

**Estuarine Wetland Fish Monitoring Project Report  
2001-2003**

Oregon Watershed Enhancement Board

Grant #200-032

Final Grant Report

Grant Administered by: Coos Watershed Association and  
Slough National Estuarine Research Reserve

**(1) A description of the project including background on the problem which generated the project.**

Coos Bay is the second largest estuary in Oregon. An estimated 86% of its salt marsh habitat has been lost due to dredging, diking and filling for commercial, recreational, residential, and agricultural purposes. These perturbations have altered estuarine food webs, tidal dynamics, and the feeding and migratory behavior of salmon smolts and returning adults. South Slough National Estuarine Research Reserve (SSNERR) is a 5,000 acre parcel of land managed to conserve unaltered wetlands and uplands and to restore altered habitats. With the recent decline of salmonid populations along the Oregon Coast, it is critical to understand how juvenile salmonids use natural and restored estuarine habitats, such as those found in the SSNERR.

Estuaries are hypothesized as critical to survival for salmonids. They provide foraging habitat, habitat for the physiological transition from fresh to salt water, and refugia from predators. These monitoring projects were designed to further understand salmonid use of restored estuarine wetlands in the SSNERR.

In collaboration with the Oregon Department of Fish and Wildlife (ODFW) and SSNERR, we sampled juvenile salmonids in the upper estuary, lower estuary, and recently restored estuarine habitats in South Slough. We used a variety of methods. Adult coho salmon were monitored with a weir trap operated on Winchester Creek, the primary water source for the Slough, from October through December. A rotary screw trap in Winchester Creek was monitored daily from December through May to investigate juvenile salmonid movement. Coho salmon and cutthroat trout smolts were also monitored using ultrasonic transmitters and a stationary receiver array. Salmonids rearing in diverse estuarine habitats were captured using a variety of techniques. All work supplemented previous work monitoring salmonids in South Slough sponsored by OWEB or GWEB grants (#99-372 and #97-080) and other agencies.

**(2) A list of the volunteers who participated in the project including the work accomplished and total hours worked.**

This project would not have been possible without the help of the following volunteers and participants:

<u>Project Component</u>	<u>Volunteer</u>	<u>Agency</u>	<u>Approximate Hours Worked</u>
<i>Planning</i>	Winchester Tidelands Advisory Group Members	<i>Various</i>	20 to 40
	Sean Clements	<i>Oregon State University</i>	8
	Si Simenstad	<i>University of Washington</i>	8
	Kurt Fresh	<i>NOAA Fisheries</i>	4
	Jeffery Cordell	<i>University of Washington</i>	6
<i>Execution</i>	Ty Herbertt	<i>University of Oregon</i>	8
	Andrea Crumpacker	<i>Alaskan Observers, Inc.</i>	20
	SSNERR Staff (at large)	<i>SSNERR</i>	80
<i>Analysis and Writing</i>	Jan Hodder	<i>OIMB</i>	4
	Jessica Miller	<i>OIMB</i>	4

**(3) A list of other participants who assisted with the project.**

Other Participants:

<u>Project Component</u>	<u>Participant</u>	<u>Contribution</u>
<i>Adult trapping</i>	<i>ODFW</i>	adult weir trap
<i>Juvenile trapping</i>	<i>ODFW</i>	smolt trap
<i>Other Monitoring</i>	<i>ODFW</i>	electrofishing equipment
<i>Other Monitoring</i>	<i>ODFW</i>	fish marking equipment
<i>Other Monitoring</i>	<i>SSNERR</i>	supplies

#### **(4) The materials and methods used in the project.**

##### *Adult trapping:*

Spawning escapement of coho salmon was monitored by trapping and surveys of spawning grounds in Winchester Creek. This sampling was part of a broader effort by ODFW to monitor status and trends of coastal populations of salmonids and is coordinated under the Oregon Plan for Salmon and Watersheds. Fork length and sex were recorded for all coho that entered the trap, and Floy tags were implanted in all wild coho. No coho of hatchery origin were passed above the trap. Observations of the percentage of tagged fish on spawning grounds were used to conduct a Peterson estimate of the spawning population.

##### *Juvenile trapping:*

Downstream movement of juvenile coho salmon in Winchester Creek was monitored with a 1.53 m-diameter rotary screw trap. This monitoring was also part of the Oregon Plan for Salmon and Watersheds and was conducted by the ODFW. We checked the trap daily from February through May in 2002 and December through May in the 2002-03 migrant season. The trap was placed near the head of tide (Figure 1). At the trap, all fish in the live box were measured and weighed when possible, then released downstream to continue their migration. We clipped the dorsal caudal fin of a subsample of fish and released them above the trap to measure trap efficiency. Trap efficiency is necessary to utilize the Peterson mark-recapture method, used to determine salmonid population size in Winchester Creek.

