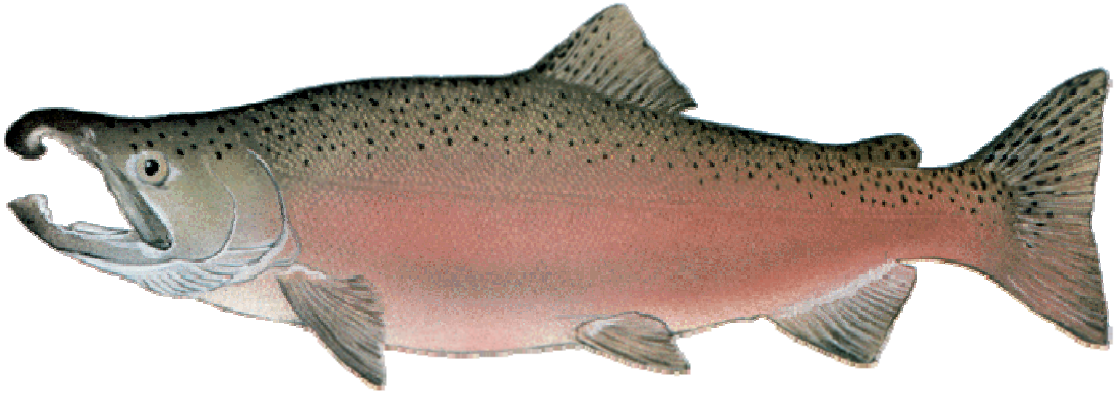
West Fork Smith River
Salmonid Life-Cycle Monitoring

Final Report: 2000-2001

FY 2000 Allocation
BLM Contract Number: HAC991021



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Introduction

In 1998, as part of the Oregon Plan for Salmon and Watersheds, the Oregon Department of Fish and Wildlife began a program to monitor survival and downstream migration of salmonid fishes (*Oncorhynchus spp*.). As part of this program the Salmonid Life-cycle Monitoring project developed two objectives; 1) estimate the abundance of adult salmonids and downstream-migrating juvenile salmonids, and 2) estimate the marine and freshwater survival rates for coho salmon.

This report summarizes fish monitoring in the West Fork Smith River, Oregon (Umpqua Basin) for the 2000-2001 run year of returning adult salmonid fishes and year 2001 out-migration of juvenile fish. A full description of sampling methods is provided in Solazzi et al. (2000).

Adult Trap Operation

The adult trap was operated continuously from September 15, 2000 to May 26, 2001. During October and November, precipitation was below average and as a consequence, streamflows were very low. Few coho salmon or chinook salmon were able to reach or enter the adult trap until streamflows increased slightly in late November. Although fish could not ascend West Fork Smith River early in the migration period, many fish were observed holding in pools in the 1.5km reach below the adult trap.

During higher streamflows in December, accumulation of suspended leaves on the floating barrier weir at the adult trap caused the weir to submerge on two occasions that totaled four days. Most fish that were holding in pools below the trap were able to bypass the trap when the weir was submerged. After December, leaf accumulation on the weir was not a problem and the weir remained an effective barrier to fish passage. Beginning February 2, a small portion of the weir was intentionally submerged to allow downstream passage of post-spawned (kelt) winter steelhead. Although not a complete barrier when operated in this manner, the weir still functioned to trap most returning steelhead. The floating weir was removed from the river on May 26 and sections of the head dam and attachment sill were opened to allow downstream passage of steelhead adults and eliminate these barriers to passage of small fish.

Fork length of each fish captured was measured, sex and presence of fin marks was recorded, and two yellow Floy-tags were implanted near the dorsal fin. The adult trap also functioned as a recapture site for fish tagged at Smith River Falls, and tag number and color were recorded for previously tagged fish. Tags were removed from fish previously tagged at Smith River Falls and all fish were re-tagged with two yellow Floy tags. Some steelhead entered the trap with yellow tags implanted the previous run year (1999-2000), indicating they were repeat spawners. The tag numbers of repeat spawners were recorded and the old tags left in place. If the fish was missing one of two tags originally implanted, a new tag was inserted.

Total numbers of adult salmonids trapped in the West Fork Smith River are shown in Table 1.

Table 1. Number of fish trapped at the West Fork Smith River adult fish trap, October 2000 through May 2001.

