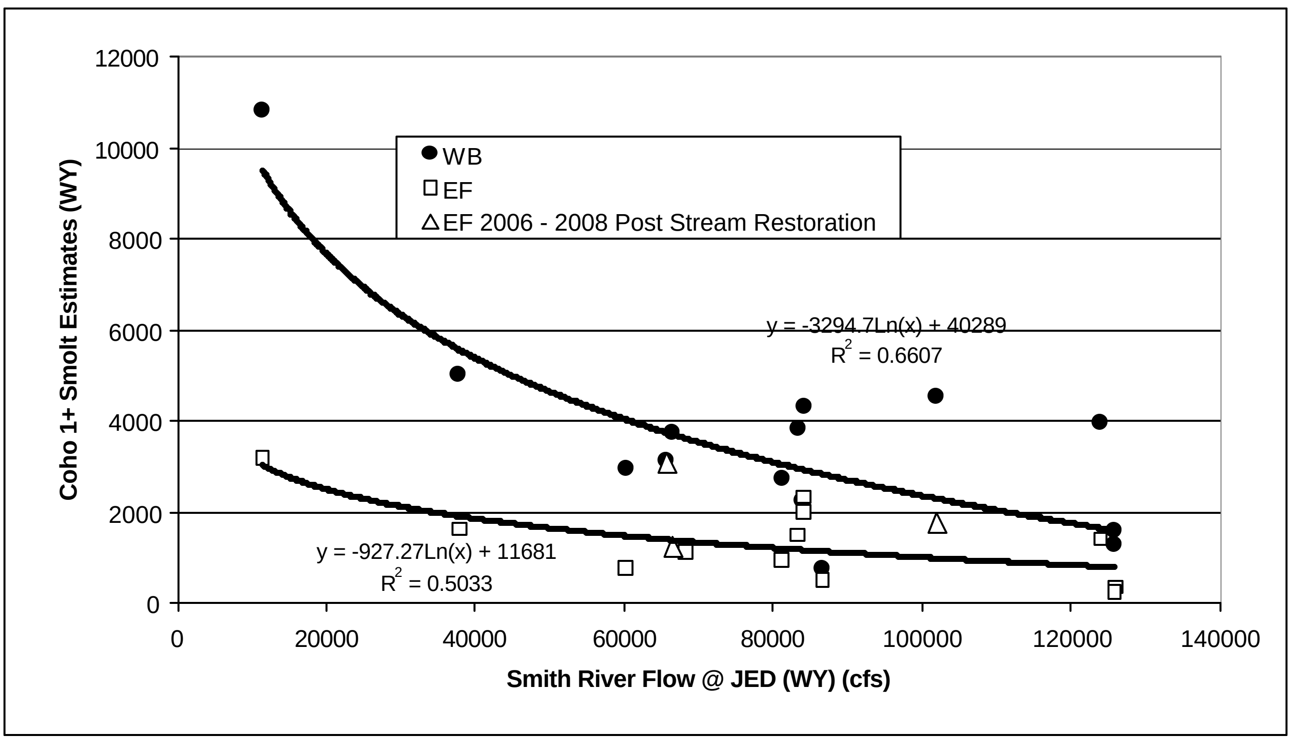


Figure 30. Estimated numbers of 1+ coho salmon smolts vs. peak winter flow (cfs) from the preceding water year, West Branch Mill Creek and East Fork Mill Creek, WY 1996 to 2008.

8.0 APPENDICIES

Appendix A. Live salmon, carcass and redd counts by survey date (WY 2008).

Appendix A (1). 2008 Lower Mainstem Mill Creek Chinook and coho salmon live fish, carcass and redd counts by survey date.

WY 2008 Lower Mainstem Mill Creek Spawner Surveys

	CHINOOK SALMON LIVE COUNTS				CHINOOK SALMON CARCASS				Total Chinook Count	Chinook Redds	COHO SALMON LIVE COUNTS				COHO SALMON CARCASS				Total Coho Count	Coho Redds	Unknown Salmon Redds
Date	M	F	Jack	Unknown	M	F	J	U			M	F	J	U	M	F	J	U			
8-Nov-07	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
1-Dec-07	1	1	0	0	2	1	2	2	9	21	0	0	0	0	0	0	0	0	0	0	0
15-Dec-07	4	5	0	0	0	2	1	0	12	10	1	1	0	0	0	0	0	0	2	4	5

Appendix A (2). 2008 Upper Mainstem Mill Creek Chinook and coho salmon live fish, carcass and redd counts by survey date.

WY 2008 Upper Mainstem Mill Creek Spawner Surveys

	CHINOOK SALMON LIVE COUNTS				CHINOOK SALMON CARCASS				Total Chinook Count	Chinook Redds	COHO SALMON LIVE COUNTS				COHO SALMON CARCASS				Total Coho Count	Coho Redds	Unknown Salmon Redds
Date	M	F	Jack	Unknown	M	F	J	U			M	F	J	U	M	F	J	U			
8-Nov-07	0	0	0	16	0	0	0	0	16	1	0	0	0	0	0	0	0	0	0	0	0
1-Dec-07	1	1	1	0	1	0	1	0	5	7	0	0	0	0	0	0	0	0	0	0	0
15-Dec-07	3	4	1	0	1	1	1	1	12	11	0	0	0	0	0	0	0	0	0	0	2
15-Feb-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix A (3). 2008 WB Mill Creek Reach 1 Chinook and coho salmon live fish, carcass and redd counts by survey date.