##### *Ultrasonic telemetry:*

Ultrasonic telemetry techniques were used to monitor coho salmon and cutthroat trout smolt use of the lower (marine-dominated) estuary. This study was designed to determine smolt duration and habitat use in the estuary. We arranged twelve stationary receivers throughout the estuary to investigate movement throughout the estuary and time spent in five habitat types: upper tidewater, high density eelgrass, low density eelgrass, estuarine side channels and lower estuary (Figure 2, Table 1). Vemco ultrasonic transmitters were surgically implanted into 19 coho smolts and 21 cutthroat smolts caught in Winchester Creek in April and May 2003. The fish were monitored by the stationary receiver array for approximately three months.

##### *Other monitoring:*

Seining and backpack electrofishing techniques were used to monitor salmonid use of restored freshwater and tidal habitats in South Slough for rearing. In 2002, we investigated coho smolts rearing in five different habitats of Winchester Creek: main reach (three sites), West Fork Winchester Creek, and Dalton Creek (Table 2). This study was designed to examine whether or not rearing habitats were related to fish size. We seined or electrofished, where appropriate, for juvenile coho in the different reaches from May through September. Fish were measured and weighed, when possible.

A construction rescue/ creek fish sampling was conducted in 2002 on a restoration project in Anderson Creek. Organized by SSNERR, the restoration project re-directed Anderson Creek from an incised, straight drainage ditch into a newly-excavated meandering channel. During the construction process, the old channel was filled with dirt from the excavation. We used amphibian nets, seines, and backpack electrofishing equipment to rescue as many aquatic vertebrates as possible from the old channel prior to its filling. A subsample of the fish caught in this effort were measured and weighed; these data will be used in comparison with fish numbers and sizes in the new channel this fall and in subsequent years. The rescued vertebrates were relocated downstream beyond the restoration project.

#### **(5) The results shown or expected from the completed project.**

##### *Adult trapping:*

The Winchester Creek adult trap was operated continuously from 15 September, 2001 to 6 January, 2002 and from 8 November to 31 December, 2002 (Table 3). Although in 2001 the trap was operated into 2002, those data will be referred to as from the 2001-2002 run year. The estimated total number of wild coho adults in 2001 and 2002 was 302 and 321 respectively. Of these, 176 fish in 2001 and 177 fish in 2002 were estimated to be females in both years. The mean size for fish in 2001 was 628 mm fork length (FL), with females averaging 726 mm FL and males averaging 637 mm FL. In 2002, the mean size for fish was 685 mm FL, while females averaged 731 mm FL and males averaged 657 mm FL. These data are summarized in Table 3. In the 2001 season, hatchery strays (fish from a hatchery in a system other than Winchester Creek) formed a minute proportion of the population estimate (five hatchery coho spawners). In 2002, no hatchery strays were included in the analysis. An estimated 20 hatchery coho returned and spawned in 2002-2003 run year.

##### *Juvenile Trapping:*

Coho salmon juveniles and other salmonids were captured at the rotary screw trap in Winchester Creek. The estimated total population of coho fry in 2002 was 50,426 and the estimated smolt population was 998 (Figure 3). In 2003, the estimated total population of coho fry was 47,455 and the estimated population of smolts was 11,452 (Figure 4). Peak migration for coho fry and smolts in 2002 and 2003 took place between April 1 and 21. In 2002 and 2003, juvenile cutthroat trout and steelhead salmon were caught at the trap in small numbers.

Total season mean size of coho fry in 2002 was 40 mm FL. Total season mean size of coho smolts in 2002 was 115.6. In 2003, total season mean size of coho fry was 45 mm FL (Figure 5). Smolts averaged 84 mm FL in the 2003 season. In weekly analysis, fry were largest from April 29 to May 5 in 2002 and from May 12 to 18 in 2003. Smolts were largest from April 24 to 28 in 2002 and from May 28 to June 1 in 2003 (Figure 5).

*Ultrasonic Telemetry:*

In April 2003, 19 coho salmon smolts were monitored with ultrasonic tags and receivers throughout South Slough. The mean length of tagged fish was 155 mm FL; the mean weight of the fish was 42 g. The mean minimum residence time between the release site (upper tidewater) and the Charleston Bridge (north boundary of South Slough) was 18 days. Fourteen smolts were detected at Charleston Bridge, but seven of those smolts went back to the lower estuary habitat where monitoring ceased. Coho smolts followed three general patterns of movement and holding in the estuary: 1) quick movement out of the estuary, 2) holding time spent in the upper tidewater then movement out of the estuary, or 3) quick movement to the lower estuary, where fish spend a few days before heading out of the estuary.

In April and May 2003, 21 cutthroat trout smolts were monitored with ultrasonic tags and receivers throughout South Slough. The mean length of tagged fish was 204 mm FL; the mean weight of the fish was 56 g. All smolts chosen for this study were partially or fully "silvered," meaning they were exhibiting physical signs of smolting. The mean minimum residence time between the release site (upper tidewater) and the Charleston Bridge (north boundary of South Slough) was 30 days. Three smolts were detected at the Charleston Bridge. Thirteen smolts did not extend beyond the upper tidewater habitat. Two smolts used the side channel habitats, Joe Ney, or Sengstacken sloughs. Cutthroat trout smolts primarily stayed in the upper tidewater during the duration of this study. This pattern has also been observed in the Salmon River, OR. Some cutthroat smolts do not head out of the estuary during April, May, or June.

