THE OREGON PLAN *for Salmon and Watersheds*

Salmonid Life-Cycle Monitoring Project, 2002

Report Number: OPSW-ODFW-2003-2

SALMONID LIFE-CYCLE MONITORING PROJECT 2002

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February 14, 2003

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Funds provided in part by:
Oregon Department of Fish and Wildlife
Sport Fish and Wildlife Restoration Program administered by the U.S. Fish and Wildlife Service F-171-R
Bureau of Land Management Salem and Coos Bay Districts
Oregon Plan for Salmon and Watersheds
Oregon Department of Forestry

Citation: Solazzi, M.F., S.L. Johnson, B. Miller, T. Dalton, K.A. Leader 2003. Salmonid Life-Cycle Monitoring Project 2002 Monitoring Program Report Number OPSW-ODFW-2003-2, Oregon Department of Fish and Wildlife, Portland, Oregon.

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PART I. SMOLT AND ADULT MONITORING

Introduction

In 1998, as part of the Oregon Plan for Salmon and Watersheds, the Oregon Department of Fish and Wildlife (ODFW) began monitoring survival and downstream migration of salmonid fishes (*Oncorhynchus spp*.) in coastal basins. As a part of this program the Salmonid Life-cycle Monitoring project developed three objectives: 1) estimate abundance of adult salmonids and downstream migrating juvenile salmonids, 2) estimate marine and freshwater survival rates for coho salmon (*Oncorhynchus kisutch)* and 3) evaluate effects of habitat modification on the abundance of juvenile salmonids in Cummins and Tenmile creeks.

This report summarizes data collected on downstream migration of juvenile salmonids during the spring of 2002, and spawning adult returns from the winter of 2001-02. During 2001 we estimated abundance of adult salmonids at seven locations: North Fork Scappoose Creek (Lower Columbia), North Fork Nehalem River, Mill Creek (Siletz Basin), Mill Creek (Yaquina Basin), Cascade Creek (Alsea Basin), West Fork Smith River and Winchester Creek (South Slough, Coos Bay). We monitored downstream migration of juvenile fish at these same locations plus six other locations where adult fish could not be counted (Solazzi et al 2001). A manuscript on the effectiveness of habitat improvements in Cummins and Tenmile creeks is in preparation.

Methods for Estimating Abundance of Migrating Juvenile Salmonids

Rotary screw traps or rotating incline-plane traps were used to capture downstream-migrating juvenile salmonids. Traps generally began fishing in early March and fished continuously until catches diminished to low levels (or low streamflows precluded further operation of the traps), usually by mid June. The traps were normally checked and cleared of fish and debris once a day, although, to ensure fish safety, visits were more frequent during storm events and periods of high debris. Fish were anesthetized with MS-222 and enumerated by species, size class, age, and development (smoltification) class as indicated by visible brightness.

Each species was classified by age or size group. Coho salmon *(O. kisutch)* were identified as fry (age 0+) or smolts (age 1+). All chum salmon (*O. keta*) captured were fry (age 0+). Chinook salmon (*O. tshawytscha*), also age 0+, were identified either as fry that migrated soon after emergence (<60 mm fork-length) and or fingerlings that remained to rear until $\geq$60 mm. Trout species were measured by size classes that roughly correspond to age classes. Trout Fry (<60 mm) were not differentiated by species. Size classes for steelhead (*O. mykiss*) were 60-89, 90-119 and $\geq$120 mm and 60-89, 90-119, 120-159 and $\geq$160 mm for cutthroat trout (*O. clarki*).

To calibrate the efficiency of the traps and to estimate total outmigration, up to 25 fish of each species and size class were marked each day with a small clip on the caudal fin, then released upstream of the traps for recapture. Marked fish were released at dusk from a floating timer-actuated release device (Miller et al. 2000). Recaptured marked fish were enumerated and estimates of total outmigrants were made by expanding trap catches using the following equations:

$$N = n_i / E_i,$$

and

$$E_i = r_i / m_i,$$

where N = total estimated outmigrants, n_i = number of fish captured, E_i = estimated trap efficiency, r_i = number of recaptured marked fish, and m_i = number of marked fish released. Values used in these estimates were usually weekly totals. However, when recaptures were infrequent, catch totals for adjacent weeks were pooled. Total out-migrants for the season were the sum of weekly estimates. Population estimates were not calculated if fewer than five marked fish of a particular species and size class were recaptured.

A bootstrap procedure was used to determine the variance and 95% confidence interval for each population estimate (Thedinga et al 1994). An estimate of the population bias was also obtained from the bootstrap procedure. A negative bias indicated that the true population size was likely underestimated, while a positive bias indicated that the true population size was likely overestimated. The percentage values associated with the population estimates in this report represent the percentage of times that the bootstrap procedure calculated a larger or smaller value for the population. Variance estimates were based on 1,000 iterations of the bootstrap procedure. Average fork length of coho salmon smolts (age-1+), steelhead smolts (>120mm), and all cutthroat trout (size classes combined) were calculated during the week of peak migration.

Results and Discussion

Estimates of Population Size

Populations of coho salmon smolts measured in 2002 were generally higher than were previously measured since monitoring began in 1998 (Figure 1). One exception was the North Fork Nehalem where the number of out-migrants was lower than the mean for the previous four years, although the estimate for 2002 may be biased because the trap was inoperable for several weeks due to damage.

For the period 1998-2002, the 95% confidence interval for coho salmon smolts averaged $\pm$14.2% of the population estimate and had an average bias of –0.6%. Abundance of Coho salmon fry during 2002 was higher than the five-year average at all sites except for the Little South Fork Kilchis and the Little North Fork Wilson River (Figure 2). The average confidence interval for coho fry was $\pm$34% of the population estimate and had an average bias of –2.9%. Abundance of Chinook salmon fry in 2002 was relatively high compared to previous years, especially in the north coast streams (Figure 3). The average confidence intervals for chinook salmon fry was $\pm$13% of the population estimate and had an average bias of -0.69%. Steelhead smolt populations tended to be lower in 2002 than in 2001 (Figure 4). Confidence intervals for steelhead smolts averaged $\pm$27% of the population estimates and had an average bias of –1.7%. Populations of cutthroat trout were variable, with the West Fork Smith having the highest abundance on record. At other locations abundance was generally below the previous year (Figure 5). The average confidence interval for cutthroat trout was $\pm$50% of the population estimate and the bias averaged –4.3%.

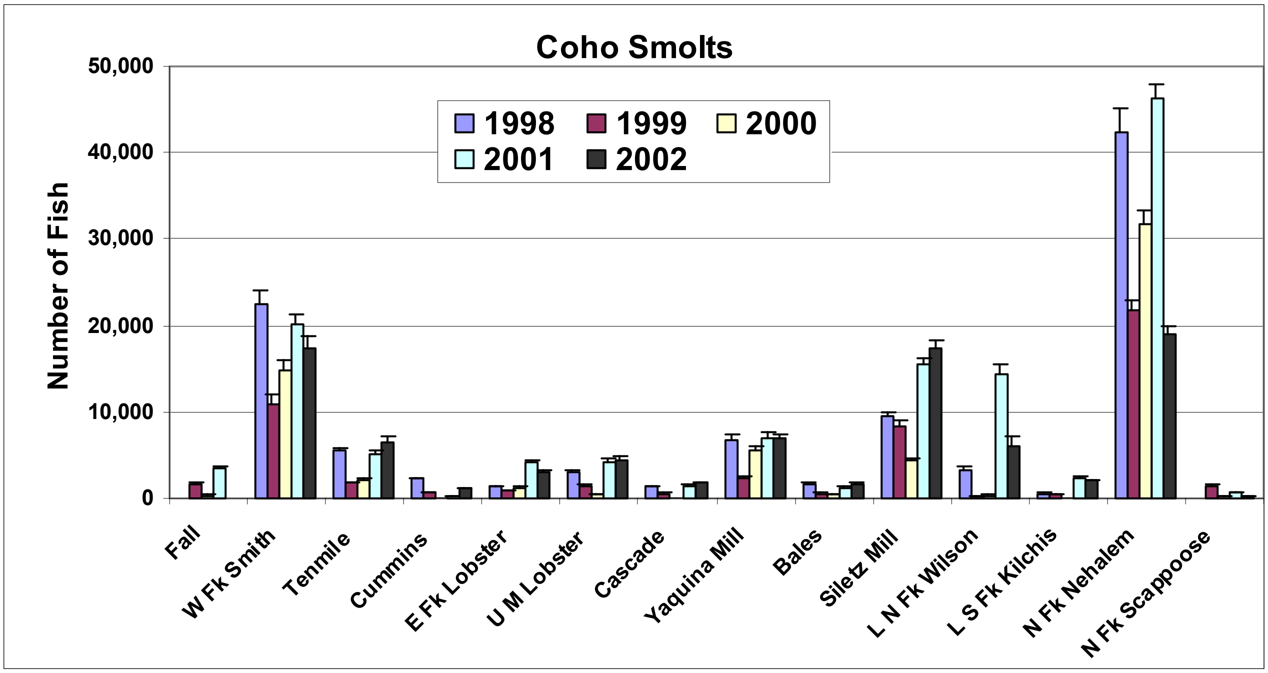

Figure 1. Population estimates and 95% confidence intervals for coho salmon smolts at 14 life cycle monitoring sites, 1998–2002.

