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THE UTILIZATION OF NETARTS BAY BY JUVENILE CHUM SALMON - 1985

by

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FIELD REPORT

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## INTRODUCTION

The School of Oceanography, Oregon State University, initiated a study during the spring of 1984 to investigate the utilization of Netarts Bay by juvenile chum salmon, and the potential of the bay as a nursery to produce juvenile chum salmon. Specific objectives the first year were to determine: 1) the utilization of the estuary by hatchery and wild chum salmon, 2) the residence time of chum salmon in Netarts Bay, and 3) the size at which the fish emigrated from the bay. Objectives for the second year were similar and provided data necessary to assess interannual variation in patterns of estuarine use by juvenile chum salmon. This report presents methods and some preliminary results from the 1985 field season.

## MATERIALS AND METHODS

## Sampling Area

Netarts Bay is located approximately 96 km (60 mi) south of the mouth of the Columbia River and is considered the sixth largest estuary in Oregon with a surface area of 10.1 km (3.9 mi) at MHW (Kreag 1979). About 12% of the Bay is subtidal (Kreag 1979), with extensive eelgrass beds located in many of these areas as well as other lower intertidal areas. Sediments in the bay are composed of fine-to-medium sands and silts (Glanzman et al. 1971, Stout 1976). The east side of the lower bay has been extensively rip rapped. Of the 13 small streams that drain into Netarts Bay, Whiskey Creek is considered the largest, extending approximately 8.0 km (5.0 mi) in length (Stout 1976, Kreag 1979). Glanzman et al. (1971) estimated an average annual flow rate for Whiskey Creek of 28.3 liters/sec. (10 cfs). Whiskey Creek is the site of the Oregon State University experimental research hatchery for rearing chum salmon (Lannan 1975).

## Gear - Whiskey Creek

A fyke net, 3.2 m long (Fig. 1a), was used to sample outmigrating wild chum salmon fry in Whiskey Creek from 24 February to 18 May 1985. The net was situated approximately 35 m upstream from the highway bridge across Whiskey Creek. Steel fence posts were placed approximately 1.25 m apart across the width of the creek immediately upstream from the fyke net. Each wing was secured to a fence post and, depending on the combination of posts selected, the net opening could be altered

to sample various widths of the stream. The net extended across more than 95% of the width of the stream on 51 of the 70 days sampled, but as little as one-half of the stream was sampled during periods of high flow. When less than 100% of the stream was sampled, the catch was expanded proportionately to estimate the total catch for the entire stream.

#### Environmental Data - Whiskey Creek

Flow rates of Whiskey Creek were not measured directly although water depth was monitored to the nearest 1.0 cm to provide a relative index of water flow. Water temperature to the nearest 0.5°C and cloud cover was also recorded.

#### Sampling Procedure - Whiskey Creek

All species captured in the fyke net were identified, counted, and measured. Fork lengths of all species were determined to the nearest 1.0 mm. Occasionally, chum fry were subsampled for stomach content analysis and age determination. From 24 February through 24 April the fyke net was fished continuously over 24 hours except on seven occasions due to high water flow. After 24 April 1985 the net was removed from the creek between 0800 hrs and 1800 hrs because few, if any, fish had outmigrated between these hours in 1984 (Wilson and Pearcy 1985) or 1985. We were unable to sample the creek daily after 24 April

because of limited personnel and thus slightly underestimated the total number of chum fry outmigrating from Whiskey Creek during 1985.

#### Releases of Chum Salmon from the Whiskey Creek Hatchery

A estimated total of 374,000 juvenile chum salmon were released from the OSU Whiskey Creek hatchery into Netarts Bay on the evenings of 19 April and 26 April 1985. This number is based on total weight and average weights of fish. Ten percent or 38,400 of these fish were fin clipped. Four workers (51 man hours) clipped the right ventral fin from 18,200 fish (mean weight ( $\bar{w}$ ) 1.6 g) during 15-16 April, and 4 workers (46 man hours) clipped the left ventral fin from 20,200 fish ( $\bar{w}$  1.9 g) during 22-23 April.