*Other monitoring:*

Juvenile coho salmon captured at different rearing habitats in freshwater and tidal areas of Winchester Creek differed in average size (Figure 6). Coho caught in early spring (April and May) at different habitats were all close in size. However, in early June, coho in tidally-influenced Dalton Creek became the largest. By late June, fish caught in Main Reach 1 (freshwater tidal) were the largest but Main Reach 5 (freshwater, not tidal) fish are close in size (Figure 5). It is believed that by this time coho migrate from tidal habitats like Dalton Creek up to freshwater areas of the system. Throughout the seasons, fish caught in the fresh, non-tidal West Fork of Winchester Creek were the smallest in size (Figure 6). This may be because fish get trapped behind beaver dams where food is limited and competition for resources is high. Figure 6 shows that by December, fish caught in the migrant trap were of various sizes; these are migrants from the entire system, so these data are not surprising. At the end of December, fish caught in Main Reach 5 were still the largest, while fish caught in West Fork were still the smallest.

Coho salmon, cutthroat trout of various sizes were rescued from pre-restoration Anderson Creek. Coho varied in size from 69 to 86 mm FL and 4 to 8.7 grams, while cutthroat were measured from 45 to 138 mm FL and one to 25.5 g. One juvenile steelhead salmon was rescued from Anderson Creek, measuring 51 mm FL and weighing 1.3 g. These data will become important pre-restoration figures for future monitoring at Anderson Creek.

**(6) Such other information as would be helpful in evaluating the strengths and weaknesses of project methods, materials or assumptions.**

Most of the techniques used in these studies were previously tested or already in use in South Slough. Each technique has a purpose for monitoring complex salmonid life histories in a variable environment. The monitoring undertaken in this grant provides useful information on salmonid use of estuarine habitats. We discovered some differences in rearing habitats for coho salmon, we monitored populations of adult and juvenile coho salmon, and tracked coho and cutthroat trout smolts throughout the estuary, further defining their residence time and habitat use. These data and observations are applicable to salmonids in other Pacific Northwest estuaries and contribute greatly to general knowledge of how fish use these habitats.

Monitoring juvenile salmonid use of estuaries remains a valuable process. The work done by ODFW and SSNERR in South Slough shows that juvenile salmonids use estuaries through various seasons and in different life history stages. These data can be used to prioritize estuarine restoration in coastal watersheds. However, South Slough is a relatively unaltered estuary. How do smolts use developed estuaries? More research is necessary to fully understand the value of altered and unaltered estuaries to juvenile salmonids.

Education and Public Outreach:

*Peer-reviewed papers:* Copies of these papers are attached to this document.

Miller, B.A., and S. Sadro. 2003. Residence time and seasonal movements of juvenile coho salmon in the ecotone and lower estuary of Winchester Creek, South Slough, Oregon. *Transactions of the American Fisheries Society*. 132: 546-559.

Cornu, C.E., and S. Sadro. 2002. Physical and functional responses to marsh surface elevation manipulation in Coos Bay's South Slough. *Restoration Ecology*. 10(3): 474-486.

*Presentations:*

Sadro S., and B. Miller, Oregon AFS, Sun River, OR, February 2002

Koehler, M.E., Oregon AFS, Eugene, OR, February 2003

Koehler, M.E., SSNERR Management Commission Meeting, Charleston, OR, May 2003

Koehler, M.E., Fisheries Legislative Task Force Meeting, Charleston, OR, May 2003

*Field trips:*

Winchester Tidelands Advisory Group, January 2003

NERR Educators, February 2003

Jim Carleton's class, April 2003

**(7) Final accounting required non-OWEB 25% match funds (In-kind/Donations).**

Match Funding Source	Dollar Value
ODFW Fish Monitoring Coordinator	\$23,000
ODFW Fish Monitoring Assistant	\$4,000
ODFW Smolt Trap	\$12,000
ODFW Electrofishing Equipment	\$1,500
ODFW Fish Marking Equipment	\$1,500
SSNERR Stewardship Coordinator	\$5,400
SSNERR Boats	\$1,000
SSNERR Supplies	\$2,000

\$60,800

**(8) An accounting of all other funding, in-kind contributions and donations.**

See attached sheet.