WY 2008 West Branch Mill Creek Reach 1 Spawner Surveys

	CHINOOK SALMON										COHO SALMON										
	LIVE COUNTS				CARCASS				Total Chinook	Chinook	LIVE COUNTS				CARCASS				Total Coho	Coho	Unknown Salmon
Date	M	F	Jack	Unknown	M	F	J	U	Count	Redds	M	F	J	U	M	F	J	U	Count	Redds	Redds
28-Nov-07	0	2	0	0	0	1	0	0	3	5	0	0	0	0	0	0	0	0	0	0	0
10-Dec-07	1	1	0	0	0	1	1	0	4	2	0	0	0	0	0	0	0	0	0	0	0
17-Jan-08	0	0	0	0	1	0	0	2	3	6	0	0	0	0	0	0	0	0	0	0	2

Appendix A (4). 2008 WB Mill Creek Reach 2 Chinook and coho salmon live fish, carcass and redd counts by survey date.

WY 2008 West Branch Mill Creek Reach 2 Spawner Surveys

	CHINOOK SALMON										COHO SALMON										
	LIVE COUNTS				CARCASS				Total Chinook	Chinook	LIVE COUNTS				CARCASS				Total Coho	Coho	Unknown Salmon
Date	M	F	Jack	Unknown	M	F	J	U	Count	Redds	M	F	J	U	M	F	J	U	Count	Redds	Redds
23-Oct-07	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
14-Nov-07	3	3	3	5	0	0	0	0	14	9	0	0	0	0	0	0	0	0	0	0	0
27-Nov-07	11	10	25	8	0	0	0	0	54	53	0	0	0	0	0	0	0	0	0	0	10
9-Dec-07	11	11	2	0	1	0	1	3	29	34	0	1	0	0	0	0	0	0	1	1	0
14-Dec-07	13	18	4	0	3	4	5	1	48	50	0	0	0	0	2	1	0	0	3	3	4
1-Jan-08	2	5	0	0	8	6	1	1	23	40	0	0	0	0	3	0	0	0	3	0	18
16-Jan-08	3	1	1	0	1	4	2	3	15	29	0	0	0	0	1	0	0	0	1	0	16
24-Jan-08	3	3	0	1	8	5	1	2	23	7	0	0	0	0	4	6	0	1	11	1	8
8-Feb-08	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0

Appendix A (5). 2008 WB Mill Creek Reach 3 Chinook and coho salmon live fish, carcass and redd counts by survey date.

WY 2008 West Branch Mill Creek Reach 3Spawner Surveys

	CHINOOK SALMON										COHO SALMON										
	LIVE COUNTS				CARCASS				Total Chinook	Chinook	LIVE COUNTS				CARCASS				Total Coho	Coho	Unknown Salmon
Date	M	F	Jack	Unknown	M	F	J	U	Count	Redds	M	F	J	U	M	F	J	U	Count	Redds	Redds
26-Nov-07	4	0	2	9	1	0	0	0	16	26	0	1	0	0	0	1	0	0	2	0	1
8-Dec-07	2	3	2	1	0	2	1	0	11	12	2	2	0	0	0	0	0	0	4	3	1
13-Dec-07	6	9	3	2	4	8	1	2	35	37	1	2	1	0	0	0	0	1	5	4	8
31-Dec-07	0	3	0	0	1	1	1	0	6	13	1	1	0	0	0	1	0	1	4	1	15
18-Jan-08	0	0	1	0	0	2	0	5	8	20	0	0	0	1	0	0	0	0	1	0	12
26-Jan-08	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	2	0	0	2	10	9
8-Feb-08	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	4

Appendix A (6). 2008 East Fork Mill Creek Reach 1 Chinook and coho salmon live fish, carcass and redd counts by survey date.

WY 2008 East Fork Reach 1 Spawner Surveys

	CHINOOK SALMON										COHO SALMON										
	LIVE COUNTS				CARCASS				Total Chinook	Chinook	LIVE COUNTS				CARCASS				Total Coho	Coho	Unknown Salmon
Date	M	F	Jack	Unknown	M	F	J	U	Count	Redds	M	F	J	U	M	F	J	U	Count	Redds	Redds
7-Nov-07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-Nov-07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22-Nov-07	4	3	2	0	0	0	0	0	9	9	0	0	0	0	0	0	0	0	0	0	0
28-Nov-07	7	4	3	2	0	0	0	0	16	14	0	0	0	0	0	0	0	0	0	2	4
9-Dec-07	11	9	1	1	0	1	0	1	24	18	0	0	0	0	0	0	0	0	0	0	1
2-Jan-08	3	4	0	1	2	5	1	0	16	15	0	0	0	0	0	0	0	0	0	0	6
15-Jan-08	0	1	0	1	0	1	0	0	3	1	0	0	0	0	0	0	0	0	0	0	4
22-Jan-08	0	0	1	0	0	1	0	1	3	3	0	0	0	0	2	0	0	0	2	2	3
29-Jan-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
9-Feb-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-Feb-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2