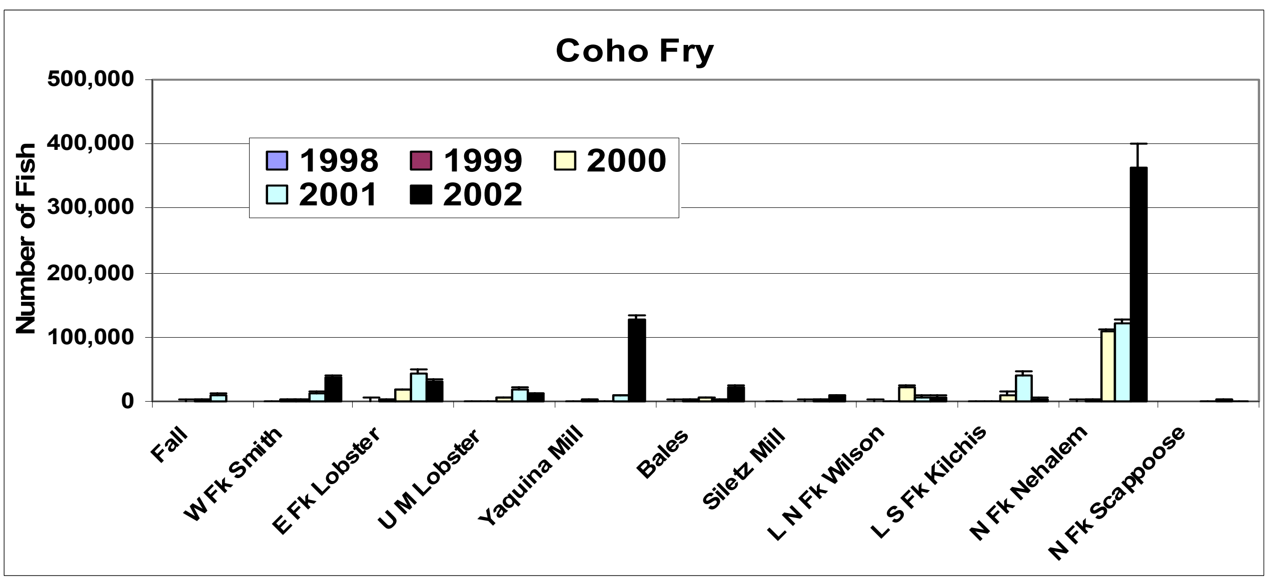

Figure 2. Population estimates and 95% confidence intervals for coho salmon fry at 11 life cycle monitoring sites, 1998-2002.

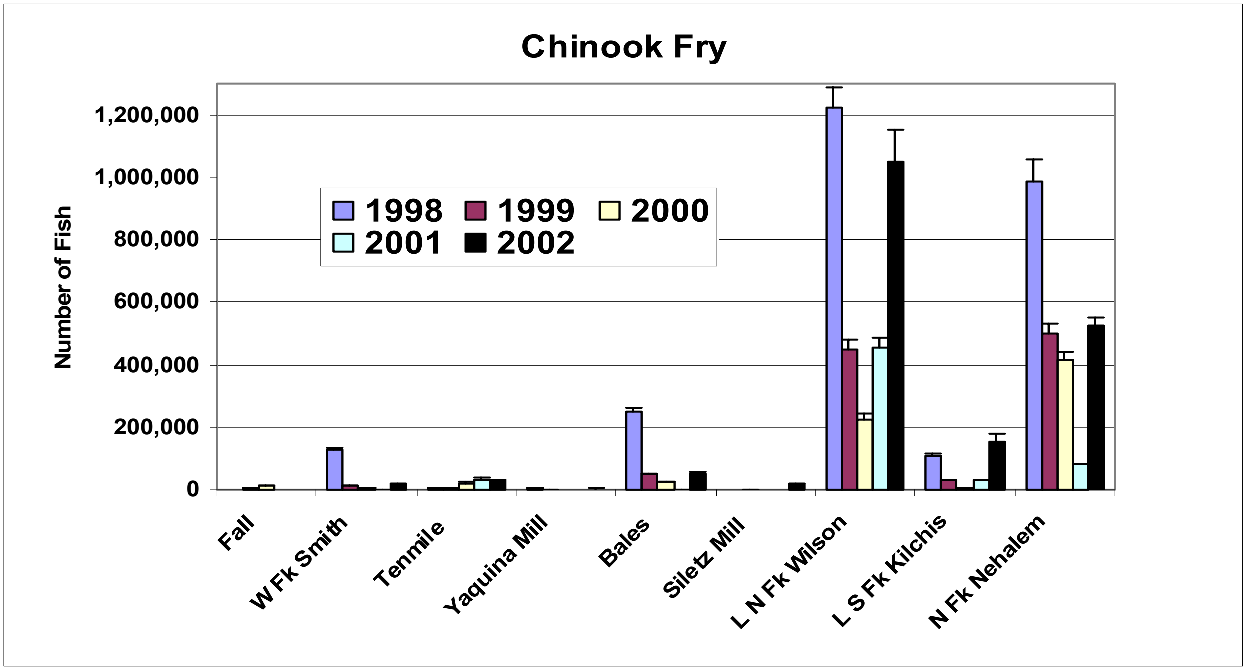

Figure 3. Population estimates and 95% confidence intervals for chinook salmon fry at 9 life cycle monitoring sites, 1998-2002.

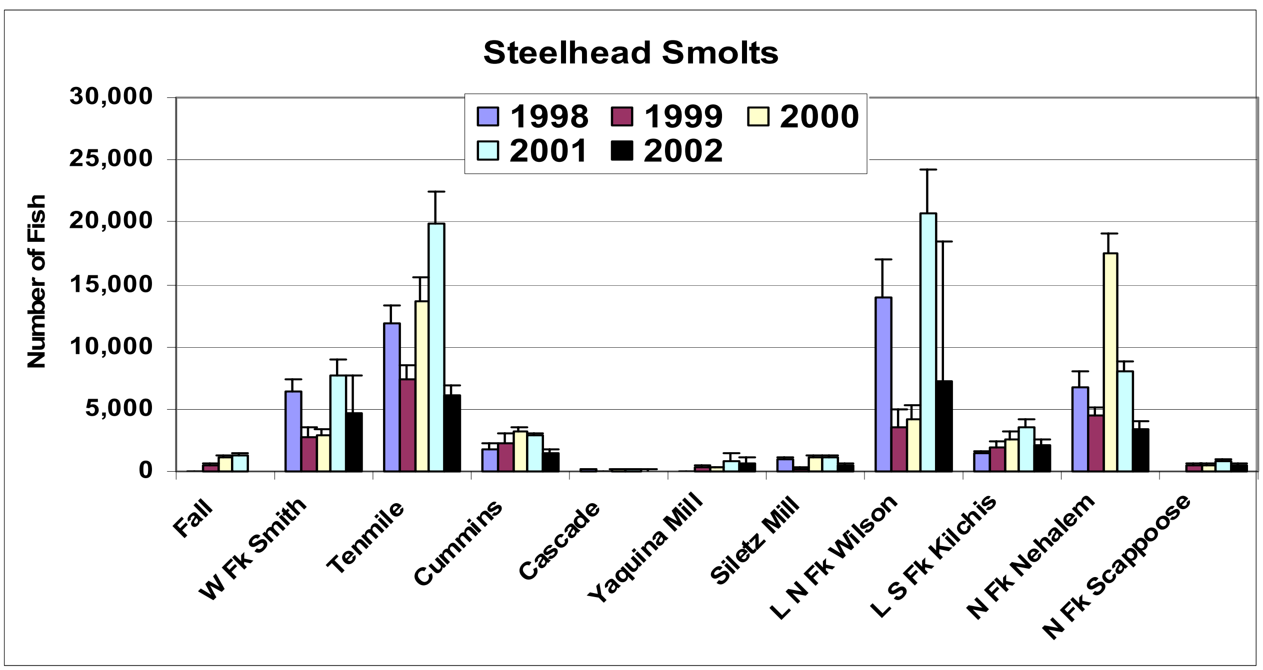

Figure 4. Population estimates and 95% confidence intervals for steelhead smolts at 11 life-cycle monitoring sites, 1998-2002.