Species	Female	Male	Jack	Mortalities
Chinook salmon	1	26 [a]	7	2 jack [d] , 4 males [e]
Coho salmon	46 [b]	56 [c]	24	1 jack [d] , 1 male [e] , 2 females [e]
Chum salmon	0	1		0
Winter Steelhead	142	127		0

[a] two tagged males subsequently swam down onto the floating weir and were passed below; actual number passed above trap is 24.
[b] includes one female that escaped from trap before passing and did not re-enter trap, and one female that was passed but subsequently swam down onto floating weir and died. Actual number passed above trap is 44.
[c] includes one male that was passed but subsequently swam down onto floating weir and died. Actual number passed above trap is 55.
[d] gilled in entrance fyke to trap
[e] stranded on floating weir.

Run timing into the adult trap was strongly influenced by streamflow. Most chinook entered following the first freshet in late November. A few coho also entered the trap in late November, but most were trapped following a strong freshet in mid-December. Winter steelhead were trapped as early as December, but the peak in run timing occurred during a series of moderate freshets in March (Figure 1). Length distribution of adult spawners is shown in Figure 2.

Estimation of Spawner Escapement

Spawning surveys were conducted between December 4, 2000, and May 20, 2001 to collect data used to estimate total number of spawners in the West Fork Smith River. Eight reaches in five tributaries (Coon, Crane, Moore, Gold and Beaver creeks), and five reaches in the mainstem were surveyed to record information on coho salmon and chinook salmon spawners. Four additional reaches in the mainstem was surveyed after December to enumerate winter steelhead spawners. Survey conditions were generally good throughout the sample period and a survey frequency of approximately seven days was maintained for most reaches.

During surveys conducted to record coho spawners, total number of old and new redds found within each reach was recorded. This permitted the determination of a peak redd count, but these counts did not represent the season total of females that utilized each reach. For steelhead, each redd was marked with a painted rock and flagged along shore. This enabled us to record only new redds on subsequent surveys and provided a season-total number of redds within each reach. Results of spawning surveys are shown in Table 2.

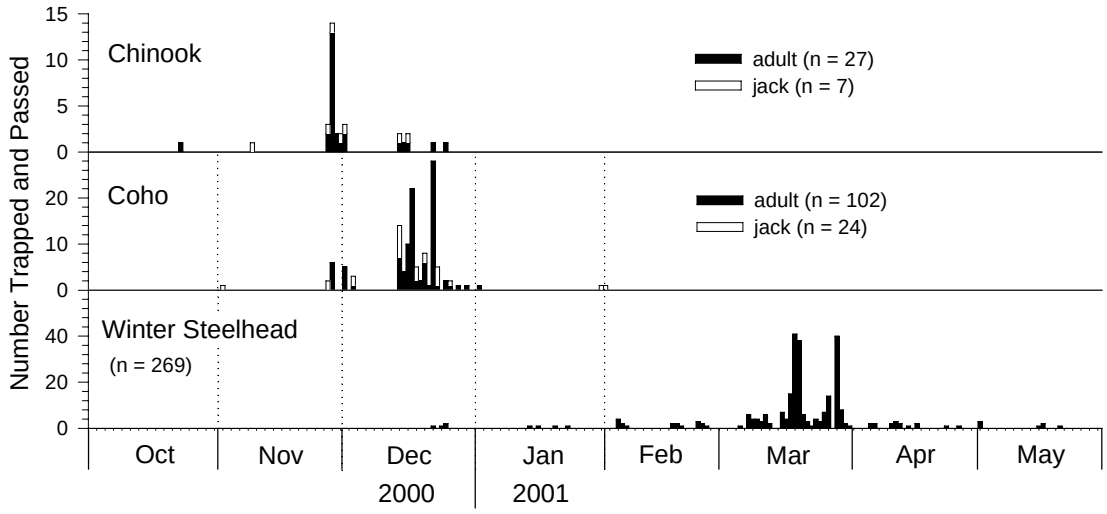

Figure 1. Timing of chinook salmon, coho salmon, and winter steelhead trapped in the West Fork Smith River during the 2000-2001 run year.