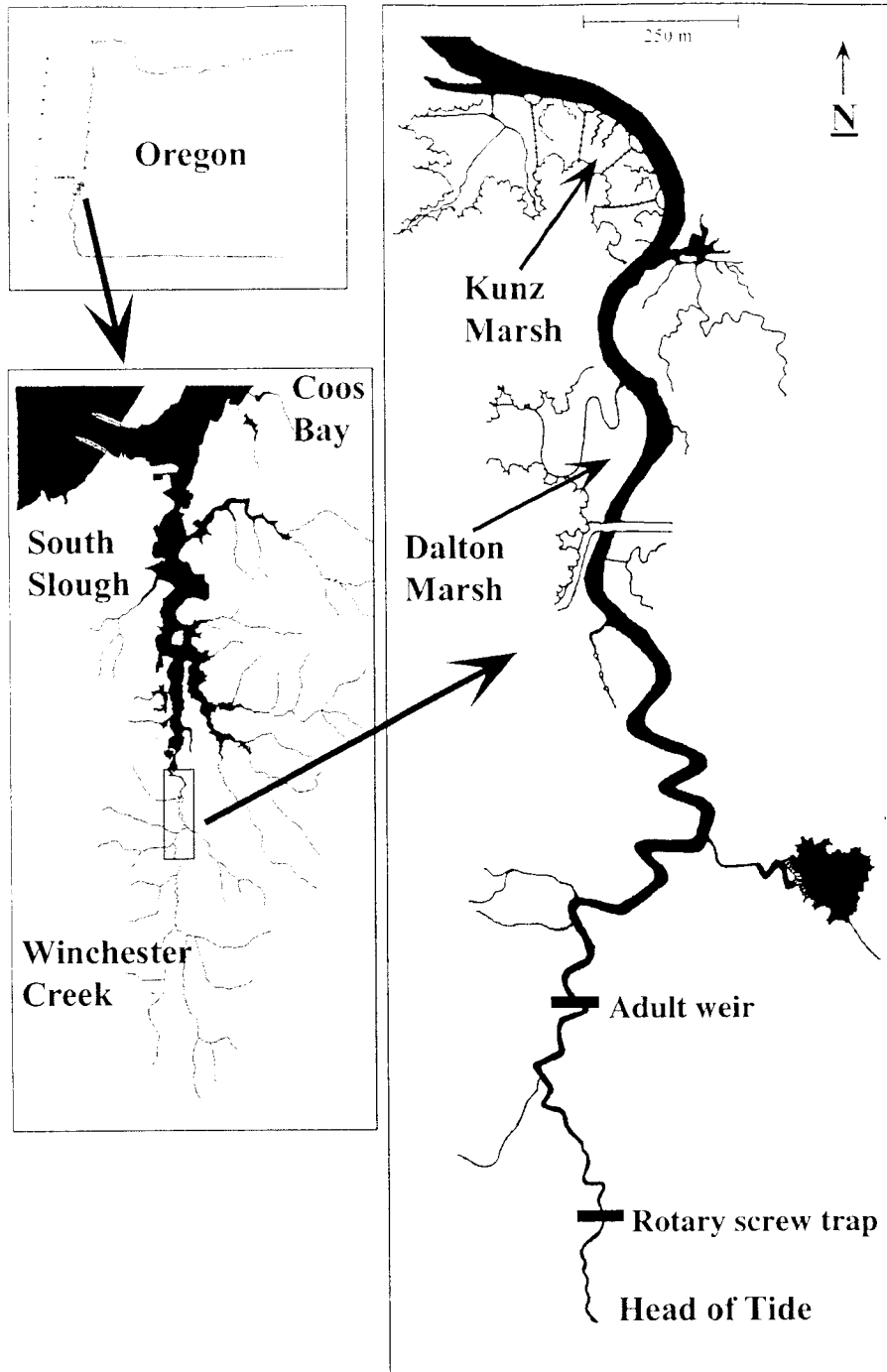


Figure 1. Map of Coos Bay's South Slough showing Winchester Creek adult salmon weir and rotary screw trap locations.