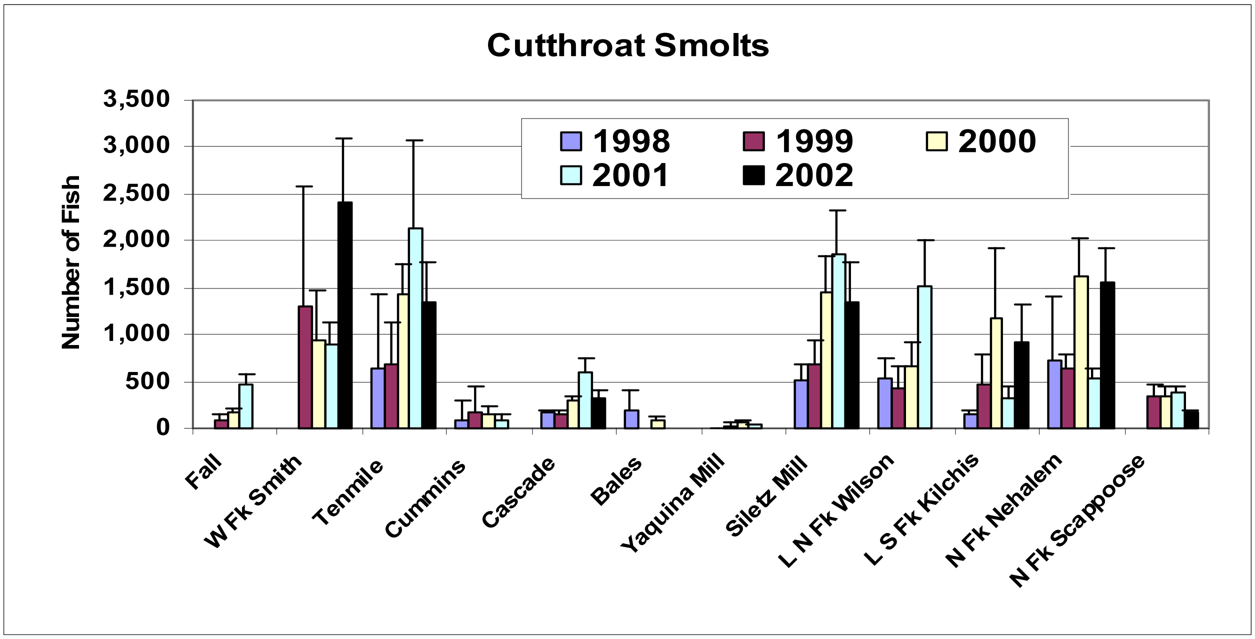

Figure 5. Population estimates and 95% confidence intervals for cutthroat trout smolts at 12 life-cycle monitoring sites, 1998-2002.

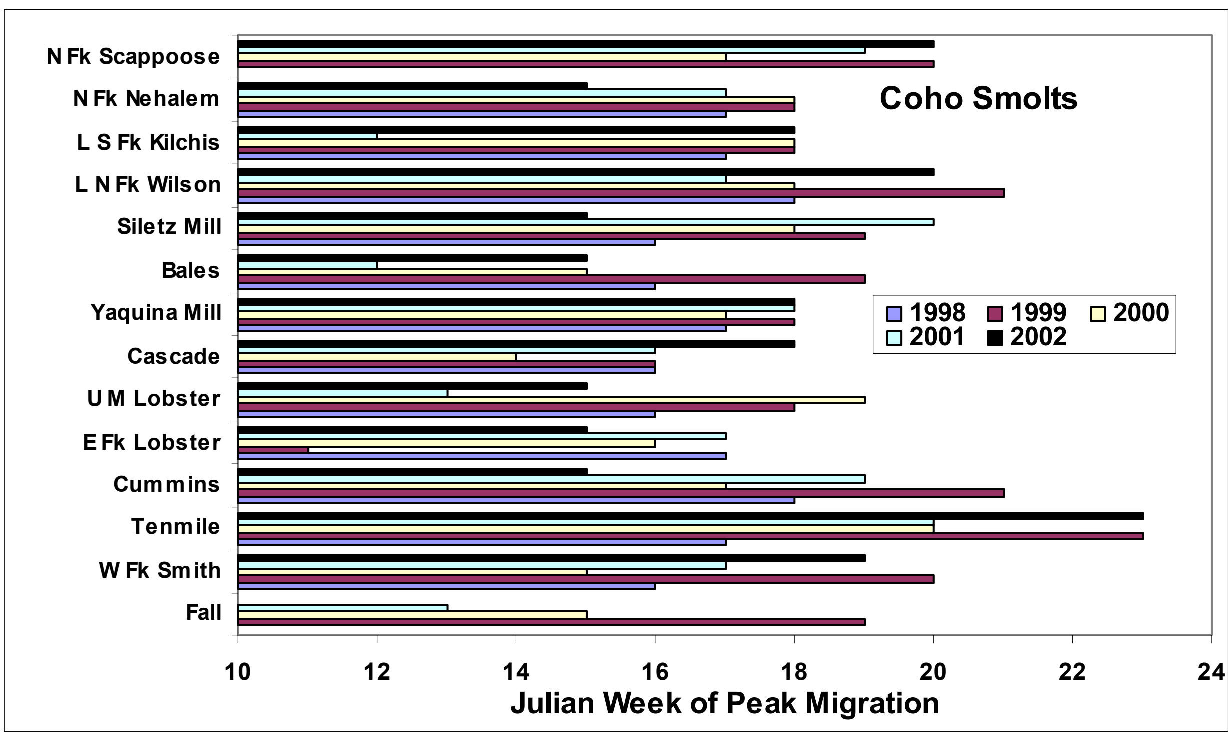

Figure 6. Julian week of peak migration of coho salmon smolts at 14 life-cycle monitoring sites, 1998-2002.

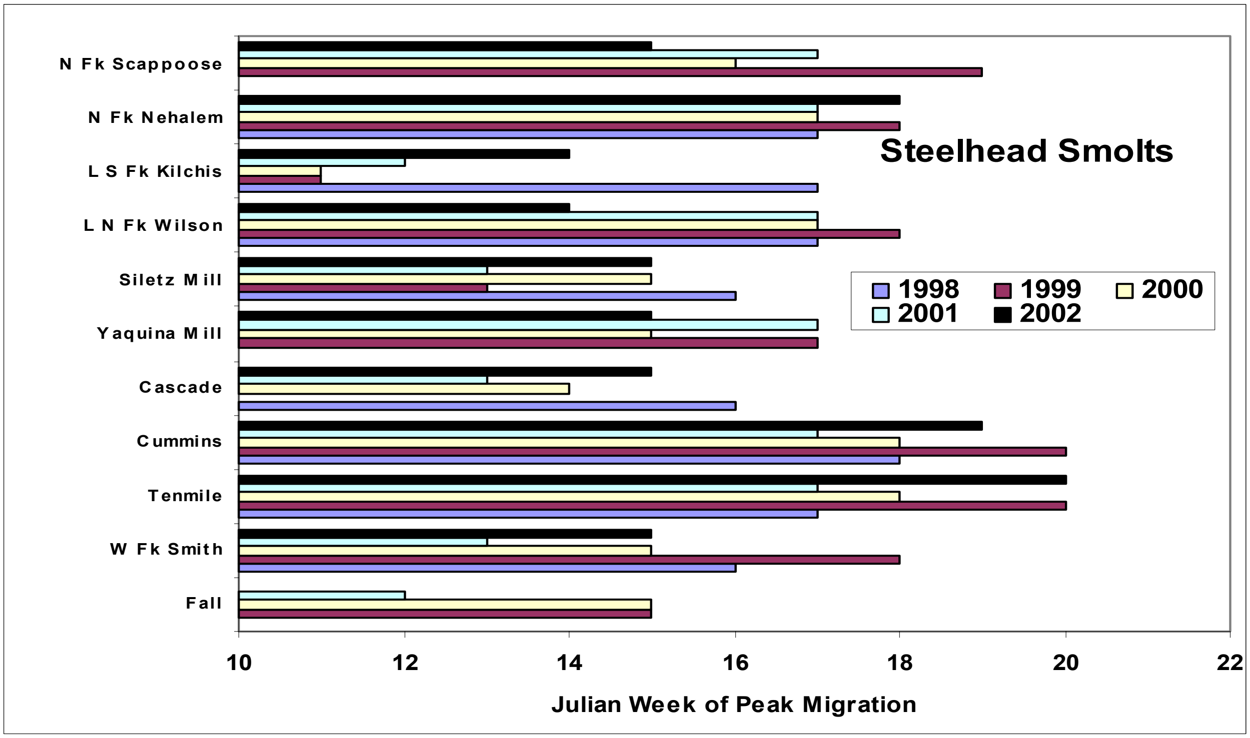

Figure 7. Julian week of peak migration of steelhead smolts at 11 life-cycle monitoring sites, 1998-2002.