The first group was released on 19 April and included 137,400 unclipped fish (mean weight ( $\bar{w}$ ) 1.8 g, mean fork length ( $\bar{FL}$ ) 56 mm) and 18,200 right ventral fin clipped fish ( $\bar{w}$  1.8 g,  $\bar{FL}$  56 mm). The second group was released on 26 April and included the remaining 198,200 unclipped fish and 20,200 left ventral fin clipped fish ( $\bar{w}$  1.9 g,  $\bar{FL}$  59 mm). A simple random sample of 587 fish from the second release group yielded 71 left ventral fin clipped fish or 12% of the total sample.

#### Gear - Netarts Bay

A 37-m long tapered floating beach seine, constructed by Eastside Net Shop (Seattle), was used to sample fishes in Netarts Bay. The physical dimensions of the net are presented in Fig. 1b. The net was set in a semi-circle from the shoreline using a

4.6 m (15') aluminum skiff outfitted with a 15 hp outboard motor.

An 8.3 m (27 ft) long Kvichak net (tow net) with a mouth opening of 2.8 m<sup>2</sup> (9 x 9 ft), body section mesh from 0.6 cm (1.5 in) to 0.1 cm (1/8 in), and codend of 0.05 cm (1/8 in) mesh was constructed by Eastside Net shop (Seattle) and used to sample the main tidal channel in Netarts Bay. A 5.5 m (18 ft) boat with a 70 hp outboard and a 4.6 m (15 ft) boat outfitted with a towing post and 40 hp outboard were used to pull the net.

#### Environmental Data - Netarts Bay

Surface temperatures were measured to the nearest 0.5° C using a bucket thermometer and surface salinities were determined with a refractometer (American Optical, Model 10419) at the location of each successful beach seine and tow net set. Percent cloud cover, wind speed and direction were also recorded. Stage of tide and rough estimates of turbidity were made relative to the depth of water, e.g. if the bottom was visible beneath 2 m of water on station, visibility was recorded as equal to or exceeding 2 m. Substrate type, vegetation type, estimated maximum depth sampled, and distance the net was set from shore were also noted for each beach seine set.

#### Sampling Procedure - Netarts Bay

Beach Seine - A total of 11 high tide and 10 low tide stations, some marked with wooden stakes, were repeatedly sampled (Fig 2). Descriptions of the specific beach seine stations are presented in Wilson and Pearcy (1985). Date, time of day, and performance



of the gear were recorded. All stations were usually sampled at least once during a 1-2 day sampling period. All high tide stations could be sampled on tides 6.6 ft or higher (uncorrected tidal height as stated in the 1984 OSU Marine Science Center tide tables). Correction factors for times and elevations of slack low and high tides near the mouth of Netarts Bay are found in Stout (1976). Generally, a time lag of 40 and 80 minutes was found for high and low water, respectively, near the mouth. Sampling at high or low tide stations usually commenced at least 30 minutes before slack tide. Stations near the mouth were sampled first and stations farther up the estuary were usually sampled later as the slack high or low tide progressed up the bay. Slack high and low tides in the upper estuary were delayed by as much as 45 to 120 minutes, respectively, after slack high and low water at the mouth.

At each site all fish species captured were identified and counted. Large catches were subsampled. Fork lengths of the common species were determined to the nearest 1.0 mm. If substantial numbers of species other than chum salmon were captured, subsamples were preserved for stomach contents and size frequency analyses. Potential fish predators of juvenile chum salmon including rainbow trout and cutthroat trout were occasionally captured and retained for stomach content analysis.

All juvenile chum salmon, or a subsample of 50-100 individuals, were counted and checked for ventral fin clips. Fish that had been examined were then placed in a recovery bucket and released in groups of 100. A subsample of 5-50 chum was

placed in 10% formalin or 95% ethanol for stomach content analysis and age determination, respectively. Fork lengths of all preserved fish were measured in the laboratory and converted to fresh fish lengths using the relationships determined from measurements of individual fresh and preserved fish (Wilson and Pearcy 1985; Appendix 1). A model describing the relationship between fresh fish length and fresh weight is presented in Appendix 2.

Tow Net - Only a single 900 m long transect in the main channel of the lower bay was deep enough at high tide to sample with the tow net (Fig 2). Because of the restricted area available to the gear, sampling occurred during minimal tidal flow. Hence sampling commenced approximately 1/2 hour before high slack and ceased approximately 1 1/2 hours later. The catch was processed as described for beach seine catches.