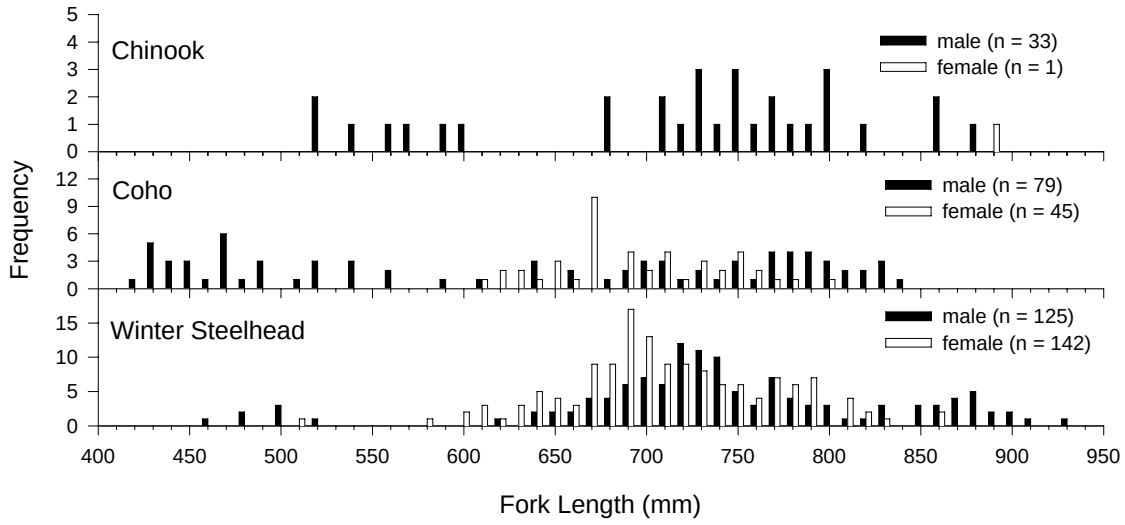

Figure 2. Length-frequency of chinook salmon, coho salmon, and winter steelhead trapped in the West Fork Smith River during the 2000-2001 run year. Sample size (n) is lower than number trapped in some cases because not all fish were measured.

Table 2. Peak redd counts for coho salmon and season total redd counts for winter steelhead in the West Fork Smith River for the period December 2000 to May 2001.

Survey Reach	Reach Length (km)	Coho Peak Count	Steelhead Season Total
Tributaries			
Coon Cr.	1.12	20	5
Crane Cr.	1.28	20	6
Moore Cr, lower	1.12	15	12
Moore Cr, upper	2.08	14	2
Beaver Cr, lower	2.08	15	13
Beaver Cr, upper	2.40	34	5
Gold Cr, lower	1.28	9	14
Gold Cr, upper	1.76	9	13
Mainstem			
Trib. B to Crane Cr.	1.76	21	25
Crane Cr. to Trib. C	0.48	not surveyed	5
Moore Cr to Trib. D	1.92	9	34
Trib. D to Trib. E	1.28	not surveyed	13
Trib. F to Beaver Cr.	1.12	not surveyed	23
Gold Cr. to left tributary	1.60	16	39
Above bridge, Section 3	1.76	6	14
Above bridge, Section 4	1.12	6	9
Above bridge, Section 5	1.92	not surveyed	9
Total			241

Table 3. Number of live fish observed on spawning surveys or recovered as carcasses in the West Fork Smith River during the period December 2000 through May 2001. The percentage of yellow-tagged fish represents the proportion observed on spawning grounds. The percentage of non-yellow-tagged fish represents the proportion caught in the adult trap because non-yellow tags were removed in the trap and replaced with yellow tags. Non-yellow-tagged fish on spawning grounds were those that bypassed the barrier weir and trap.

Species	Age	Spawning Surveys Live Count	Spawning Surveys Carcasses	Carcasses on Trap Weir	Percent Yellow	Percent Non-Yellow
Coho	adult	377	117	31	18.3	32.4
	jack	58	13	0	10.1	16.7
Chinook	adult	1	1	2 [a]	--	--
	jack	0	0	0	--	--
Steelhead		167	12	2	87.3	38.7

[a] includes the one female trapped and tagged at the West Fork Smith adult trap.

Chinook Salmon Escapement

Only one live chinook salmon was observed on spawning surveys and a total of three carcasses were recovered. No yellow-tagged chinook were observed and no estimate of spawners was made. Although it is likely that some chinook bypassed the trap when the weir was submerged in November and December, the low incidence of live-fish observation and carcass recovery suggests that run size was relatively small. The low streamflows that prevailed until late in the migration period likely influenced the number of chinook that entered the West Fork Smith River. Another factor that may have influenced number of chinook spawners is the strength of the brood year that would have contributed most to chinook escapement in fall 2000. During fall 1996, very high streamflows likely affected spawning success and egg survival of the 1996 brood year. Four-year olds from this brood year would have returned to the Smith River in fall 2000. Although chinook mature at different ages, four-year old fish comprise a major component of total spawners of a year class, thus if spawning success was poor in fall 1996, this would be reflected in low escapement during fall 2000.