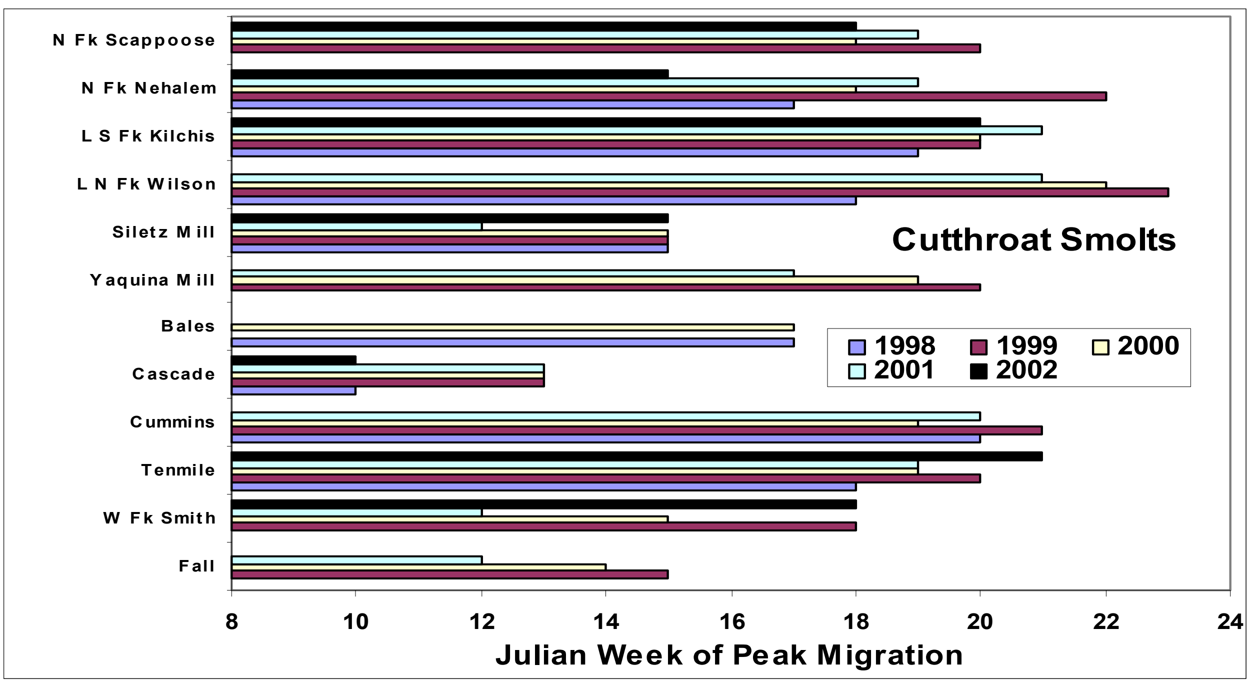

Figure 8. Julian week of peak migration of cutthroat trout smolts at 12 life-cycle monitoring sites, 1998-2002.

Timing of Downstream Migration

Peak migration timing for juvenile coho salmon, steelhead, and cutthroat trout smolts (1998-2002) is summarized in Figures 6-8. The migration peak of coho salmon smolts in 2002 was the earliest on record at three locations (Nehalem, Siletz and Cummins) and the latest on record at Cascade Creek. No significant trends were observed for either steelhead or cutthroat trout smolts (Figures 7 and 8).

Average Size of Downstream Migrants

Coho salmon smolts from Yaquina Mill Creek continued to be larger at the time of peak migration than smolts from the other sites monitored except N. Fk. Scappoose Creek (Figure 9). During 2002 the average size of coho salmon smolts at most locations was smaller than previously observed and may be a consequence of increased juvenile abundance. Coho salmon smolts in North Fork Scappoose Creek continued to be larger than those found in coastal basins, as reported in previous years (Solazzi et al 2001 and Solazzi et al 2002). The low abundance and rearing density of this population could be a significant factor contributing to their larger size at peak migration. The coho salmon smolts in Lobster Creek, from both the East Fork and Upper Mainstem, continued to migrate at a smaller average size than was observed in other coastal streams. This may be related to the location of the traps, which are higher in the watershed than in other systems that are monitored.

The steelhead smolts from Yaquina Mill Creek continued to be slightly larger than those observed at the other monitoring locations (Figure 10). However, the difference was not as pronounced as in previous years. This was probably related to the fish's use of the reservoir for rearing before migrating downstream. The average lengths of steelhead smolts at the time of peak migration continue to be similar between years within locations. Most of the steelhead populations that we monitor average about 150mm at the time of peak migration.

Cutthroat trout continued to be larger at peak migration in Tenmile Creek than in the other locations (Figure 11). The difference in average length during 2002 was not as large as observed in previous years. The large average length of cutthroat trout smolts from Tenmile Creek may be due to differences in life history and migration behavior from that observed in the other populations that we monitor. We did not capture enough cutthroat trout in Yaquina Mill Creek to compare average lengths to previous years.

Density of Downstream Migrants

The numbers of smolts produced per meter of stream length are summarized in Figures 12-14. The average density of coho salmon smolts ranged from a high of 0.44 smolts/meter in 2001 to a low of 0.13 smolts/meter in 2000,with an average of 0.39 smolts/meter in 2002. Density of steelhead smolts ranged from 0.11 smolts/meter in 1999 to 0.29 smolts/meter in 2001, with an average of 0.19 smolts/meter in 2002. Density of cutthroat trout smolts averaged 0.02 smolts/meter during 1998 and 1999 and increased to 0.04 smolts/meter during 2001 and 2002.

Abundance of Returning Adult Salmonids

North Fork Scappoose Creek

Adult salmonids were trapped in a fish ladder located at Bonnie Falls. The fish ladder provides passage around a waterfall that is considered a complete barrier to upstream migration of adult salmon and steelhead. The trap began operation in mid September 2001 and was fished continuously through June 2002. All fish that entered the trap were examined for marks, identified as male or female, measured for fork length, given a lower caudal mark, then released upstream from the trap. The caudal mark was used to determine if any fish had fallen back over the falls and re-entered the trap. The numbers of each species captured at this facility are summarized in Tables 1-3.

Table 1. Number of coho salmon captured at eight life-cycle monitoring sites for the 2001-2002 run year.

	At Trap					
	Wild			Hatchery		
Location	Males	Females	Jacks	Males	Females	Jacks
Scappoose	8	4	3	3	0	0
N. Nehalem	202	181	7	284	311	49
Siletz Mill	89	113	21	16	12	7
Yaquina Mill	247	377	204	2	3	0
Cascade	17	5	21	4	1	1
W. F. Smith	57	48	6	11	8	--
Fall	55	27	16	6	5	--
Winchester	100	140	21	57	46	1

Table 2. Population estimates for coho salmon at eight life-cycle monitoring sites for the 2001-2002 run year.

	Estimated coho salmon spawners above trap site					
	Wild			Hatchery		
Location	Males	Females	Jacks	Males	Females	Jacks
N. Scappoose	8	4	3	3	0	0
N. Nehalem	1,140	984	--	855	969	--
Siletz Mill	122	155	121	--	--	--
Yaquina Mill	245	375	197	0	0	0
Cascade	17	5	19	0	0	0
W. Fk. Smith	714	673	--	52	70	--
Fall	--	--	--	--	--	--
Winchester	114	176	--	9	3	0

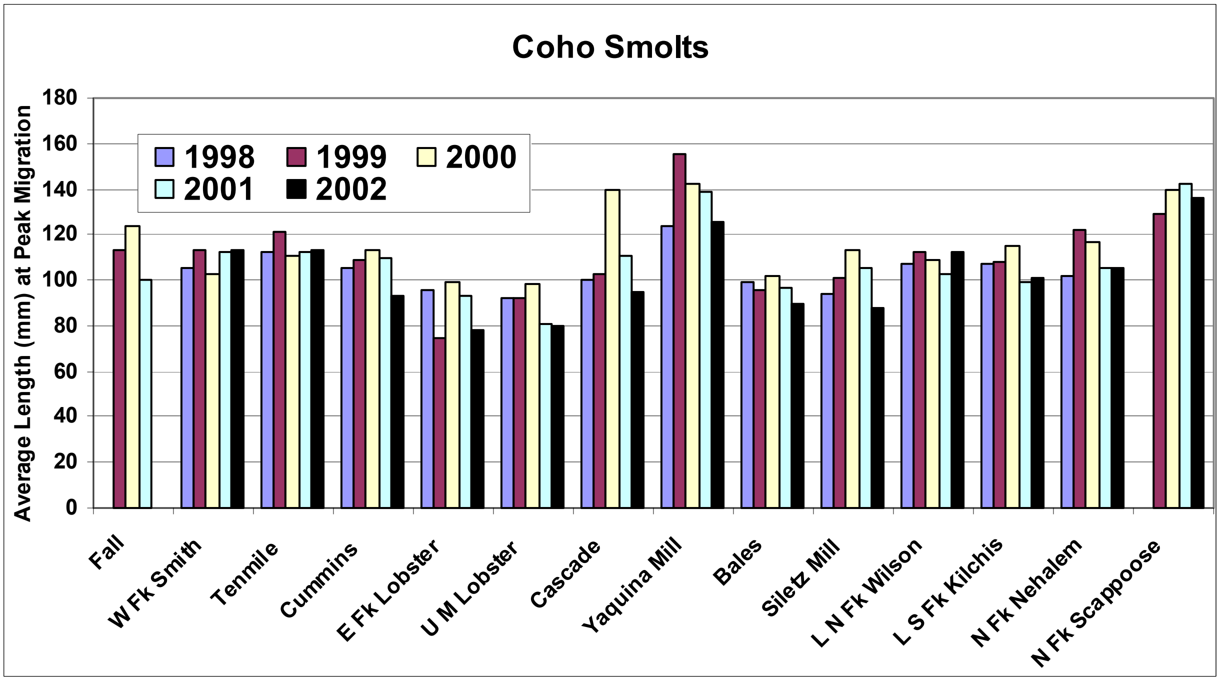

Figure 9. Average length at peak migration of coho salmon smolts at 14 life-cycle monitoring sites, 1998-2002.