Appendix A (7). *2008 East Fork Mill Creek Reach 2 Chinook and coho salmon live fish, carcass and redd counts by survey date.*

WY 2008 East Fork Reach 2 Spawner Surveys

	CHINOOK SALMON										COHO SALMON										
	LIVE COUNTS				CARCASS				Total Chinook	Chinook	LIVE COUNTS				CARCASS				Total Coho	Coho	Unknown Salmon
Date	M	F	Jack	Unknown	M	F	J	U	Count	Redds	M	F	J	U	M	F	J	U	Count	Redds	Redds
6-Nov-07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13-Nov-07	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
21-Nov-07	1	1	2	1	0	0	0	0	5	15	0	0	0	0	0	0	0	0	0	0	2
27-Nov-07	2	1	0	0	0	0	0	0	3	5	0	0	0	0	0	0	0	0	0	0	2
6-Dec-07	0	1	1	1	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0	2
10-Dec-07	1	4	1	0	0	0	0	0	6	7	0	0	0	0	0	0	0	0	0	0	6
2-Jan-08	0	8	1	0	0	0	0	0	9	22	0	0	0	0	0	0	0	0	0	0	11
10-Jan-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
14-Jan-08	2	3	0	0	1	1	0	0	7	10	0	0	0	0	0	0	0	0	0	0	4
21-Jan-08	0	1	0	0	0	0	0	0	1	2	1	0	0	1	0	0	0	0	2	3	3
28-Jan-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
6-Feb-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12-Feb-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2

Appendix A (8). *2008 Bummer Lake Creek Chinook and coho salmon live fish, carcass and redd counts by survey date.*

WY 2008 Bummer Lake Creek Spawner Surveys

	CHINOOK SALMON										COHO SALMON										
	LIVE COUNTS				CARCASS				Total Chinook	Chinook	LIVE COUNTS				CARCASS				Total Coho	Coho	Unknown Salmon
Date	M	F	Jack	Unknown	M	F	J	U	Count	Redds	M	F	J	U	M	F	J	U	Count	Redds	Redds
31-Oct-07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21-Nov-07	0	2	1	0	0	0	0	0	3	2	0	0	0	0	0	0	0	0	0	0	1
30-Nov-07	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	1	4
11-Dec-07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19-Dec-07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7-Jan-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-Jan-08	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	3
22-Jan-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6-Feb-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix A (9). *2008 Kelly Creek (a.k.a. Chewie) Chinook and coho salmon live fish, carcass and redd counts by survey date.*

WY 2008 Chewie Creek Spawner Surveys

	CHINOOK SALMON										COHO SALMON										
	LIVE COUNTS				CARCASS				Total Chinook	Chinook	LIVE COUNTS				CARCASS				Total Coho	Coho	Unknown Salmon
Date	**M**	**F**	**Jack**	**Unknown**	**M**	**F**	**J**	**U**	**Count**	**Redds**	**M**	**F**	**J**	**U**	**M**	**F**	**J**	**U**	**Count**	**Redds**	**Redds**
21-Nov-07	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	2
30-Nov-07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
5-Dec-07	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
11-Dec-07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
19-Dec-07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30-Dec-07	0	1	0	0	0	0	1	0	2	1	0	0	0	0	0	0	0	0	0	0	7
7-Jan-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-Jan-08	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	11
22-Jan-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0
8-Feb-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix A (10). *2008 Low Divide Creek Chinook and coho salmon live fish, carcass and redd counts by survey date.*

WY 2008 Low Divide Creek Spawner Surveys

	CHINOOK SALMON										COHO SALMON										
	LIVE COUNTS				CARCASS				Total Chinook	Chinook	LIVE COUNTS				CARCASS				Total Coho	Coho	Unknown Salmon
Date	**M**	**F**	**Jack**	**Unknown**	**M**	**F**	**J**	**U**	**Count**	**Redds**	**M**	**F**	**J**	**U**	**M**	**F**	**J**	**U**	**Count**	**Redds**	**Redds**
6-Nov-07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13-Nov-07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21-Nov-07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27-Nov-07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
6-Dec-07	1	1	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	0
10-Dec-07	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	3
2-Jan-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0
10-Jan-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-Jan-08	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	2	0
21-Jan-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
6-Feb-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14-Feb-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix A (11). *2008 Rock Creek Chinook and coho salmon live fish, carcass and redd counts by survey date.*

WY 2008 Rock Creek Spawner Surveys																					
	CHINOOK SALMON										COHO SALMON										
	LIVE COUNTS				CARCASS				Total Chinook	Chinook	LIVE COUNTS				CARCASS				Total Coho	Coho	Unknown Salmon
Date	M	F	Jack	Unknown	M	F	J	U	Count	Redds	M	F	J	U	M	F	J	U	Count	Redds	Redds
15-Nov-07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23-Nov-07	1	3	0	0	0	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0
29-Nov-07	2	1	2	0	0	0	0	0	5	7	0	0	0	0	0	0	0	0	0	0	0
7-Dec-07	1	2	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0
12-Dec-07	0	1	0	0	0	0	0	0	1	5	0	0	0	0	0	0	0	0	0	0	0
3-Jan-08	0	1	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	1
17-Jan-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23-Jan-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix B. Live salmon, carcass and redd counts by survey date (WY 2009).