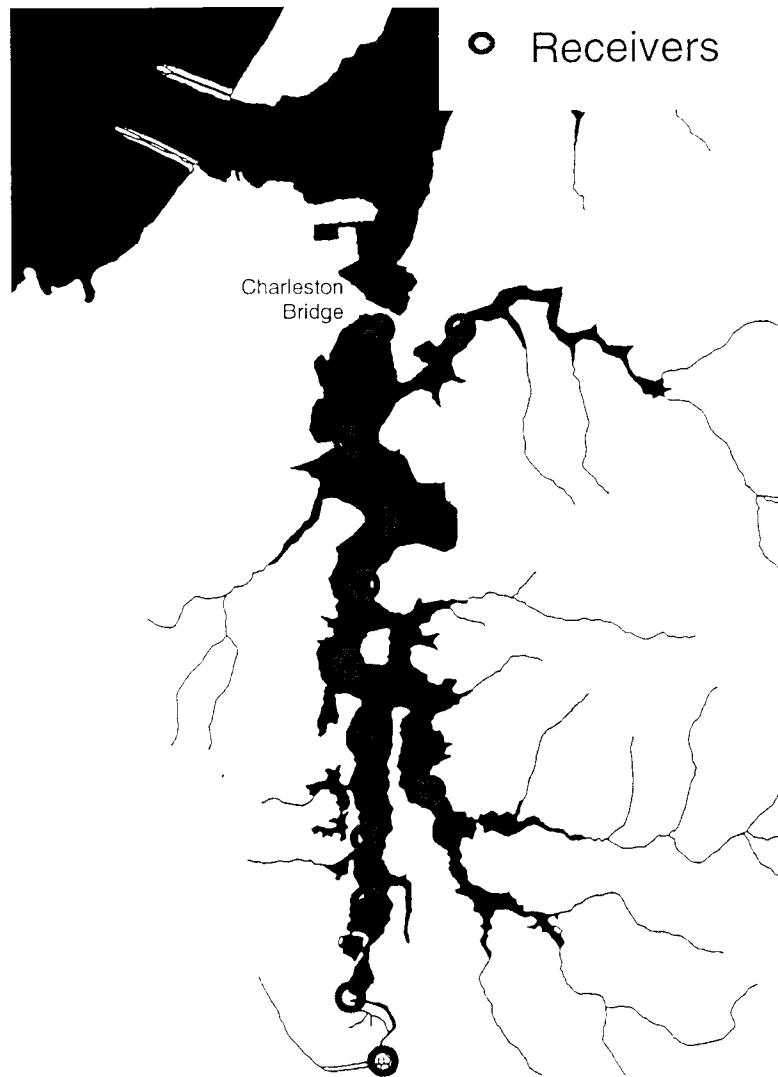


Figure 2. Map of Coos Bay's South Slough showing stationary ultrasonic telemetry receiver array.

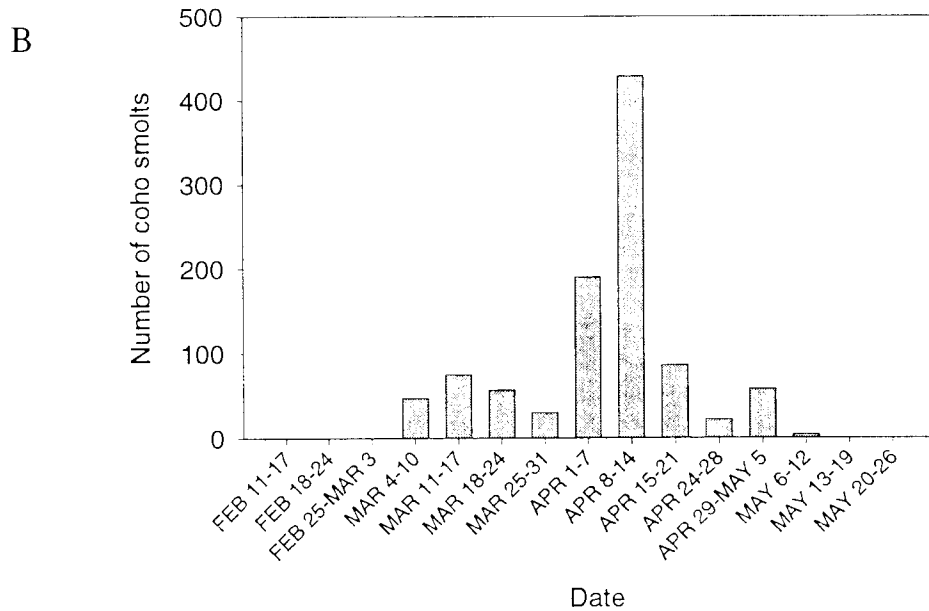
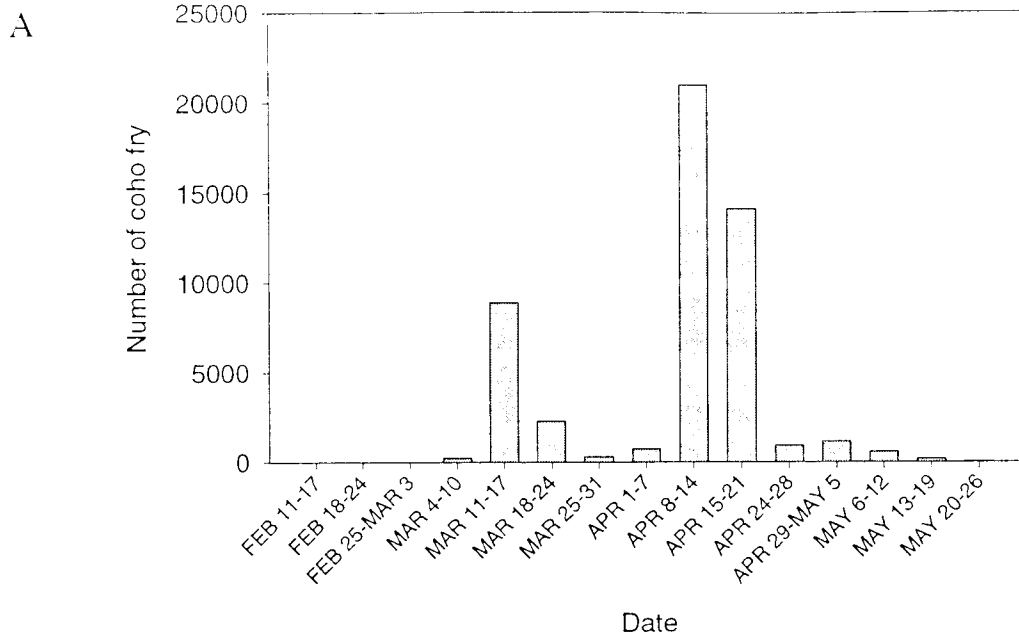