Coho Salmon Escapement

A population estimate of adult coho salmon spawners (>510mm fork length) was made based on number of yellow tags observed on spawning surveys plus those recovered from carcasses. A modified Peterson estimate was made using the formula:

$$N = \frac{(M(1-p^2) + 1)(C+1)}{(R + 1)}$$

where:

N = estimated population above the West Fork Smith trap
M = (99) the number of fish yellow-tagged and passed above the trap
C = (502) the number of fish observed (live counts + carcass recoveries) for tags
R = (93) the number of fish with yellow tags
p^2 = the probability that a fish lost both yellow tags before being observed

The probability that a fish lost one of the two tags implanted was estimated by the formula:

$$p = n_1 / (2n_2 + n_1)$$

where:

n_1 = (6) the number of fish observed with one yellow tag
n_2 = (87) the number of fish observed with two tags

Using this methodology, a total of 535 coho salmon spawned in the West Fork Smith River during the 2000-2001 run year. This estimate includes 241 females, based on the sex ratio of fish that entered the adult trap. Using this estimate of total spawners, trap efficiency for coho salmon was 0.191.

Winter Steelhead Escapement

An estimate of steelhead spawners was made using the same methodology, where:

M = (269) the number of fish yellow-tagged and passed above the trap
C = (181) the number of fish observed (live counts + carcass recoveries) for tags
R = (158) the number of fish with yellow tags
n_1 = (23) the number of fish observed with one yellow tag
n_2 = (131) the number of fish observed with two tags

Using these data, the estimated number of steelhead spawners (N) was 307. Based on the sex ratio of steelhead trapped at the West Fork Smith trap, 162 females were calculated to have spawned above the trap. Using this estimate of total escapement, trap efficiency for steelhead was 0.876, and the ratio of total number of redds counted to estimated number of female spawners was 1.49.

A total of 37 female and 11 male steelhead entered either the Smith Falls trap or the West Fork Smith trap with yellow tags that had been implanted during the 1999-2000 run year, indicating they were repeat spawners. The return rate for repeat spawners (the percentage of tagged fish that returned to spawn the following year) was influenced by several factors, including the stray rate and the rate of tag loss between run years. In order to calculate return rate, these factors are accounted for in turn.

Twenty fish were captured at Smith Falls that were originally tagged in the West Fork Smith during the previous (1999-2000) run year. The calculated trap efficiency at the falls trap was 0.387, based on number of fish tagged at the falls and recaptured in the West Fork Smith trap. Using this trap efficiency, an estimated 52 repeat spawners from the West Fork Smith passed Smith Falls. A total of 41 tagged repeat spawners entered the West Fork Smith trap. Trap efficiency at the West Fork trap was 0.87, thus it is likely that a total of 47 repeat spawners returned to the West Fork Smith River. This is fewer than the number estimated to have passed Smith Falls, suggesting that not all fish originally tagged in the West Fork returned to that tributary. This is supported by the recapture rate of fish first sampled at the falls trap. Of the 20 yellow-tagged fish sampled at the falls, only 13 subsequently entered the West Fork Smith trap. Of the remaining seven fish, one likely bypassed the trap (7*0.87 trap efficiency) and six spawned elsewhere in the Smith River system. This is consistent with the number estimated to have passed the falls (52) and the number that subsequently entered the West Fork Smith (47). The number estimated to have passed the falls was used as the total number of tagged repeat spawners that entered the Smith River system. In addition to the six fish that likely strayed within-system, one fish tagged in 1999-2000 strayed out of system and was recovered at Millicoma Hatchery in the Coos River system, south of the Umpqua River. This indicates a stray rate of 13.2% (7/53) for repeat spawners originally tagged in the West Fork Smith River.

Fifteen out of 48 yellow-tagged repeat spawners sampled at both Smith Falls and the West Fork Smith trap had lost one of the two yellow tags applied in 2000. The tendency to lose tags differed by sex. Males had the highest rate of single-tag loss, 72.7%, while only 18.9% of female repeat spawners had lost one tag. Because of this difference, the

probability of losing both tags was calculated for each sex, with $p^2 = 0.327$ for male and 0.011 for female repeat spawners.