Appendix B (1). *2009 Lower Mainstem Mill Creek Chinook and coho salmon live fish, carcass and redd counts by survey date.*

WY 2009 Lower Mainstem Mill Creek Spawner Surveys																					
	CHINOOK SALMON										COHO SALMON										
	LIVE COUNTS				CARCASS				Total Chinook	Chinook	LIVE COUNTS				CARCASS				Total Coho	Coho	Unknown Salmon
Date	M	F	Jack	Unknown	M	F	J	U	Count	Redds	M	F	J	U	M	F	J	U	Count	Redds	Redds
25-Oct-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4-Nov-08	2	6	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0
25-Nov-08	4	3	0	0	3	2	0	0	12	14	0	0	0	0	0	0	0	0	0	0	4
26-Jan-09	0	0	0	0	3	3	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0

Appendix B (2). 2009 Upper Mainstem Mill Creek Chinook and coho salmon live fish, carcass and redd counts by survey date.

WY 2009 Upper Mainstem Mill Creek Spawner Surveys

	CHINOOK SALMON										COHO SALMON										
	LIVE COUNTS				CARCASS				Total Chinook	Chinook	LIVE COUNTS				CARCASS				Total Coho	Coho	Unknown Salmon
Date	M	F	Jack	Unknown	M	F	J	U	Count	Redds	M	F	J	U	M	F	J	U	Count	Redds	Redds
31-Oct-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4-Nov-08	1	4	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0
25-Nov-08	7	6	1	22	4	2	0	0	42	20	0	0	0	0	0	0	0	0	0	0	0
8-Dec-08	1	1	20	0	6	8	0	1	37	6	0	0	0	0	0	0	0	0	0	0	0
26-Jan-09	1	0	0	1	3	1	0	2	8	0	0	0	0	1	0	0	0	0	1	0	0

Appendix B (3). 2009 WB Mill Creek Reach 1 Chinook and coho salmon live fish, carcass and redd counts by survey date.

WY 2009 West Branch Mill Creek Reach 1 Spawner Surveys

	CHINOOK SALMON										COHO SALMON										
	LIVE COUNTS				CARCASS				Total Chinook	Chinook	LIVE COUNTS				CARCASS				Total Coho	Coho	Unknown Salmon
Date	M	F	Jack	Unknown	M	F	J	U	Count	Redds	M	F	J	U	M	F	J	U	Count	Redds	Redds
17-Nov-08	10	9	3	7	0	0	0	0	29	13	0	0	0	0	0	0	0	0	0	0	0
8-Dec-08	1	0	0	0	1	2	6	0	10	15	0	0	0	0	0	0	0	0	0	0	0
4-Feb-09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3

Appendix B (4). 2009 WB Mill Creek Reach 2 Chinook and coho salmon live fish, carcass and redd counts by survey date.

WY 2009 West Branch Mill Creek Reach 2 Spawner Surveys

	CHINOOK SALMON										COHO SALMON										
	LIVE COUNTS				CARCASS				Total Chinook Count	Chinook Redds	LIVE COUNTS				CARCASS				Total Coho Count	Coho Redds	Unknown Salmon Redds
Date	M	F	Jack	Unknown	M	F	J	U			M	F	J	U	M	F	J	U			
7-Nov-08	4	1	11	10	0	0	0	0	26	3	0	0	0	0	0	0	0	0	0	0	0
14-Nov-08	15	10	7	28	0	0	0	0	60	50	0	0	0	0	0	0	0	0	0	0	3
18-Nov-08	45	24	7	35	0	1	0	0	112	28	0	0	0	0	0	0	0	0	0	0	2
26-Nov-08	50	24	8	27	6	3	4	1	123	36	0	0	0	0	0	0	0	0	0	0	0
3-Dec-08	24	7	1	2	3	8	18	2	65	6	0	0	0	0	0	0	0	0	0	0	0
12-Dec-08	6	2	0	0	3	5	4	0	20	5	0	0	0	0	0	0	0	0	0	0	0
19-Dec-08	15	4	11	31	1	0	3	1	66	19	0	0	0	0	0	0	0	0	0	0	8
12-Jan-09	2	1	0	0	13	10	6	1	33	4	0	0	0	0	1	0	0	0	1	1	1
19-Jan-09	0	0	0	0	5	7	2	1	15	1	1	1	0	0	0	0	0	0	2	1	4
29-Jan-09	0	0	0	0	0	5	0	1	6	1	0	0	0	0	1	0	0	0	1	0	0
18-Feb-09	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	4

Appendix B (5). 2009 WB Mill Creek Reach 3 Chinook and coho salmon live fish, carcass and redd counts by survey date.