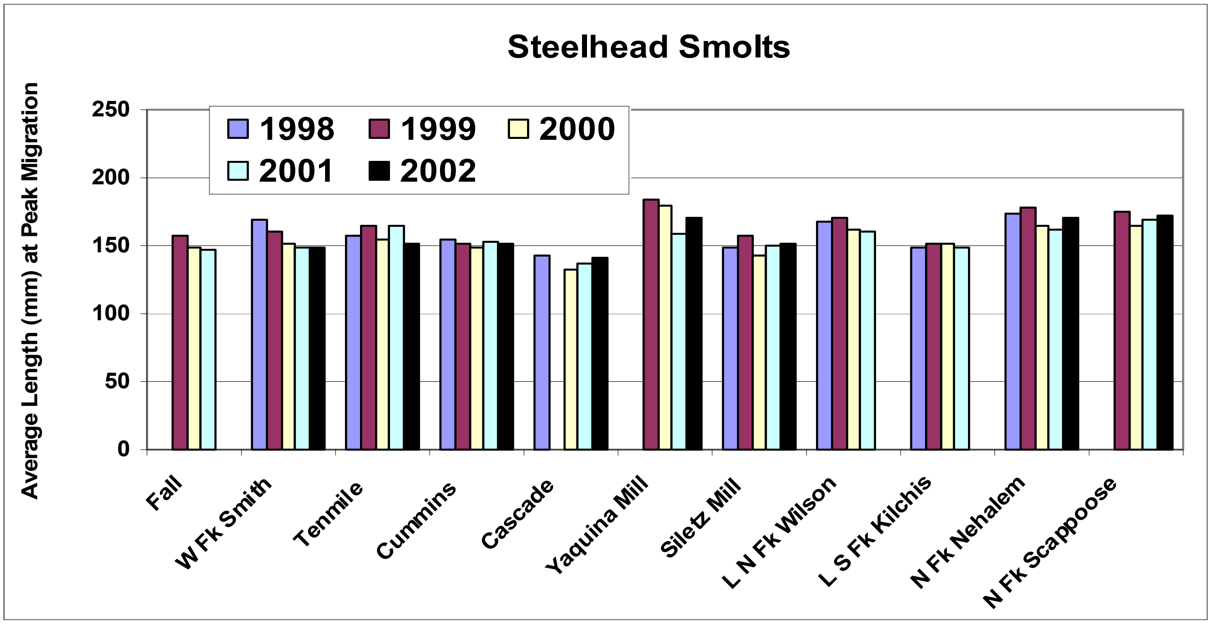

Figure 10. Average length at peak migration of steelhead smolts at 11 life-cycle monitoring sites, 1998-2002.

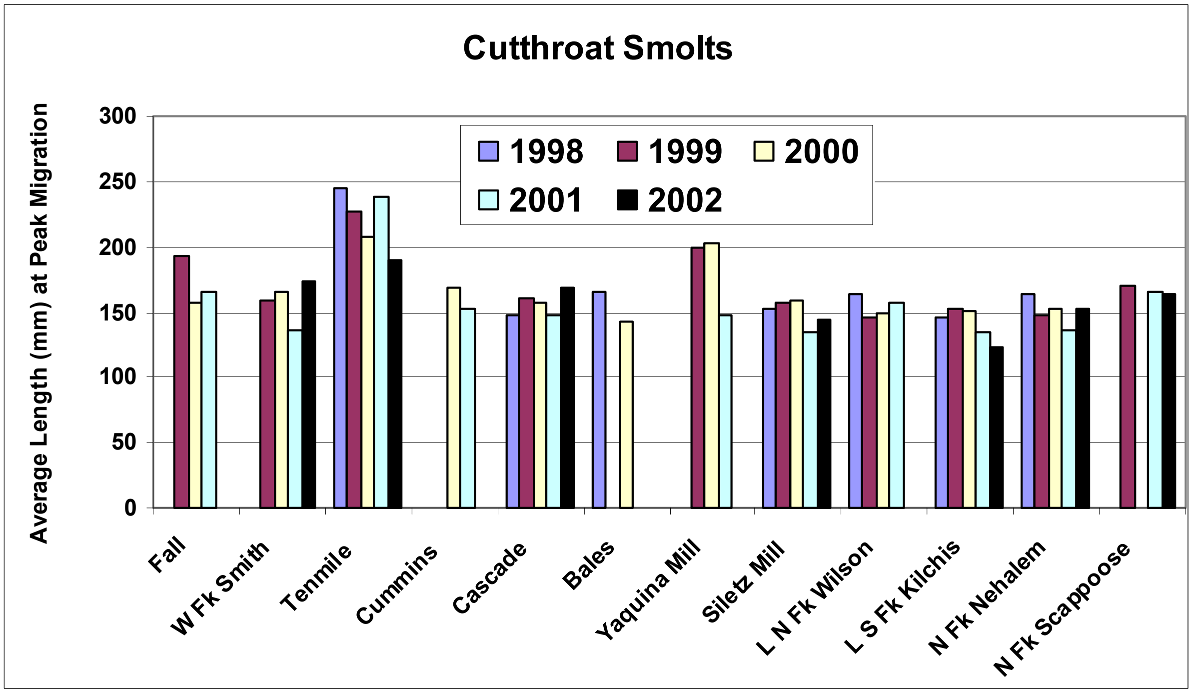

Figure 11. Average length at peak migration of cutthroat trout smolts at 12 life-cycle monitoring sites, 1998-2002.

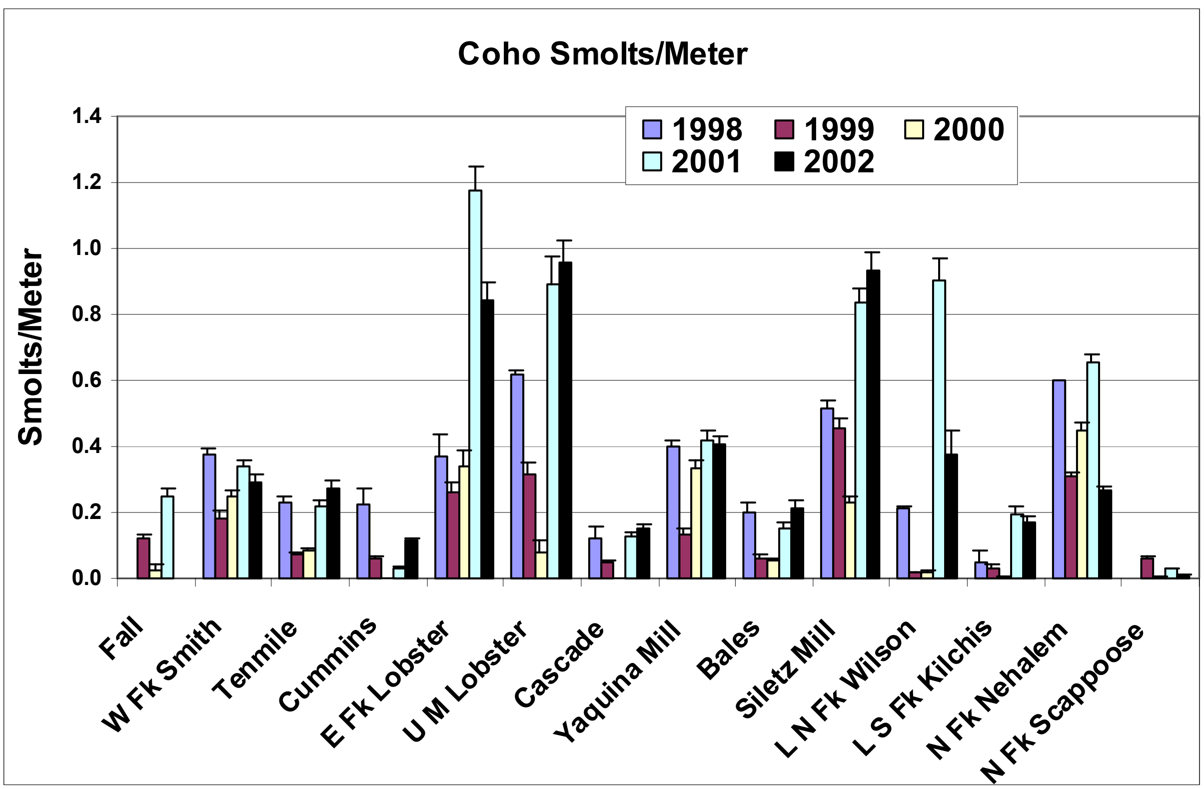

Figure 12. Coho salmon smolts produced per meter of stream length at 14 life-cycle monitoring sites, 1998-2002.