A total of 245 female and 159 male steelhead were tagged in the West Fork Smith River during the 1999-2000 run year. Applying the sex ratio of repeat spawners trapped in 2001 (37 female/11male) to the estimated escapement of repeat spawners that passed Smith Falls (52), a calculated 40 females and 12 males that spawned in 2001 were originally tagged in the West Fork Smith River. The return rate of repeat spawners was calculated as: (number of tagged spawners in current run year / number tagged previous run year) / (1- p^2). Using this methodology, return rate of repeat spawners to the Smith River system was 16.5% for females and 10.3% for males.

Juvenile Out-Migrant Trap Operation

The juvenile migrant trap on the West Fork Smith was installed on January 25 and removed on May 29 when low streamflows made it difficult to continue operation. The trap sampled continuously except for one 24-hour period in late March when the trap was pulled from the main current to avoid damage during a strong freshet. On two occasions, the trap box filled with floating debris during storm events and caused significant mortality of trapped fish.

Estimated numbers of out-migrants for each species and size class are shown in Table 4, and migration timing of coho smolts and fry, steelhead smolts, and chinook fry is shown in Figure 3.

Table 4. Estimated number of out-migrants and calculated trap efficiency determined at the juvenile migrant trap at river kilometer 1.6 on the West Fork Smith River for the period January 25 to May 27, 2001.

Species / Size Class		Estimated Total Migrants	Trap Efficiency	Mortalities
Coho	smolts (age-1+)	20091	0.35	161
	fry (age-0)	13550	0.10	41
Chinook fry (age-0)		937	0.13	3
Trout fry (< 60mm)		304 [a]	- -	14
Steelhead				
	> 120mm	7678	0.19	6
	90 – 119mm	3883	0.32	9
	60 - 89mm	620	0.37	0
Cutthroat				
	> 160mm	901	0.25	0
	120 – 159mm	1633	0.22	1
	90 - 119mm	472	0.13	0
	60 - 89mm	31 [a]	- -	2

[a] Total number caught; no expanded estimate of migrants was made because fewer than five marked fish were recaptured.

For the four-year period that juvenile out-migration has been monitored in the West Fork Smith River, the number of coho smolts in 2001 was the second highest measured, and the number of steelhead smolts was the highest measured (Figure 4). The number of chinook fry migrants has significantly declined since 1998. The low number of chinook fry found in 2001 reflects the low number of adult spawners observed the previous fall.

Mean fork length of coho smolts measured during the three-week period of peak migration has varied by less than a centimeter between 1998 and 2001, but mean fork length of steelhead smolts has consistently declined during this same period (Figure 5). This apparent trend may be a function, in part, of migration timing; the peak out-migration of steelhead smolts in 2001 occurred two to five weeks earlier than peaks measured during the previous three years. The numeric and proportional increase in migration of steelhead migrants less than 120mm (Figure 4) suggests density-dependent factors may also have some influence on size of migrants, but the relationship of seeding levels to available summer-rearing and over-winter habitat in the West Fork Smith River is not clear.