#### Data Analysis

For the purpose of data analysis the field season was divided into 21 sampling periods in which every beach seine station was usually sampled at least once. Toward the end of the field season some upper bay stations were not sampled during each period. The bay was arbitrarily divided into an upper bay (stations 1-4 and 12-14) and lower bay (stations 5-11 and 15-21) (Fig 2). Mean lengths and numbers of fish caught from different regions of the bay were compared using a t-test and Mann-Whitney test, respectively (Zar, 1974). Estimates of growth were compared using an F test for parallelism (Neter and 1957).

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## RESULTS

## Whiskey Creek

A total of 23,289 chum salmon fry were estimated to have outmigrated from Whiskey Creek into Netarts Bay between 24 February and 18 May. This outmigration of wild chum salmon fry was approximately 6.2% of the total chum salmon releases from Whiskey Creek hatchery in 1985.

The outmigration of chum fry occurred in two broad pulses (Fig 3a). The first pulse between 22 March and 29-30 March comprised approximately one-fifth of the total numbers of chum outmigrants for 1985 while a larger broader pulse of three peaks between 6 April and 24 April represented 71% of the total outmigrants caught (Table 1). The peaks of outmigration did not appear positively associated with the new moon as reported for other outmigrating salmonid fry (Mason 1975). For example, two peaks of outmigration occurred shortly after the full moon on 5 April, although large numbers of fish outmigrated after the new moon on 21 March and 20 April (Table 1). Neither stream temperature, which ranged from 6.4° to 12.9° (mean 8.5), nor stream flow showed any strong correlation with the pulses of outmigrating chum, although the second outmigration pulse followed an abrupt increase in water temperature (Table 1; Figs. 3a,b,c). The first peak of outmigration occurred during high stream flow (water level >20 cm) whereas subsequent peaks occurred during low flow.

### Netarts Bay

Beach Seine - A total of 333 beach seine sets were made in Netarts Bay from 25 February through 3 July 1985. Table 2 lists the date, time of day, gear performance, tide stage, water temperature, salinity, and turbidity for each beach seine set. The water temperature from all stations averaged 12.9°C and ranged from 8.0°C to 26.2°C. During the course of the field season mean water temperatures from high or low tide stations in the upper or lower bay varied by as much as 15°C (high tide stations in upper bay; Tables 3, 4). All areas of the bay showed a seasonal increase in temperature (Figs. 4a,b). During the latter third of the field season water temperatures in the upper bay were generally greater than those in the lower bay (Fig. 5). Mean salinity for all sites was 26 ppt and ranged from 7 to 36 ppt.

An estimated 11,068 juvenile chum salmon were caught from 3 March to 21 June. The number of chum salmon caught at each beach seine station are listed in Table 5. The average number of chum caught per beach seine set, all sites combined, ranged from 0 to 102 over the field season (Fig 6; Table 6). Large standard deviations of the number of fish per set (Table 6), as well as results from repeated sets (Table 7), indicate that chum salmon often occurred in schools or aggregations within the bay.

The first noticeable increase in the mean number of chum per beach seine set coincided with the first peak of outmigration of fish from Whiskey Creek on 24-25 March (Table 6; Fig. 6). As of

18 April nearly 80% of all downstream migrants from Whiskey Creek had entered the bay; increasing beach seine catches to an average of approximately 20 fish per set. The greatest increase between consecutive sampling periods immediately followed the first hatchery release on 19 April when mean numbers per set increased to over 90 (Fig 6). The largest mean number of chum per set occurred during 3-4 May, immediately following the second hatchery release on 26 April. Catches remained high the following week and then declined to less than 2 fish per set during late May and June (Table 6). The last 3 chum salmon were caught near the mouth of the bay at site 12 on 21 June.