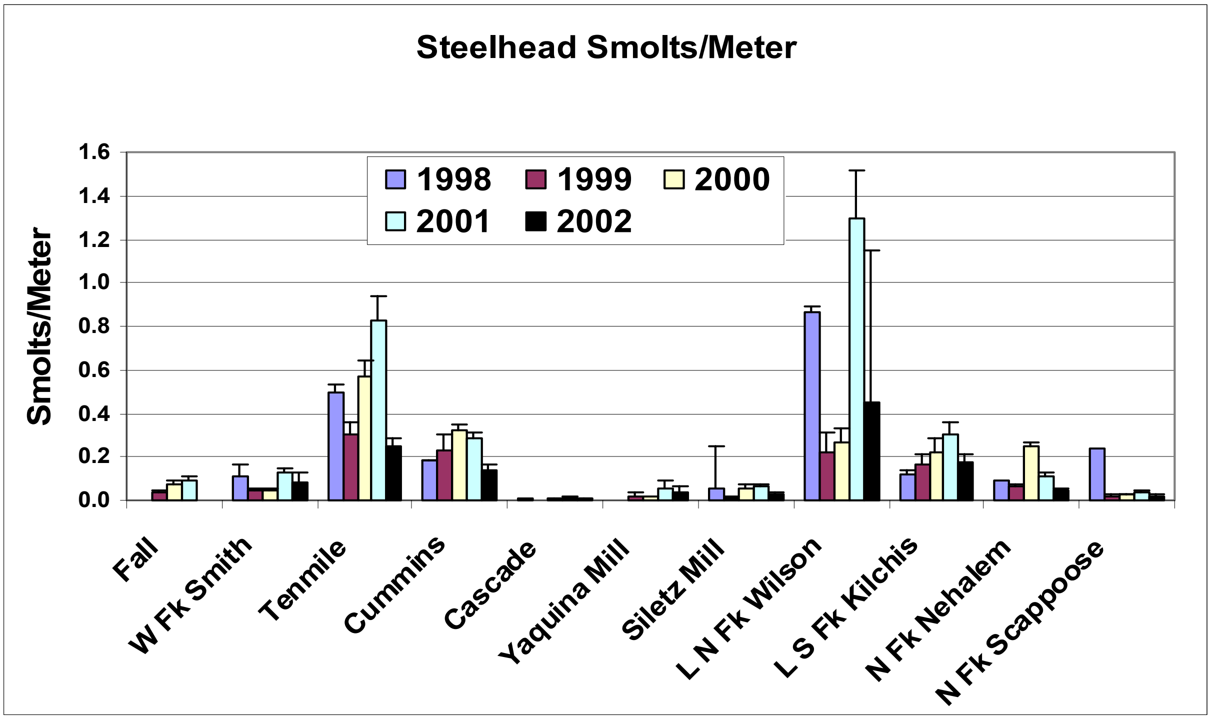

Figure 13. Steelhead smolts produced per meter of stream length at 11 life-cycle monitoring sites, 1998-2002.

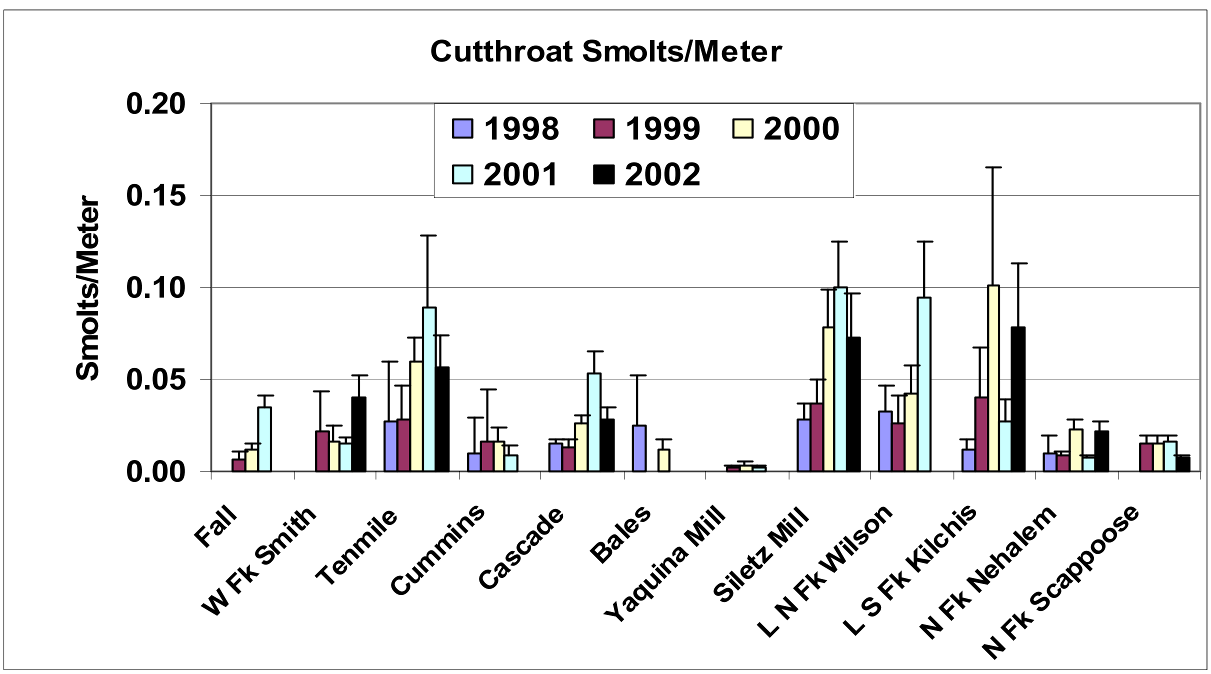

Figure 14. Cutthroat trout smolts produced per meter of stream length at 12 life-cycle monitoring sites, 1998-2002.

Table 3. Population estimates of chinook, steelhead and cutthroat at eight monitoring sites for the 2001-2002 run year. Estimates do not include jacks.

Location	Chinook	Steelhead	Cutthroat[a]
N. Scappoose	0	10	42
N. Nehalem	659	1,033	--
Siletz Mill	56	92[b,c]	2
Yaquina Mill	39	75[c]	8
Cascade	5	4[c]	78
W. Fk. Smith	38[b]	731	--
Fall	--	--	--
Winchester	0	--	--

[a]The cutthroat trout number represents the number of fish captured and is incomplete because the bar spacing in the traps allows cutthroat trout to pass.
[b]Number of fish captured at the trap.
[c] Includes both hatchery and wild fish

North Fork Nehalem River

Returning adult coho and chinook salmon and winter steelhead were trapped and tagged in fish ladders at Waterhouse Falls and at an unnamed falls above the confluence with Fall Creek. Both falls are partial barriers to upstream migration. The traps were operated from September 25 through June 19. Fish were inspected for marks, identified to species, sex and origin (hatchery or wild), and fork-length was measured. Coho salmon and steelhead <51 cm and chinook salmon <61 cm were designated jacks. Coho salmon of hatchery origin were killed and returned to the hatchery. Hatchery steelhead caught at Waterhouse Falls were either floy tagged and transported downstream to provide additional fishery opportunities or taken to the hatchery to spawn. Hatchery steelhead caught at the upstream ladder were passed upstream untagged. At both ladders, wild fish were implanted with two floy tags, given a hole punch in the operculum, and passed upstream.

Trapping efficiency at Waterhouse Falls was measured by determining the proportion of tagged fish above the falls, either at the upstream trap or on spawning surveys, from carcasses or live-fish observations. Recoveries of post-spawn adult steelhead were also made during spring at the juvenile out-migrant traps. The number of wild spawners was estimated using an adjusted Petersen Mark-Recapture methodology:

$$N = ((M + 1) (C + 1)) / (R + 1)$$

where:

M = the number of wild adults marked with floy tags.

C = the number of wild adult adults sampled upstream of Waterhouse Falls for which floy tag presence or absence could be determined.

R = the number of wild adults sampled upstream of Waterhouse Falls that were marked with floy tags.

Wild and hatchery coho salmon, were first caught in the Waterhouse Falls trap near the end of September. Wild adults were trapped as late as December 11, and hatchery adults as late as November 21. Highest catches at the traps occurred during the second week of October. The numbers of wild adult spawners upstream of Waterhouse Falls were estimated using the above methodology, where:

M = 372, the number of wild adult coho salmon marked with floy tags.

C = 838, the number of wild adult coho salmon sampled upstream of Waterhouse Falls for which floy tag presence or absence could be determined.
R = 146, the number of wild adult coho salmon sampled upstream of Waterhouse Falls that were marked with floy tags.

Using this methodology, the spawning escapement of wild adult coho salmon upstream of Waterhouse Falls was estimated to be 2124 adults (95% CI = 1865-2383). This estimate includes 984 females, based on the sex ratio of wild fish in the adult traps and found as carcasses on surveys. The wild/hatchery ratio determined from carcasses or observations of live fish on surveys was used to estimate that 1823 hatchery coho bypassed the trap at Waterhouse Falls and spawned upstream. This number includes 968 females based on the sex ratio of hatchery fish in the traps and carcasses found on spawning surveys.