WY 2009 West Branch Mill Creek Reach 3 Spawner Surveys

	CHINOOK SALMON										COHO SALMON										
	LIVE COUNTS				CARCASS				Total Chinook Count	Chinook Redds	LIVE COUNTS				CARCASS				Total Coho Count	Coho Redds	Unknown Salmon Redds
Date	M	F	Jack	Unknown	M	F	J	U			M	F	J	U	M	F	J	U			
10-Nov-08	0	0	0	1	0	0	0	0	1	1	0	1	0	3	1	0	0	0	5	2	1
19-Nov-08	3	2	3	0	0	0	0	1	9	9	1	0	0	1	0	1	0	0	3	2	1
26-Nov-08	5	4	6	0	0	0	0	0	15	2	2	1	0	0	0	0	0	0	3	2	2
10-Jan-09	3	4	0	0	9	5	1	2	24	15	0	0	0	0	0	0	0	0	0	0	2
16-Jan-09	0	1	0	0	2	3	1	0	7	10	0	0	0	0	1	0	0	0	1	2	8
22-Jan-09	0	0	0	0	0	1	0	0	1	3	0	1	0	0	1	3	0	0	5	14	13
28-Jan-09	0	0	0	0	2	1	0	0	3	0	0	0	0	0	0	0	0	0	0	0	11
19-Feb-09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4

Appendix B (6). *2009 East Fork Mill Creek Reach 1 Chinook and coho salmon live fish, carcass and redd counts by survey date.*

WY 2009 East Fork Mill Creek Reach 1 Spawner Surveys

Date	CHINOOK SALMON LIVE COUNTS M	F	Jack	Unknown	CARCASS M	F	J	U	Total Chinook Count	Chinook Redds	COHO SALMON LIVE COUNTS M	F	J	U	CARCASS M	F	J	U	Total Coho Count	Coho Redds	Unknown Salmon Redds
6-Nov-08	1	1	0	1	0	0	0	0	3	1	0	0	0	3	0	0	0	0	3	0	1
12-Nov-08	9	11	11	10	1	0	0	0	42	14	0	0	0	0	0	0	0	0	0	0	2
18-Nov-08	12	11	14	12	0	0	0	0	49	22	0	0	0	0	0	0	0	0	0	0	3
27-Nov-08	15	15	16	17	7	2	0	1	73	29	0	0	0	0	0	0	0	0	0	0	2
2-Dec-08	13	12	13	13	2	1	0	0	54	21	0	0	0	0	0	0	0	0	0	0	2
5-Dec-08	9	8	9	24	3	3	0	0	56	14	0	0	0	0	0	0	0	0	0	0	0
20-Dec-08	3	2	2	8	0	1	0	0	16	3	0	0	0	0	0	0	0	0	0	0	2
12-Jan-09	0	1	0	0	2	1	1	1	6	2	0	0	0	0	0	0	0	0	0	0	0
21-Jan-09	0	0	0	0	0	0	0	2	2	2	0	0	0	0	1	1	0	0	2	0	0
27-Jan-09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
3-Feb-09	0	0	0	0	1	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0
18-Feb-09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2

Appendix B (7). *2009 East Fork Mill Creek Reach 2 Chinook and coho salmon live fish, carcass and redd counts by survey date.*

WY 2009 East Fork Mill Creek Reach 2 Spawner Surveys																					
	CHINOOK SALMON										COHO SALMON										
	LIVE COUNTS				CARCASS				Total Chinook	Chinook	LIVE COUNTS				CARCASS				Total Coho	Coho	Unknown Salmon
Date	M	F	Jack	Unknown	M	F	J	U	Count	Redds	M	F	J	U	M	F	J	U	Count	Redds	Redds
5-Nov-08	2	1	1	3	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0
11-Nov-08	8	8	9	4	0	0	0	0	29	15	0	0	0	0	0	0	0	0	0	0	4
17-Nov-08	7	8	9	9	0	0	0	1	34	12	0	0	0	0	0	0	0	0	0	0	2
24-Nov-08	5	3	5	1	1	1	0	0	16	0	0	0	0	0	0	0	0	0	0	0	0
1-Dec-08	0	0	0	0	0	0	0	1	1	7	0	0	0	0	0	0	0	0	0	0	0
16-Dec-08	0	0	0	1	2	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0	1
7-Jan-09	4	3	0	0	2	0	2	0	11	8	0	0	0	0	0	0	0	0	0	0	2
14-Jan-09	0	3	0	0	0	0	1	0	4	5	0	0	0	0	0	0	0	0	0	0	2
20-Jan-09	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	1	3	1
26-Jan-09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
2-Feb-09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
9-Feb-09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
16-Feb-09	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	2	2

Appendix B (8). *2009 Bummer Lake Creek Chinook and coho salmon live fish, carcass and redd counts by survey date.*