Before 3-4 May a trend towards larger catches of chum salmon occurred at high rather than low tide with significant differences seen on three occasions (Table 8; Fig. 7). After 22-23 April, however, a tendency toward smaller catches at high rather than low tide stations was observed with significant differences ( $P < 0.05$ ) seen on one occasion. To determine if this difference was related to a disproportionate number of sets in the upper or lower bay, catches at high and low tide sites were compared for both upper bay and the lower bay. The results were similar (Tables 9,10; Figs. 8). High tide stations during the first half of the season tended to produce larger catches than low tide stations whereas in the latter half of the season the reverse occurred.

Peak catches of chum salmon were made in the upper bay sites before 3-4 May and in the lower bay sites after 22-23 April (Table 11, Fig 9). This suggests a down-bay movement of fish as

a function of time. After 15-17 May an average of less than 2 fish per set was caught from the upper bay sites (Table 11). These trends were also apparent when only high or low tide stations were used to compare the catches in the upper and lower bay (Tables 9, 10; Figs. 10).

Before 4 April, chum salmon caught in the upper bay were usually larger than those caught in the lower bay with significant differences ( $P < 0.05$ ) found on two of three occasions for high tide stations (Table 12). After 24-25 March, however, larger fish were caught in the lower rather than upper bay, with significant differences ( $P < 0.05$ ) between mean lengths on four of six occasions at high tide (Table 12). These trends were not observed when only low tide sites were used (Tables 13).

Significantly larger fish were caught in the upper bay from low tide than high tide stations on three of seven occasions (Table 14). Whereas significantly larger fish were captured from high tide rather than low tide stations on four of eight comparisons in the lower bay (Table 15).

Tow Net - Tow net sampling was conducted on eight dates between 25 March and 20 June (Table 16). No fish were captured until after the last hatchery release on 26 April. Catches were low suggesting that large groups of chum were not aggregating in the lower portion of the main channel during our sampling periods. To determine if significant numbers of chum were avoiding the net during daylight hours, day and night tows were conducted on 21

May and 22 May, respectively (new moon 19 May). Mean numbers of fish captured during the two periods were not significantly different ( $P > 0.1$ ; Table 16). Fish from tow net collections were not generally larger than those from beach seine collections taken at approximately the same time (Tables 12-16). No fish were captured after 20 June although fish were caught in beach seine hauls on 21 June.

#### Recapture of marked chum salmon

A total of 277 right-ventral (RV) fin-clipped and 182 left-ventral (LV) fin-clipped chum salmon were recaptured from 22-23 April through 21-22 May in beach seine hauls within Netarts Bay (Table 17). Thirty-eight fish which had both ventral fins inadvertently clipped were also recaptured (Table 17). The proportion of ventral fin-clipped fish in the catch was nearly 8% initially but declined to less than 4% in approximately three weeks (Table 17; Fig. 11a). This suggests that hatchery released chum salmon exhibited more rapid emigration or mortality from the bay than naturally spawned fish. Both RV and LV fish experienced similar declines in percent recapture over time which was not unexpected due to the similar size and time of release of the two groups (Fig. 11b).

Growth was estimated from fork lengths of recaptured fin-clipped fish (Table 18). The increase in plotted mean lengths after release for both LV and RV groups appears linear (Fig 12). No trend for decreasing size later in the spring is obvious due to emigration of large individuals from the bay. A straight line

was fitted to individual length data by the method of least squares and resulted in the following relationships for RV and LV chum salmon (Fig 12):

$$\text{RV fish: } L=0.41T+54.85 \quad (N=283; R^2=0.38)$$

$$\text{LV fish: } L=0.48T+52.94 \quad (N=189; R^2=0.23)$$

where L represents the fork length in mm and T represents the number of days since the first hatchery release date (19 April).

Estimated growth for LV chum salmon was 0.5 mm per day which was significantly greater ( $P<0.001$ ) than the 0.4 mm per day determined for RV fish.



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Table 1. Fyke net catches of chum salmon fry, water temperature, and relative water level in Whiskey Creek.