Figure 3. Estimated number of coho fry (A) and smolts (B) per week made from catches at the rotary screw trap on Winchester Creek, in Coos Bay's South Slough in 2002.

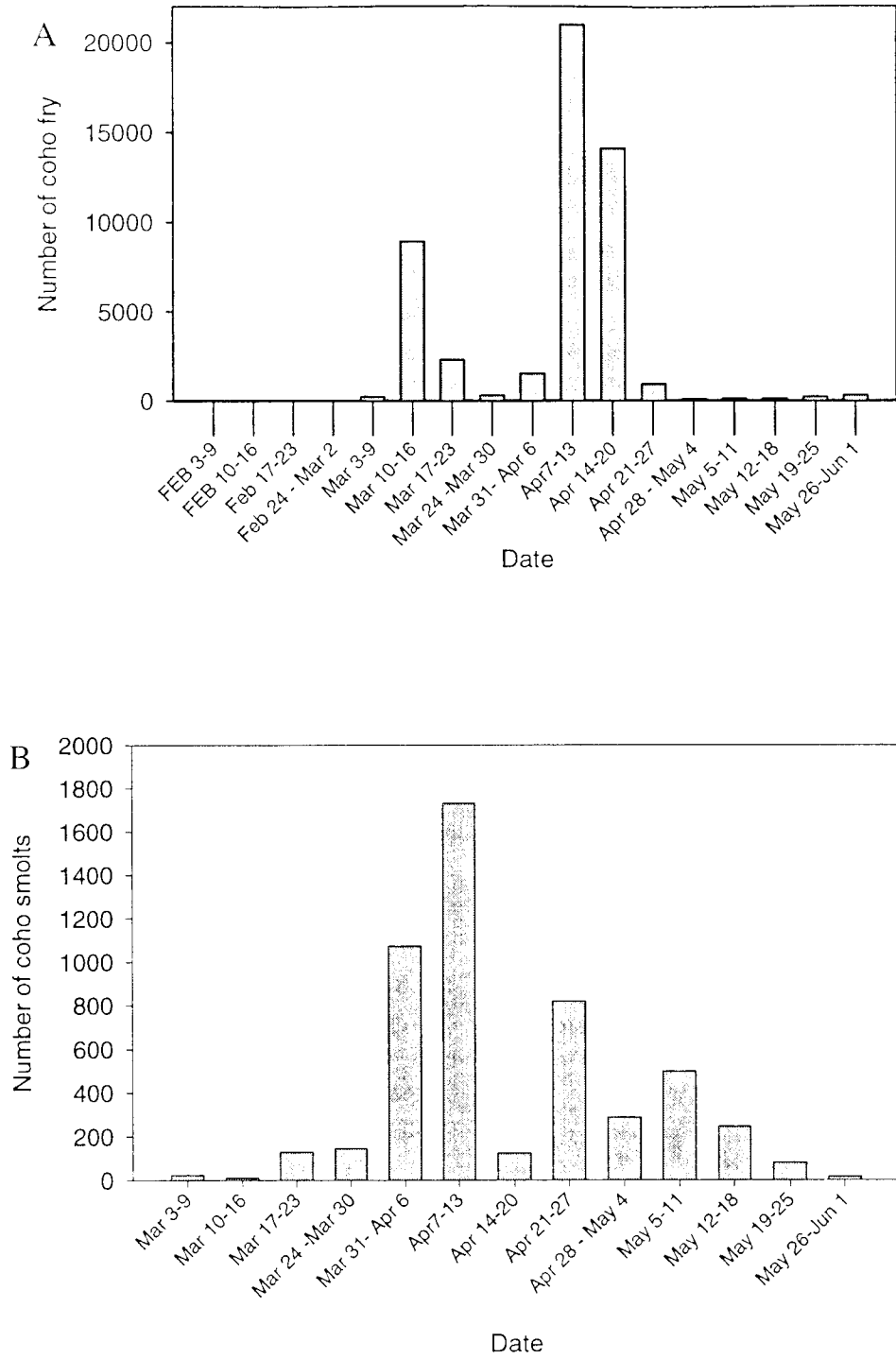


Figure 4. Estimated number of coho fry (A) and smolts (B) per week made from catches at the rotary screw trap on Winchester Creek, in Coos Bay's South Slough in 2003.