WY 2009 Bummer Lake Creek Spawner Surveys																					
	CHINOOK SALMON										COHO SALMON										
	LIVE COUNTS				CARCASS				Total Chinook	Chinook	LIVE COUNTS				CARCASS				Total Coho	Coho	Unknown Salmon
Date	M	F	Jack	Unknown	M	F	J	U	Count	Redds	M	F	J	U	M	F	J	U	Count	Redds	Redds
17-Nov-08	2	4	3	0	0	0	0	0	9	11	0	0	0	0	0	0	0	0	0	0	0
24-Nov-08	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0
2-Dec-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9-Jan-09	1	1	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0
15-Jan-09	0	1	0	0	0	1	0	0	2	1	0	0	0	0	0	0	0	0	0	0	1
20-Jan-09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
27-Jan-09	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
30-Jan-09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
5-Feb-09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12-Feb-09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix B (9). *2009 Kelly Creek (a.k.a. Chewie) Chinook and coho salmon live fish, carcass and redd counts by survey date.*

WY 2009 Kelly Creek Spawner Surveys																					
	CHINOOK SALMON										COHO SALMON										
	LIVE COUNTS				CARCASS				Total Chinook	Chinook	LIVE COUNTS				CARCASS				Total Coho	Coho	Unknown Salmon
Date	M	F	Jack	Unknown	M	F	J	U	Count	Redds	M	F	J	U	M	F	J	U	Count	Redds	Redds
12-Nov-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24-Nov-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15-Dec-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9-Jan-09	0	0	0	0	0	0	0	0	0	1	1	2	0	0	0	1	0	0	4	3	1
15-Jan-09	1	0	0	0	0	0	0	0	1	0	1	2	1	0	0	2	0	0	6	6	3
22-Jan-09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30-Jan-09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0
5-Feb-09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
12-Feb-09	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	3	1	0

Appendix B (10). 2009 Low Divide Creek Chinook and coho salmon live fish, carcass and redd counts by survey date.

WY 2009 Low Divide Creek Spawner Surveys

	CHINOOK SALMON										COHO SALMON										
	LIVE COUNTS				CARCASS				Total Chinook	Chinook	LIVE COUNTS				CARCASS				Total Coho	Coho	Unknown Salmon
Date	M	F	Jack	Unknown	M	F	J	U	Count	Redds	M	F	J	U	M	F	J	U	Count	Redds	Redds
5-Nov-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11-Nov-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
17-Nov-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
24-Nov-08	1	1	0	0	0	0	0	0	2	3	0	0	0	0	0	0	0	0	0	0	1
1-Dec-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
16-Dec-08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
7-Jan-09	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
14-Jan-09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20-Jan-09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
26-Jan-09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2-Feb-09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
9-Feb-09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16-Feb-09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix B (11). 2009 Rock Creek Chinook and coho salmon live fish, carcass and redd counts by survey date.

WY 2009 Rock Creek Spawner Surveys

	CHINOOK SALMON										COHO SALMON										
	LIVE COUNTS				CARCASS				Total Chinook	Chinook	LIVE COUNTS				CARCASS				Total Coho	Coho	Unknown Salmon
Date	M	F	Jack	Unknown	M	F	J	U	Count	Redds	M	F	J	U	M	F	J	U	Count	Redds	Redds
7-Nov-08	3	4	0	6	0	0	0	0	13	4	0	0	0	0	0	0	0	0	0	0	0
14-Nov-08	6	7	12	25	0	0	0	0	50	15	0	0	0	0	0	0	0	0	0	0	0
21-Nov-08	20	7	5	10	0	0	0	0	42	16	0	0	0	0	0	0	0	0	0	0	0
23-Jan-09	0	0	0	0	0	1	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0

Appendix C. Adult Salmon Escapement (WY 2008)

Appendix C (1). Minimum spawning escapement count for all Chinook salmon in the West Branch, East Fork and East Fork Tributaries of Mill Creek (WY 2008).

Chinook	WB Reach 3	WB Reach 2	EF Reach 2	EF Reach 1	Chewie	Bummer	Low Divide
Length of Reach (miles)	2.75	1.70	1.50	2.25	0.75	0.50	0.25
Total Chinook Observed	42	98	21	36	3	6	2
M = males	8	31	5	14	0	0	1
F = females	22	30	12	15	2	2	1
J = jacks	5	26	3	4	1	1	0
Unknown sex	7	11	1	3	0	3	0
Adults (fish/mile)	11	36	11	13	3	4	8
Jacks (fish/mile)	2	15	2	2	1	2	0
Total Chinook (fish/mile)	**15**	**58**	**14**	**16**	**4**	**12**	**8**

Appendix C (2). Minimum spawning escapement count for all coho salmon in the West Branch, East Fork and East Fork Tributaries of Mill Creek (WY 2008).