Moon phase	Date	Chum caught (number)	Chum caught (% of total)	Water temp (C)	Water level (CM)
	24 Feb 85	4	0.0	8.2	11.4
	25 Feb 85	2	0.0	7.1	9.9
Fst Qtr	26 Feb 85	0	0.0	6.6	8.6
	27 Feb 85	0	0.0	6.8	7.6
	28 Feb 85	2	0.0	7.8	6.4
	1 Mar 85	3	0.0	7.1	6.4
	2 Mar 85	2	0.0	6.4	5.1
	3 Mar 85	9	0.0	7.1	12.7
	4 Mar 85	3	0.0	6.6	26.2
	5 Mar 85	7	0.0	6.4	19.8
Full	6 Mar 85	3	0.0	6.5	15.0
	7 Mar 85	2	0.0	6.4	10.9
	8 Mar 85	0	0.0	7.1	9.7
	9 Mar 85	0	0.0	7.5	7.4
	10 Mar 85	4	0.0	7.3	6.4
	11 Mar 85	3	0.0	7.4	6.1
Lst Qtr	12 Mar 85	7	0.0	6.6	4.8
	13 Mar 85	2	0.0	7.1	4.3
	14 Mar 85	12	0.1	7.2	3.8
	15 Mar 85	28	0.1	7.1	2.3
	16 Mar 85	19	0.1	7.1	1.8
	17 Mar 85	54	0.2	7.0	1.5
	18 Mar 85	43	0.2	6.9	1.5
	19 Mar 85	176	0.8	7.9	1.0
New	20 Mar 85	128	0.5	7.1	3.3
	21 Mar 85	34	0.1	7.2	9.7
	22 Mar 85	1046	4.5	7.5	14.7
	23 Mar 85	--	--	--	41.9
	24 Mar 85	1214	5.2	6.8	21.1
	25 Mar 85	1442	6.2	6.8	19.3
	26 Mar 85	143	0.6	6.8	31.0
	27 Mar 85	--	--	6.9	29.2
Fst Qtr	28 Mar 85	460	2.0	7.6	21.3
	29 Mar 85	554	2.4	7.0	25.1
	30 Mar 85	--	--	--	48.3
	31 Mar 85	16	0.1	10.0	30.0
	1 Apr 85	49	0.2	10.0	22.6
	2 Apr 85	143	0.6	10.0	19.6
	3 Apr 85	235	1.0	10.0	16.0
Full	4 Apr 85	213	0.9	8.8	15.2
	5 Apr 85	382	1.6	9.3	12.7
	6 Apr 85	713	3.1	10.2	11.4

Table 1. (continued)

Moon phase	Date	Chum caught (number)	Chum caught (% of total)	Water temp (C)	Water level (CM)
	7 Apr 85	1423	6.1	9.8	10.4
	8 Apr 85	590	2.5	9.7	10.2
	9 Apr 85	--	--	--	--
	10 Apr 85	667	2.9	10.0	10.7
	11 Apr 85	2303	9.9	10.3	11.9
Lst Qtr	12 Apr 85	1098	4.7	10.8	9.9
	13 Apr 85	1301	5.6	10.8	9.4
	14 Apr 85	1335	5.7	10.3	8.6
	15 Apr 85	806	3.5	10.0	7.9
	16 Apr 85	>603	>2.6	10.6	7.6
	17 Apr 85	1191	5.1	9.3	8.1
	18 Apr 85	797	3.4	8.2	7.9
	19 Apr 85	343	1.5	8.1	7.6
New	20 Apr 85	397	1.7	7.5	11.9
	21 Apr 85	639	2.7	8.4	10.2
	22 Apr 85	1481	6.4	8.8	30.0
	23 Apr 85	642	2.8	8.7	20.8
	24 Apr 85	264	1.1	8.5	18.8
	25 Apr 85	--	--	--	--
	26 Apr 85	41	0.2	9.2	18.5
	27 Apr 85	--	0.0	--	--
Fst Qtr	28 Apr 85	58	0.2	8.8	17.0
	29 Apr 85	--	--	--	--
	30 Apr 85	43	0.2	9.6	13.7
	1 May 85	--	--	--	--
	2 May 85	39	0.2	10.0	14.5
	3 May 85	19	0.1	9.9	14.5
Full	4 May 85	4	0.0	10.2	14.0
	5 May 85	--	--	--	--
	6 May 85	16	0.1	10.1	11.9
	7 May 85	1	0.0	9.4	10.4
	8 May 85	16	0.1	9.6	10.4
	9 May 85	--	--	--	--
Lst Qtr	10 May 85	6	0.0	8.8	9.7
	11 May 85	--	--	--	--
	12 May 85	5	0.0	9.0	9.7
	13 May 85	--	--	--	--
	14 May 85	4	0.0	9.3	9.4
	15 May 85	--	--	--	--
	16 May 85	0	0.0	12.9	8.1
	17 May 85	0	0.0	11.8	17.0
	18 May 85	0	0.0	11.9	6.9