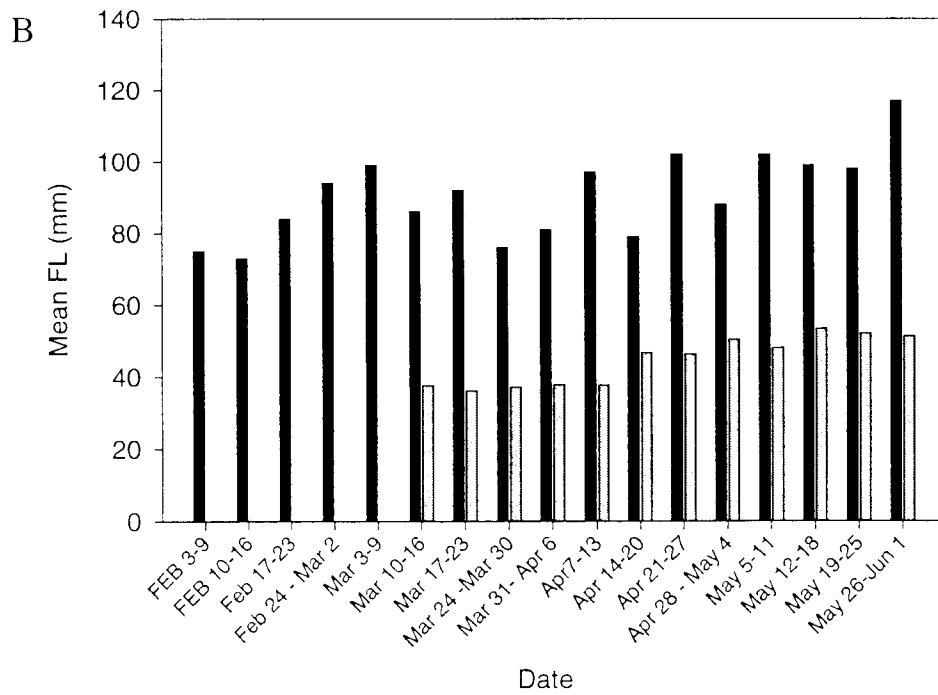
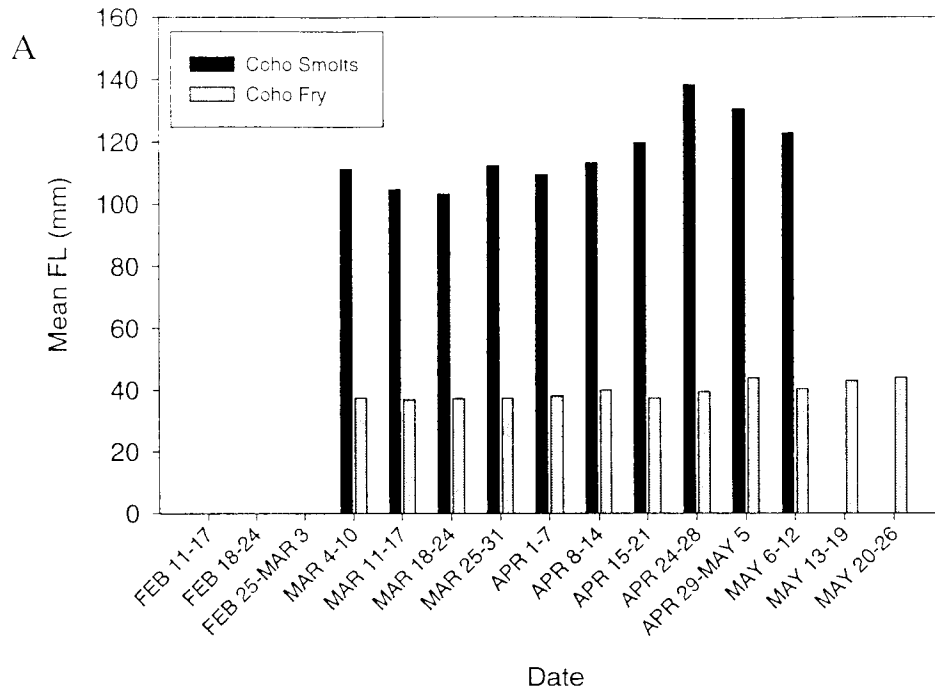


Figure 5. Mean length (mm FL) of coho smolts and fry caught at the rotary screw trap near the head of tide in Winchester Creek in 2002 (A) and 2003 (B).