Coho	WB Reach 3	WB Reach 2	EF Reach 2	EF Reach 1	Chewie	Bummer	Low Divide
Length of Reach (miles)	2.75	1.70	1.50	2.25	0.75	0.50	0.25
Total coho Observed	9	19	2	2	1	0	1
M = males	2	10	1	2	1	0	0
F = females	5	7	0	0	0	0	1
J = jacks	1	0	0	0	0	0	0
Unknown sex	1	2	1	0	0	0	0
Adults (fish/mile)	3	10	1	1	1	0	4
Jacks (fish/mile)	0	0	0	0	0	0	0
Total coho (fish/mile)	**3**	**11**	**1**	**1**	**1**	**0**	**4**

Appendix C (3). *Minimum spawning escapement estimates for all Chinook and coho salmon in the West Branch Reach 1, Mainstem Mill Creek, and Rock creek study sections (WY 2008).*

	WB Reach 1		**Mainstem**		**Rock Creek**	
Length of Reach (miles)	0.5		1.5		0.47	
Year	Chinook	Coho	Chinook	Coho	Chinook	Coho
Total fish Observed	7	0	22	2	10	0
M = males	1	0	4	1	3	0
F = females	2	0	4	1	5	0
J = jacks	1	0	6	0	2	0
Unknown sex	3	0	8	0	0	0
Adults (fish/mile)	2	0	5	1	17	0
Jacks (fish/mile)	1	0	4	0	4	0
Total (fish/mile)	**4**	**0**	**15**	**1**	**21**	**0**

Appendix D. Adult Salmon Escapement (WY 2009)

Appendix D (1). *Minimum spawning escapement count for all Chinook salmon in the West Branch, East Fork and East Fork Tributaries of Mill Creek (WY 2009).*

Chinook	**WB Reach 3**	**WB Reach 2**	**EF Reach 2**	**EF Reach 1**	**Chewie**	**Bummer**	**Low Divide**
Length of Reach (miles)	2.75	1.70	1.50	2.25	0.75	0.50	0.25
Total Chinook Observed	30	193	44	100	2	12	2
M = males	12	94	15	28	0	3	1
F = females	10	54	12	23	0	6	1
J = jacks	4	40	9	20	1	3	0
Unknown sex	4	5	8	29	1	0	0
Adults (fish/mile)	8	87	18	23	0	18	8
Jacks (fish/mile)	1	24	6	9	1	6	0
Total Chinook (fish/mile)	**11**	**114**	**29**	**44**	**3**	**24**	**8**

Appendix D (2). *Minimum spawning escapement count for all coho salmon in the West Branch, East Fork and East Fork Tributaries of Mill Creek (WY 2009).*

Coho	WB Reach 3	WB Reach 2	EF Reach 2	EF Reach 1	Chewie	Bummer	Low Divide
Length of Reach (miles)	2.75	1.70	1.50	2.25	0.75	0.50	0.25
Total coho Observed	8	4	2	3	10	1	0
M = males	3	2	1	1	3	0	0
F = females	5	1	1	1	6	0	0
J = jacks	0	0	0	0	1	0	0
Unknown sex	0	1	0	1	0	1	0
Adults (fish/mile)	3	2	1	1	12	0	0
Jacks (fish/mile)	0	0	0	0	1	0	0
Total coho (fish/mile)	**3**	**2**	**1**	**1**	**13**	**2**	**0**

Appendix D (3). *Minimum spawning escapement estimates for all Chinook and coho salmon in the West Branch Reach 1, Mainstem Mill Creek, and Rock creek study sections (WY 2009).*

	WB Reach 1		**Mainstem**		**Rock Creek**	
Length of Reach (miles)	0.5		1.5		0.47	
Year	Chinook	Coho	Chinook	Coho	Chinook	Coho
Total Fish Observed	30	0	55	2	50	0
M = males	12	0	16	1	20	0
F = females	11	0	16	1	8	0
J = jacks	6	0	9	0	12	0
Unknown sex	1	0	14	0	10	0
Adults (fish/mile)	14	0	21	1	60	0
Jacks (fish/mile)	4	0	6	0	26	0
Total (fish/mile)	**18**	**0**	**37**	**1**	**106**	**0**

Appendix E. Research, Monitoring and Evaluation Projects – Reporting Metrics (MD, MO)

Appendix E. Research, Monitoring and Evaluation Projects – Reporting Metrics (MD, MO)

The following contains a brief comment to Reporting Metric questions.

- *State whether or not the project is directly related to key anadromous salmonid management questions regarding recovery and/or sustainability of healthy anadromous salmonid stocks;*

The project addresses both issues related to key recovery questions for anadromous salmonid management and sustainability of healthy anadromous salmonid stocks. The salmonid monitoring data that has been collected within the Mill Creek drainage, tributary to the Smith River, is the longest running life-history data set for coho salmon within the Southern Oregon/Northern California ESU and represents a valuable data set for assessing restoration efforts and the response of the species to these efforts. Mill Creek coho salmon, in addition to Chinook, steelhead and cutthroat trout are a valuable sport and commercial species within northern California. Sustaining healthy stocks for in-river fisheries and the ocean commercial season is extremely valuable to the local economy. Data developed to follow trends in adult returns and smolt outputs is valuable to State regulatory agencies that wish to maintain healthy anadromous stocks and monitor status for elevating the species from Threatened to Endangered within the ESU.