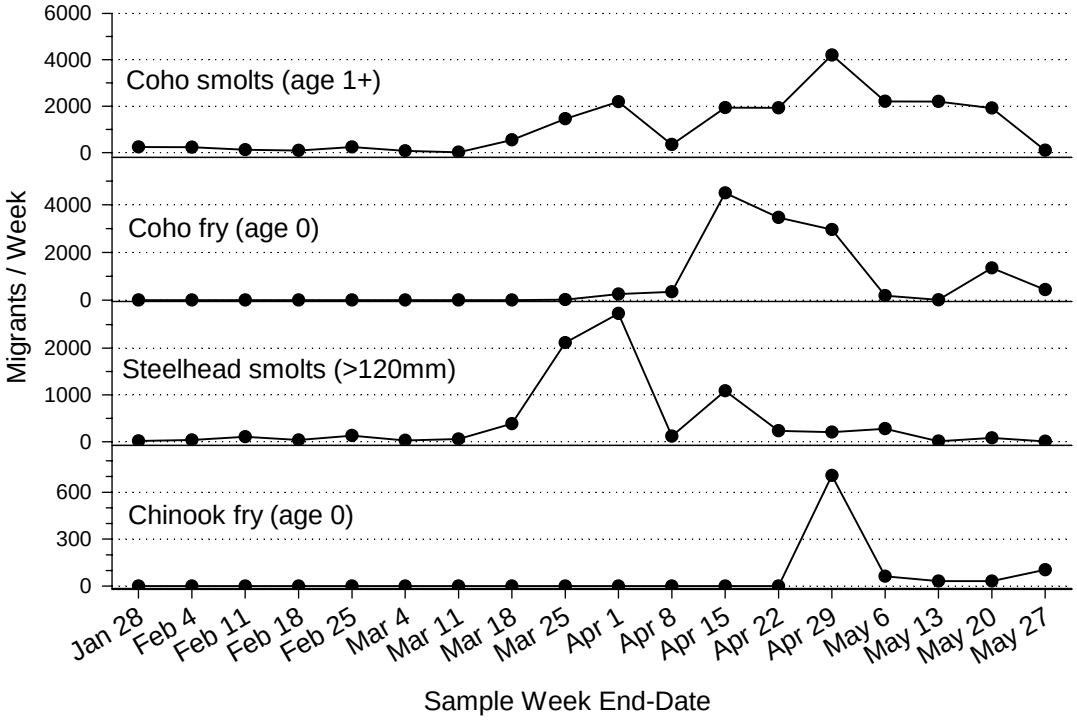

Figure 3. Migration timing of juvenile out-migrants from the West Fork Smith River in 2001.

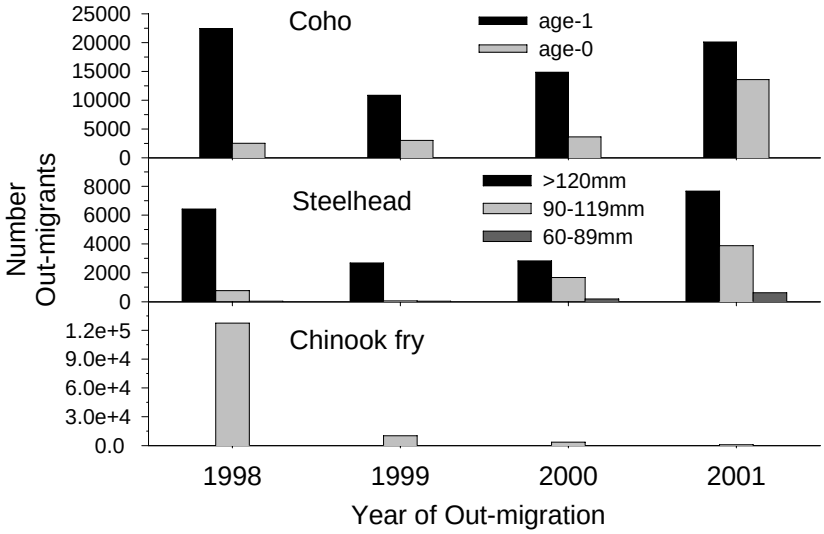

Figure 4. Number of juvenile out-migrant coho salmon, winter steelhead, and chinook salmon measured at river kilometer 1.6 in the West Fork Smith River, Oregon, for the period 1998 through 2001.

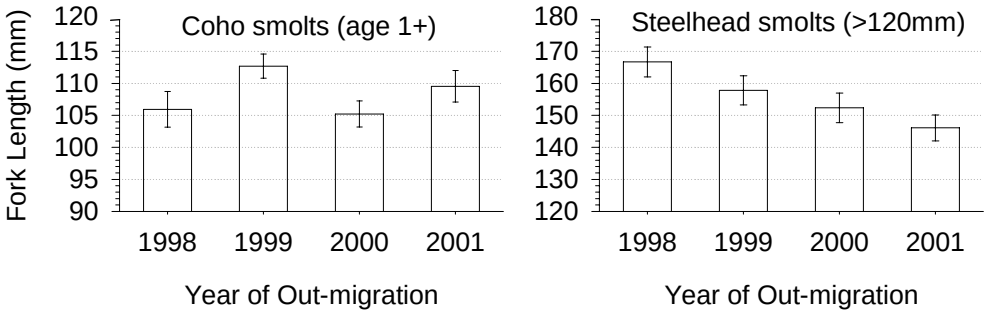

Figure 5. Mean fork length (±95%CI) of coho and winter steelhead smolts for the three-week period of peak out-migration in the West Fork Smith River for the years 1998 through 2001.

Literature Cited

Solazzi, M.F., S.L. Johnson, B. Miller, T. Dalton 2000. Salmonid Life-Cycle Monitoring Project 1998 and 1999. Monitoring Program Report Number OPSW-ODFW-2000-3, Oregon Department of Fish and Wildlife, Portland, Oregon.