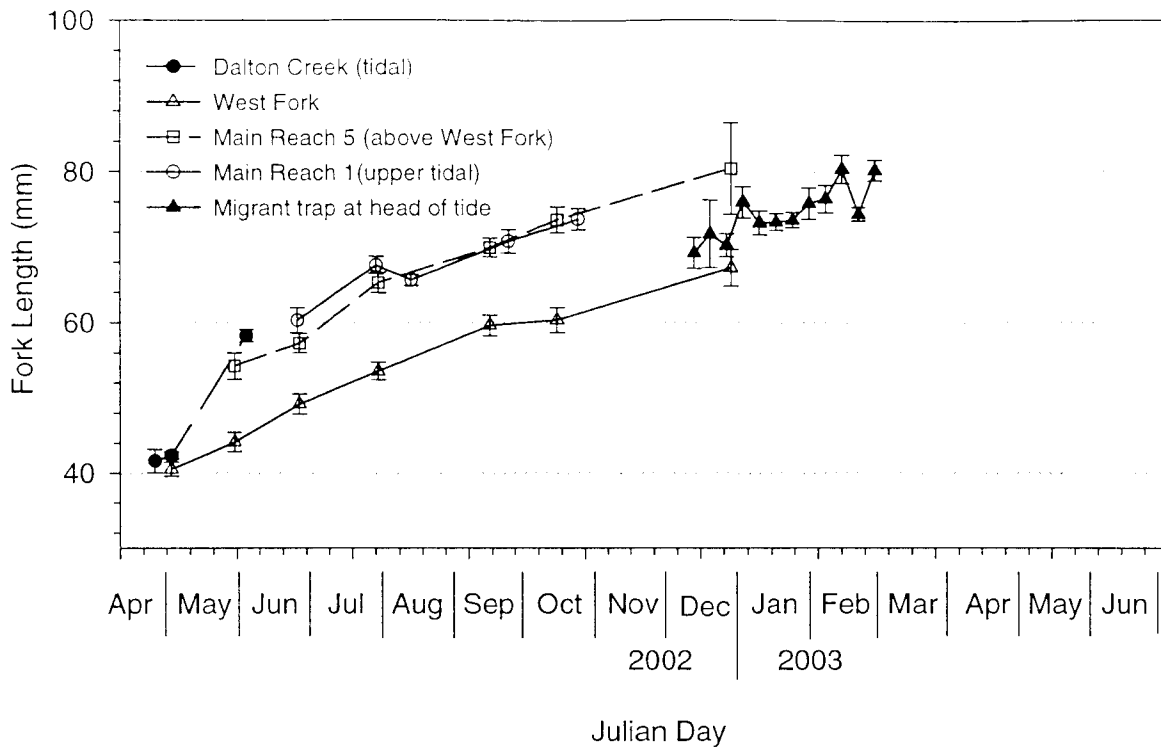


Figure 6. Mean fork length (mm) ± standard deviation of juvenile coho salmon rearing in various sections of Winchester Creek and at the migrant (rotary screw) trap at the head of tide in 2002 and 2003.

<b>Habitat</b>	<b>Location</b>	<b>Attributes</b>
<b>Upper tidewater</b>	<i>Hinch Bridge to Danger Point</i>	meandering, narrow channel, small side channels, low salinity, in-channel woody debris, overhanging banks, very little habitat available at low tide
<b>High density eelgrass</b>	<i>Danger Point to Long Island 2</i>	narrow, meandering channel, variable salinity, relatively high eelgrass density (average in April, 2003: 60 stems/ m <sup>2</sup> )
<b>Low density eelgrass</b>	<i>Long Island 2 to North Long Island</i>	straight, wide channel, variable salinity, relatively low eelgrass density (average in April '03: 16 stems/ m <sup>2</sup> ), some oyster culture
<b>Estuarine side channels</b>	<i>Sengstacken and Joe Ney Sloughs</i>	wide, meandering channel, salinity varies with tides, eelgrass variable, loss of habitat at low tide
<b>Main estuary</b>	<i>north of North Long Island and below Sengstacken and Joe Ney Sloughs</i>	wide channel, high salinity, variable eelgrass, oyster culture, deep water habitat

Table 1. Habitat stratifications, locations, and descriptions in South Slough created to determine salmonid smolt use of the estuary. Locations are shown geographically in Figure 1.

<b>Habitat</b>	<b>Channel Description</b>	<b>In-Channel attributes</b>	<b>Surroundings</b>
<b>West Fork Winchester Creek</b>	freshwater, not tidally influenced, channel width: <1 m	woody debris and many beaver dams	Mature coniferous forest
<b>Winchester Creek Main Reach 1</b>	freshwater, tidally influenced, channel width: 2-3 m, gently meandering channel	some woody debris	Agrarian pasture
<b>Winchester Creek Main Reach 3</b>	freshwater, not tidally influenced, channel width: 0-1 m, meandering channel	me woody debris	Agrarian pasture
<b>Winchester Creek Main Reach 5</b>	freshwater, not tidally influenced, channel width: <1 m, meandering channel	woody debris and some beaver dams	Mature coniferous forest
<b>Dalton Creek</b>	variable salinity, tidally influenced, meandering channel	some woody debris	Restored estuarine floodplain

Table 2. Description of rearing habitats for coho salmon in Winchester Creek, South Slough.