Chinook salmon (all wild) were trapped at Waterhouse Falls from October 8 until November 21. An estimate of adult chinook salmon spawners was made using the same methodology, where:

M = 180, the number of adult chinook salmon marked with floy tag(s).
C = 203, the number of adult chinook salmon sampled upstream of Waterhouse Falls for which floy tag presence or absence could be determined.
R = 55, the number of adult chinook salmon sampled upstream of Waterhouse Falls that were marked with floy tags.

The estimate for the spawning escapement of adult chinook salmon above Waterhouse Falls was 659 fish (95% CI = 569-749). This number includes 207 females based on the sex ratio of fish in the traps.

Hatchery and wild steelhead were first caught at Waterhouse Falls on November 19 and December 11 and last caught on February 19 and May 8, respectively. Hatchery fish were caught from early December through late January, and wild fish from early January through late March. An estimate of adult steelhead spawners was made using the same methodology, where:

M = 106, the number of adult steelhead marked with floy tag(s).
C = 74, the number of adult steelhead sampled upstream of Waterhouse Falls or in juvenile traps for which floy tag presence or absence could be determined.
R = 7, the number of adult steelhead sampled upstream of Waterhouse Falls or in juvenile traps that were marked with floy tags.

Using this methodology, the estimated spawning escapement of wild adult steelhead upstream of Waterhouse Falls was 1,003 adults (95% CI=621-1385). This number includes 565 females based on the sex ratio of fish trapped at Waterhouse Falls. Based on the assumption that there was no bias in the wild/hatchery or sex ratio in fish that bypassed the ladder at Waterhouse Falls, an estimated 625 male and 1226 female hatchery steelhead spawned above the falls.

Siletz Mill Creek

Adult salmonids were trapped in a fish ladder near the mouth of Siletz Mill Creek (River Kilometer 0.4). The fish ladder provides passage around a small waterfall that is a partial barrier to adult salmon and steelhead upstream migration. The trap was fished continuously from mid-September 2001 through June 2002. All adult salmon, steelhead and cutthroat trout entering the trap were examined for marks, identified as male or female, and measured for fork length. All wild salmon and wild steelhead were given a Floy-tag on each side of the dorsal fin and released upstream. All hatchery coho were killed. If killed fish were bright and in good condition, they were taken to local food share organizations, and if dark, they were deposited below the trap in the stream. All hatchery steelhead captured in the trap were given a hole punch in the operculum and released below the falls.

The waterfall at Siletz Mill Creek is not a complete barrier to upstream migration at all river levels. Therefore, some fish may jump the falls rather than move through the fish ladder and into the trap where they can be counted. In order to estimate the total number of spawners, we conducted spawning fish surveys above the trap site to determine the proportion of tagged and untagged fish.

Ten adult coho salmon spawning surveys in the Siletz Mill Creek watershed were completed weekly from November 1, 2001 through January 31, 2002. The total length for all surveys combined was 14.3 km, and encompassed the best spawning areas within the watershed. Surveyors counted live and dead adult salmonids in each survey area to determine the tagged to untagged ratio of adult salmonids above the trap site.

Four steelhead spawning surveys in the Siletz Mill Creek watershed were completed biweekly from February 1, 2001 through April 15, 2002. The total length of these surveys combined was 7.5 km. Surveyors kept similar information on all dead and live steelhead as described above for coho salmon spawning surveys.

Table 1 summarizes the trap catch and Table 2 summarizes the population estimates at Siletz Mill Creek between October 2001 and June 2002. A total of 202 wild adult coho and 21 wild jack coho entered the trap during the winter of 2001-2002 (Table 1). Twenty-eight hatchery adult coho and 7 hatchery jack coho were collected in the trap during the winter. A total of 89 male and 113 female adult coho, and 21 wild coho jacks were released above the trap. All of these fish were double Floy-tagged.

Twenty-four wild steelhead adults (11 males and 13 females) were double-Floy-tagged and released above the trap. Sixty-eight hatchery adult steelhead also entered the trap. Hatchery fish accounted for 74% of steelhead spawners. Hatchery fish entered the trap in November and December and again in March. Steelhead that entered the trap in November and December were adipose-clipped fish and were generally dark, indicating they had been in the river for some time. Presumably, these fish were mostly Siletz summer steelhead. Most of the hatchery fish that entered the trap in late winter and spring were adipose fin and-left maxillary clipped. These fish were Siletz winter steelhead originally released from the Palmer Creek acclimation ponds near Moonshine Park.

A total of 199 live coho salmon were observed on spawning surveys. Twenty-two coho salmon carcasses were found. Seventy-two percent of the adult coho salmon observed were Floy-tagged, indicating they had been counted at the trap. Fifty live steelhead and three steelhead carcass were observed on the spawning surveys

An estimate of the adult coho spawners was made using the adjusted Petersen Mark-Recapture methodology where:

M = 202, the number of adult coho marked with Floy-tags

C = 163, the number of adult coho observed for presence of Floy-tags on spawning surveys. This includes live and dead fish. Live fish that could not be observed well enough to determine if a Floy-tag was attached were excluded from this analysis.

R = 119, the number of marked live or dead fish observed during the spawning surveys.

The spawning escapement of adult coho in Siletz Mill Creek was estimated to be 277 fish (95% CI=$\pm$13 which included 122 males and 155 females (Table 2). Because only four tagged steelhead were observed on steelhead spawning surveys, no population estimate for steelhead spawners could be made for the winter of 2001-2002.

Yaquina Mill Creek

The adult trap was installed in the fish ladder **in** late September 2001 and fished through May 2002. All adult salmonids that entered the trap were examined for marks, identified as male or female, and measured for fork length. All fish were given a hole punch in the left operculum to determine if fish were falling back down through the reservoir spillway and re-entering the ladder and trap. After processing, wild coho were placed in the reservoir and allowed to proceed upstream (Table 3). Hatchery coho were killed. Bright fish in good condition were taken to a local food-share organization. Dark fish were placed in the stream below the fish ladder. Wild and hatchery steelhead were given a hole punch in the left operculum and allowed to proceed upstream (Table 3).

A total of 624 wild coho adults, 204 wild coho jacks, and 5 hatchery coho adults were captured in the trap (Table 1). A total of 620 wild coho adults (375 females and 245 males) and 197 coho jacks were passed. Because fish cannot bypass the ladder, these numbers represent total spawners.

Cascade Creek

Adult salmonids were trapped as they moved through a fish ladder near the mouth of Cascade Creek. The fish ladder provides passage for adult salmon and steelhead around a waterfall at river kilometer 0.15. The falls are believed to be a complete barrier to upstream migration, so the trap catch represents total spawners in the basin. The adult trap was installed in the fish ladder in late September 2001, and fished through May 2002. All adult salmonids that entered the trap were examined for marks, identified as male or female, and measured for fork length. All fish were given a hole punch in the left operculum to identify them as a previously counted fish in case they returned downstream and subsequently re-entered the trap. All wild fish were placed above the falls and all hatchery fish were released below the falls.

A total of 22 wild coho adults and 21 coho jacks were captured in the trap (Table 1). Twenty-two wild adult coho (5 females and 17 males) and 19 wild jack coho were placed above the trap. Four wild adult chinook (1 female and 4 males) and three adult steelhead (2 females and 1 male) were also placed above the trap.

West Fork Smith River

The adult fish trap was operated continuously from September 17, 2001 to May 14, 2002. Precipitation and sufficient stream flow for fish to ascend the fish ladder and falls on the main stem of Smith River occurred in mid October. Fish first entered the trap in the West Fork Smith River on October 25. The floating weir was frequently submerged during high stream flows, including 4 days in November, 11 days in December, 7 days in January, and 3 days in February. Most adult fish by-passed the trap during periods of high flow.

Total numbers of adult salmonids trapped in the West Fork Smith River are shown in Table 1. All wild fish were tagged with two yellow Floy-tags and passed above the trap. In addition, eight coho of hatchery origin (including four females) were tagged and passed. Additional hatchery coho caught in the trap were hauled to the main stem of Smith River and released upstream from the West Fork.

A total of 26 live fall chinook and one carcass were observed on spawning ground surveys, but none were yellow-tagged. Moore Creek was the only tributary where live chinook were found (n = 7); most spawning activity occurred in the main stem of the West Fork, primarily between the trap and Crane Creek, and the reach downstream from Beaver Creek. A high incidence of stranded chinook on the floating weir at the adult trap suggested that many fish (either those tagged and passed or those that bypassed the trap) tended to move back downstream below the trap. As a consequence, the number of tagged chinook that remained above the trap was uncertain. No estimate of chinook spawners was made.