- *Provide the citation for the comprehensive monitoring strategy/program the project is a part of (Author, date, name, source, source address).*

California Department of Fish and Game. 2004. Recovery strategy for California coho salmon. Report to the California Fish and Game Commission. 594 pp. Copies/CDs available upon request from California Department of Fish and Game, Native Anadromous Fish and Watershed Branch, 1416 9th Street, Sacramento, CA 95814, or on-line: http://www.dfg.ca.gov/nafwb.cohorecovery

Smith River Advisory Council. 2002. Smith River Anadromous Fisheries Action Plan. Report to the Smith River Advisory Council.

- *Name the Organizations Cooperating on the Research, Monitoring and Evaluation Project*

California Department of Parks and Recreation
Redwood National and State Parks
Jay Harris
1111 Second Street
Crescent City, CA 95531

Save the Redwoods League
Ruskin Hartley
114 Sansome Street, Suite 1200
San Francisco, CA 94104
(415) 362-2352

NOAA Fisheries
Permits Coordinator
1655 Heindon Road
Arcata, CA 95521
(707) 825-5186

Stillwater Sciences
Sharon Kramer
Arcata, CA 95521

- *Cite reports prepared by the project on key management or restoration data, information and needs. These reports could be progress reports, monitoring reports, or final reports associated with research.*

Howard, C., and R. McLeod. 2005a. Anadromous fisheries monitoring of two Smith River tributaries, Del Norte County, California. 1993-2004. Prepared by Mill Creek Fisheries Monitoring Program, Crescent City, California.

Howard, C., and R. McLeod. 2005b. Anadromous fisheries monitoring of two Smith River tributaries, Del Norte County, California. 1994-2005. Final report. Prepared by Mill Creek Fisheries Monitoring Program, Crescent City, California.

Howard, C., and R. McLeod. 2005c. Chinook and coho salmon adult escapement monitoring for Mill Creek and Rock Creek, Smith River, California. 2003 & 2004 Final report. Prepared by Mill Creek Fisheries Monitoring Program, Crescent City, California.

Howard, C.F., and R.F. McLeod. 2006. Mill Creek Fisheries Monitoring Program, Interim Report, Del Norte County, California.

Howard, C.F., and R.F. McLeod. 2007. Mill Creek Fisheries Monitoring Program, Final Report, Del Norte County, California.

McLeod, R.F., and C. F. Howard. 2009. Mill Creek Fisheries Monitoring Program, Annual Report, Del Norte County, California.

Stillwater Sciences. 2006. Mill Creek fisheries monitoring program: ten year report. Final report. Prepared by Stillwater Sciences, Arcata, California for Department of Fish and Game and Save the Redwoods League, San Francisco, California.

- *Describe the Research, Monitoring and Evaluation findings utilized in adaptive management changes to anadromous salmonids and watershed programs and policies.*

Adaptive management has been used in monitoring salmonid escapement, outmigration, habitat restoration and water recovery efforts in the Mill Creek drainage.

The existing sampling methodologies for outmigrant trapping and juvenile abundance snorkel surveys have been effective. Coho smolt and juvenile data is essential for estimating population size and evaluating the potential carrying capacity, and changes in carrying capacity that result from future management actions. Monitoring methods have changed slightly in the twelve years of data collection to improve trap efficiencies and recapture probabilities, decrease observe bias during dive counts and increase accuracy at assessing population size in deep pool habitat strata.

Population modeling using existing data identified overwintering habitat as the limiting factor for coho salmon populations, and we recommend that increasing overwintering habitat be the highest priority for any restoration activities. Large woody debris enhancements could potentially help increase overwintering habitat as well as summer rearing habitat. Juvenile coho select habitat primarily on the basis of water velocity, preferring low-velocity habitats throughout the juvenile rearing period. In coastal streams, low-velocity habitat conditions are primarily created by LWD.

Through recognition of restoration needs, specifically in the East Fork of Mill Creek, efforts aimed at increasing summer and winter rearing habitat for coho salmon in 2006-2009 appear to have been successful at increasing smolt production and over-winter survival. Significant restoration dollars have been put into the Mill Creek drainage, managed by California State Parks, and advised by the Mill Creek Advisory Committee. These efforts steer significant Wildlife Conservation Board dollars (4 million) dedicated to riparian restoration, instream habitat restoration, road decommissioning and reformation of the watershed.

In addition, monitoring efforts identified key summer rearing habitats that were being dewatered within a section of the West Branch Mill Creek associated with Del Norte Redwoods State Park, Mill Creek Campground. Water was being drawn for storage and recreational use from the creek and may have contributed to flows going subsurface annually, eliminating approximately a mile of rearing habitat. Observations triggered NOAA and State Parks to evaluate water withdrawal methods and replace obsolete lines within the campground and a well to provide the facilities water needs.

- *Report stream length assessed/monitored for habitat condition, water quality, anadromous salmonid abundance and productivity.*

Approximately 11.2 miles of anadromous habitat is surveyed and monitored annually for adult escapement, smolt outmigration and juvenile abundance.