Table 2. Netarts Bay environmental data. Perf: gear performance where 1=excellent, 2=good, 3=poor (not quantitative); turbidity of 1="average" turbidity, 2="high" turbidity. Tidal stages: l=low, h=high, f=flood, e=ebb, s=slack.

Haul	Station	Date	Time	Perf	Tide	Temp (C)	Salinity (ppt)	Turbidity
1	Willow Bush Low	25 Feb 85	1330	1	lf	11.0	24	1
2	Opposite Lagoon	25 Feb 85	1400	1	lf	11.0	24	1
3	Two Stake Point	25 Feb 85	1420	1	lf	10.5	24	1
4	Whiskey Creek	3 Mar 85	1030	1	hs	8.0	31	1
5	Picnic Point	3 Mar 85	1050	1	hs	8.0	23	1
6	West-South 1	3 Mar 85	1110	1	he	8.0	25	1
7	South 1	3 Mar 85	1130	1	he	9.0	14	1
7a	South 1	3 Mar 85	1140	1	he	9.0	14	1
8	One Low	3 Mar 85	1630	1	le	9.0	30	2
9	Two Low	3 Mar 85	1655	1	ls	9.0	27	2
10	Willow Bush Low	3 Mar 85	1720	1	le	9.0	26	2
11	Opposite Lagoon	3 Mar 85	1835	1	le	9.0	26	2
12	Thirteen Low	3 Mar 85	1750	1	ls	9.0	25	1
13	Two Stake Point	3 Mar 85	1810	1	le	9.0	-	2
14	Snag Point	3 Mar 85	1835	1	lf	8.0	20	2
16	One High	4 Mar 85	1020	1	hs	8.0	30	1
17	Two High	4 Mar 85	1030	1	hs	8.0	28	1
18	Three High	4 Mar 85	1055	1	he	8.5	28	1
19	Four High	4 Mar 85	1110	1	he	8.5	28	2
20	Unnamed Creek	4 Mar 85	1125	1	he	8.0	28	2
21	Mud Paradise	4 Mar 85	1150	1	he	8.0	28	1
22	Willow Bush High	4 Mar 85	1200	1	he	8.5	28	2
23	Three High	10 Mar 85	1000	1	le	9.0	10	1
24	One Low	10 Mar 85	1023	1	ls	9.5	27	1
25	Two Low	10 Mar 85	1040	1	lf	9.5	28	1
26	Willow Bush Low	10 Mar 85	1100	1	ls	10.0	26	1
27	Opposite Lagoon	10 Mar 85	1115	1	ls	10.2	27	1
28	Lagoon	10 Mar 85	1130	1	lf	11.5	28	1
29	Thirteen Low	10 Mar 85	1145	1	lf	12.0	26	1
30	Two Stake Point	10 Mar 85	1155	1	lf	11.5	26	1
31	Snag Point	10 Mar 85	1205	1	lf	11.0	26	1
32	South-33	10 Mar 85	1215	1	lf	12.0	26	1
33	Whiskey Creek	10 Mar 85	1525	1	hf	12.5	10	2
34	Picnic Point	10 Mar 85	1545	1	hf	14.5	25	2
35	West-South 1	10 Mar 85	1600	1	hf	11.5	26	2
36	South 1	10 Mar 85	1625	2	hs	12.5	20	2
37	Mud Paradise	10 Mar 85	1645	1	hs	13.0	27	1
38	Willow Bush High	10 Mar 85	1700	1	he	12.5	27	2
39	Unnamed Creek	10 Mar 85	1720	1	he	12.0	26	2
40	Four High	10 Mar 85	1730	1	he	10.5	22	1
41	Three High	10 Mar 85	1800	1	he	10.0	28	1
42	Two High	10 Mar 85	1815	1	he	9.5	28	1
43	One High	10 Mar 85	1830	1	he	9.5	28	1