Coho spawned throughout the basin. Among the major tributaries, Moore and Beaver creeks received the most spawning activity, while in the main stem, most spawning was observed above Beaver Creek. Presence of tags was recorded on live fish and carcasses. An estimate of adult coho spawners was made using the adjusted Peterson Mark-Recapture methodology where:

M = 113, the number of adult coho marked with Floy tags
C = 1,181, the number of adult coho observed for presence of Floy-tags on spawning surveys (live fish plus carcass recoveries), excluding fish for which presence of tag could not be determined
R = 88, the number of tagged fish observed (live fish plus carcass recoveries)

Using this methodology and adjusting for tag loss, the total spawning escapement of adult coho in the West Fork Smith River was 1509 fish (95% CI = ±1490) during the 2001-2002 run year (Table 2). This estimate includes 743 females, based on the sex ratio of fish in the adult trap. The estimate of total spawners includes both wild and hatchery-origin spawners. An estimated 122 spawners were of hatchery origin, based on recoveries of tagged and untagged hatchery fish.

Winter steelhead also spawned throughout the basin. Moore and Gold creeks received most spawning activity among the tributaries, but steelhead spawners were widely distributed throughout the main stem.

An estimate of steelhead spawners was made using the adjusted Peterson Mark-Recapture methodology, where:

M = 205, the number of steelhead marked with Floy tags
C = 303, the number of steelhead observed for presence of Floy-tags on spawning surveys (live fish plus carcass recoveries), excluding fish for which presence of tag could not be determined
R = 85, the number of tagged fish observed (live fish plus carcass recoveries)

Using this methodology and adjusting for tag loss, the total spawning escapement of steelhead in the West Fork Smith River was 731 fish (95% CI = ±165) during the 2000-2001 run year (Table 3). This estimate includes 405 females, based on the sex ratio of fish in the adult trap.

Fall Creek

The adult trap installed in the Fall Creek fish ladder functioned without problems during fall 2001. However, as in previous years, the lower falls immediately downstream from the ladder was an apparent barrier to upstream migration at some stream flows. The channel above the lower falls was altered during the summer of 2001 to divert more water to the bypass channel at the lower falls, and several wooden steps were built into the bypass channel. Despite these modifications, fish had difficulty passing the lower falls at both low and very high stream flows. As a consequence, whereas some fish were trapped and passed above the ladder, it is uncertain what percentage of fish that returned to Fall Creek made it into the fish ladder and trap. A high stream flow event in late December raised the level of Fall Creek over the top of the trash rack above the ladder and filled the upper end of the trap and ladder with wood debris and sediment. Enough debris was removed to reestablish flow to the ladder and complete sampling of coho spawners, but on January 8, 2002, the trap was dismantled and flow through the ladder was left unregulated. Monitoring at this site has been discontinued.

Winchester Creek

The Winchester Creek adult trap was operated continuously from September 15, 2001 to January 6, 2002. The trap weir was likely inundated on one or two nights in mid-December when combined spring-series high tides and high stream flows allowed some fish to bypass the trap, located below head of tide. On January 6, high stream flows destroyed the trap weir and allowed late-run fish to bypass the trap. Independent estimates of the two portions of the run (pre- and post-January 6) were made to account for total escapement. An estimate of adult coho spawners that entered Winchester Creek prior to January 6 was made using the adjusted Peterson Mark-Recapture methodology, where:

M = 245, the number of adult coho marked with Floy tags
C = 118, the number of adult coho observed for presence of Floy-tags on spawning surveys (live fish plus carcass recoveries), excluding fish for which presence of tag could not be determined
R = 111, the number of tagged fish observed (live fish plus carcass recoveries).

Using this methodology and adjusting for tag loss, a total of 261 adult coho (95% CI= ± 12) entered Winchester Creek prior to January 6, 2002. Following failure of the weir at the adult trap, surveys conducted on January 9 and 11 provided a peak count of 41 untagged adults that bypassed the trap. This number was added to the estimate of fish that spawned prior to trap failure, for a total spawning escapement of 302 adults.

The estimate of spawning escapement in Winchester Creek includes both wild and hatchery fish. Seven hatchery fish were passed during the first day of trap operation, but subsequent hatchery fish were given a mark on the operculum and released below the trap. Prior to trap failure, hatchery adults comprised 30.0% of total adults trapped. By applying this percentage to the estimated 14 fish that bypassed the weir prior to January 6, four fish from the early run of spawners were of hatchery origin. Close observation of untagged fish on the spawning reach after January 6 indicated that the late run included one hatchery fish. Table **(2)** shows estimated total escapement of wild and hatchery spawners in Winchester Creek. This estimate includes 176 females, based on the sex ratio of wild fish in the adult trap.

PART II. DETERMINE FRESHWATER AND MARINE SURVIVAL RATES FOR COHO SALMON

Introduction

The purpose of estimating the freshwater and marine survival rates for coho salmon in Oregon coastal streams is to develop a database that can be used to monitor the status and trends in population abundance. In addition, this type of information will be useful to determine if any future changes in the status of coho salmon populations are being affected by freshwater or marine environmental conditions. Calculations of freshwater survival rate are only based on that part of the life history between egg deposition and arrival at the trap site and do not include subsequent mortality that may occur during out-migration. Marine survival rates include mortalities that occur below the traps in riverine or estuarine habitats before ocean entry.

Methods

The freshwater survival rate of five populations of coho salmon was calculated using the estimated number of eggs placed in redds by females that spawned in 1999-00. Fecundity of each female that spawned above the North Fork Nehalem, Siletz Mill Creek, Yaquina Mill Creek, Cascade Creek, and West Fork Smith traps was calculated using the following equation where:

Number of eggs = 7.9556 (fork length in mm) -2854.07.

This relationship between length of female coho salmon and fecundity was developed from hatchery fish returning to Fall Creek Hatchery in the Alsea basin (Johnson 1983). Freshwater survival rate for each brood was calculated by dividing the estimated number of smolts produced by the number of eggs that were deposited by their parents.
To calculate the marine survival rate for coho salmon, the estimated number of adults that returned in year t is divided by the estimated smolt abundance in year t-2.

Results and Discussion

Summary statistics used to calculate marine and freshwater survival for coho salmon are shown in Table 4. Freshwater survival rate has ranged from a high of 12.7% for the 1999 brood coho salmon in Winchester Creek to a low of 0.1% for the 1998 brood in Cascade Creek. The 2000 brood freshwater survival rate was within the ranges previously observed and no trends in survival have emerged. As the freshwater density of juvenile coho salmon increases we expect to see a concurrent decrease in freshwater survival rate.

Marine survival rate has ranged from a high of 11% for the 1998 brood in Yaquina Mill Creek and Scappoose Creek to a low of 0.2% for the 1997 brood in Winchester Creek. Marine survival rates for the 1998 brood were higher at each site than have been observed for previous broods.

Table 4. The freshwater and marine survival for coho salmon at seven life-cycle monitoring sites.

Stream	Brood Year	Female Spawners	Egg Deposition	Smolts Produced	Returning Adults Male	Returning Adults Female	FW Survival (%)	Marine Survival (%)
Scappoose	1997			1,453	24	17		2.8
	1998			134	11	4		11.2
	1999	6	15,892	659			4.1	
	2000	17	44,071	205			0.5	
	2001	4	9,905					
NF Nehalem	1996			42,427	374	363		1.7
	1997			21,702	284	328		2.8
	1998	447	1,179,267	31,776	1,140	984	2.7	6.7
	1999	568	1,623,341	46,375			2.9	
	2000	389	1,089,021	18,953			1.7	
	2001	1,953	5,818,408					
Siletz Mill	1995			8,110	30	25		0.7
	1996			9,547	64	83		1.5
	1997	48	95,945	8,409	127	130	8.8	3.1
	1998	25	52,716	4,311	122	155	8.2	6.4
	1999	83	204,416	15,475			7.6	
	2000	130	330,551	17,259			5.2	
	2001	155	438,065					
Yaquina Mill	1995			1,381	58	80		10.0
	1996			6,698	49	43		1.4
	1997	42	101,674	2,225	24	40	2.2	2.9
	1998	77	206,935	5,599	247	377	2.7	11.1
	1999	43	116,500	7,026			6.0	
	2000	40	105,800	6,833			6.5	
	2001	375	1,087,481					
Cascade	1996			1,404	4	5		0.6
	1997	17	37,321	557	34	11	1.5	8.1
	1998	5	10,104	13	17	5	0.1	169.2
	1999	5	14,927	1,485			10.0	
	2000	11	28,471	1,761			6.2	
	2001	5	15,245					
WF Smith	1996			22,412	160	104		1.2
	1997			10,866	295	243		5.0
	1998			14,663	799	715		10.3
	1999	104	291,955	20,091			6.9	
	2000	241	642,747	17,164			2.7	
	2001	743	2,099,982					
Winchester	1997			2,208	2	3		0.2
	1998			3,129	114	176		9.3
	1999	14	36,121	4,600			12.7	
	2000	3	8,344	998			12.0	
	2001	171	439,084					

ACKNOWLEDGEMENTS

We would like to thank the following organizations for providing information used in this report: ODFW Aquatic Inventory Project, CLAMS project (USFS), Salem and Coos districts of the BLM, and the Oregon Department of Forestry

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