Table 2. (continued)

Haul	Station	Date	Time	Perf	Tide	Temp (C)	Salinity (ppt)	Turbidity
44	Whiskey Creek	17 Mar 85	945	1	hf	9.0	30	1
45	Picnic Point	17 Mar 85	1005	1	hf	9.5	28	1
46	West-South 1	17 Mar 85	1015	1	hf	9.5	28	1
47	Picnic Point	17 Mar 85	1035	1	hs	9.0	22	1
48	Mud Paradise	17 Mar 85	1045	1	hs	9.5	32	1
49	Willow Bush High	17 Mar 85	1100	1	hf	9.5	32	1
50	Willow Bush High	17 Mar 85	1110	1	hf	9.5	32	1
51	Unnamed Creek	17 Mar 85	1130	1	hs	9.5	31	1
52	Four High	17 Mar 85	1145	2	he	9.8	31	1
53	Three High	17 Mar 85	1205	1	he	9.5	32	1
54	Two High	17 Mar 85	1130	1	he	10.2	32	1
55	One High	17 Mar 85	1250	1	he	10.3	31	1
56	One Low	17 Mar 85	1645	1	le	11.0	31	1
57	Two Low	17 Mar 85	1700	1	ls	10.5	30	1
58	Willow Bush Low	17 Mar 85	1730	1	le	11.2	28	1
59	Opposite Lagoon	17 Mar 85	1745	1	le	11.0	29	1
60	Thirteen Low	17 Mar 85	1800	1	le	11.2	28	1
61	Two Stake Point	17 Mar 85	1815	1	le	11.5	27	1
62	Snag Point	17 Mar 85	1830	1	le	11.0	26	1
63	South-33	17 Mar 85	1840	1	lf	11.0	29	1
64	Two Low	24 Mar 85	950	1	ls	8.0	20	1
65	One Low	24 Mar 85	1010	1	ls	8.5	23	1
66	One Low	24 Mar 85	1025	1	ls	8.5	23	1
67	Three Low	24 Mar 85	1050	1	lf	8.5	23	1
68	Willow Bush Low	24 Mar 85	1105	1	lf	8.5	22	1
69	Opposite Lagoon	24 Mar 85	1120	1	lf	8.5	23	1
70	Thirteen Low	24 Mar 85	1135	1	lf	9.5	21	1
71	Two Stake Point	24 Mar 85	1145	1	lf	9.0	22	2
72	Snag Point	24 Mar 85	1155	1	lf	9.5	22	1
73	Four High	24 Mar 85	1440	2	hf	10.0	12	2
74	Two High	24 Mar 85	1510	2	hf	9.5	10	2
75	Picnic Point	24 Mar 85	1530	1	hs	10.5	14	2
76	West-South 1	24 Mar 85	1545	1	he	10.5	18	2
77	West-South 1	24 Mar 85	1555	1	he	10.5	18	2
78	Whiskey Creek	24 Mar 85	1620	2	he	10.0	10	2
79	Mud Paradise	24 Mar 85	1640	1	he	10.5	21	1
80	Willow Bush High	24 Mar 85	1700	1	he	9.5	22	2
81	Three High	24 Mar 85	1720	1	he	9.0	24	1
82	Two High	24 Mar 85	1735	1	hs	9.0	25	1
83	One High	24 Mar 85	1753	1	he	9.0	25	1
84	South-33	25 Mar 85	1125	1	le	10.0	22	1
85	South-33	25 Mar 85	1130	1	le	10.0	22	1
86	Lagoon	25 Mar 85	1200	1	lf	8.5	22	1
87	One High	4 Apr 85	1110	1	hf	14.0	30	1

Table 2. (continued)

Haul	Station	Date	Time	Perf	Tide	Temp (C)	Salinity (ppt)	Turbidity
88	Four High	4 Apr 85	1130	1	hf	11.3	29	1
89	Picnic Point	4 Apr 85	1155	1	hf	13.9	22	1
90	West-South 1	4 Apr 85	1220	1	hf	14.5	26	1
91	South 1	4 Apr 85	1240	1	hf	13.8	10	1
92	Whiskey Creek	4 Apr 85	1310	1	hs	13.5	10	1
93	Mud Paradise	4 Apr 85	1320	1	he	13.5	25	1
94	Willow Bush High	4 Apr 85	1340	1	he	14.5	26	1
95	Unnamed Creek	4 Apr 85	1350	1	he	13.5	15	1
96	Three High	4 Apr 85	1420	1	he	11.2	29	1
97	Two High	4 Apr 85	1440	1	he	11.0	30	1
98	One Low	4 Apr 85	1700	1	le	12.5	30	1
99	Two Low	4 Apr 85	1720	1	le	12.0	28	1
100	Three Low	4 Apr 85	1730	1	le	13.2	20	1
101	Willow Bush Low	4 Apr 85	1750	1	le	13.2	17	1
102	Opposite Lagoon	4 Apr 85	1800	1	le	12.7	25	1
103	Thirteen Low	4 Apr 85	1820	1	he	12.9	23	1
104	South-33	4 Apr 85	1850	1	le	13.0	23	1
105	Snag Point	4 Apr 85	1900	2	he	12.6	24	1
106	Picnic Point	12 Apr 85	600	1	hs	11.6	25	1
107	West-South 1	12 Apr 85	620	1	hs	11.8	26	1
108	South 1	12 Apr 85	645	1	he	10.5	10	1
109	Whiskey Creek	12 Apr 85	700	1	he	11.4	24	1
110	Mud Paradise	12 Apr 85	715	1	he	11.3	28	1
111	Willow Bush High	12 Apr 85	735	1	he	11.3	28	1
112	Three High	12 Apr 85	810	1	he	10.5	30	1
113	One High	12 Apr 85	840	1	he	11.0	30	1
114	Two High	12 Apr 85	900	1	he	10.7	30	1
115	Three High	12 Apr 85	2330	2	he	--	-	1
116	Two High	12 Apr 85	2345	1	he	--	-	1
117	Unnamed Creek	13 Apr 85	845	1	he	11.2	-	1
118	Four High	13 Apr 85	810	1	he	11.3	-	1
119	One High	13 Apr 85	830	1	he	10.6	-	1
120	One High	13 Apr 85	845	1	he	10.6	-	1
121	Three High	13 Apr 85	1300	1	le	14.4	-	1
122	One Low	13 Apr 85	1322	1	le	12.9	-	1
123	Two Low	13 Apr 85	1335	1	le	13.7	-	1
124	Willow Bush Low	13 Apr 85	1355	1	le	16.4	-	1
125	Opposite Lagoon	13 Apr 85	1411	1	le	15.9	-	1
126	Thirteen Low	13 Apr 85	1423	2	le	17.0	-	1
127	South-33	13 Apr 85	1450	0	le	17.9	-	1
128	Snag Point	13 Apr 85	1503	2	le	17.2	-	1
129	Snag Point	13 Apr 85	1515	1	le	17.2	-	1
130	Two Stake Point	13 Apr 85	1530	1	le	17.6	-	1
131	One Low	18 Apr 85	710	1	ls	9.6	28	1

Table 2. (continued)

Haul	Station	Date	Time	Perf	Tide	Temp (C)	Salinity (ppt)	Turbidity
132	Two Low	18 Apr 85	720	1	lf	10.4	28	1
133	Three Low	18 Apr 85	738	1	ls	10.6	28	1
134	Willow Bush Low	18 Apr 85	755	1	lf	11.0	28	1
135	Opposite Lagoon	18 Apr 85	805	1	lf	11.2	28	1
136	Lagoon	18 Apr 85	815	1	lf	11.1	26	1
137	Thirteen Low	18 Apr 85	825	1	lf	11.3	26	1
138	Two Stake Point	18 Apr 85	840	1	lf	11.2	25	1
139	Snag Point	18 Apr 85	845	1	lf	11.3	26	1
140	South-33	18 Apr 85	900	1	lf	11.6	26	1
141	Willow Bush High	18 Apr 85	1120	1	hf	13.1	27	1
142	Unnamed Creek	18 Apr 85	1135	1	hf	13.4	26	1
143	Picnic Point	18 Apr 85	1200	1	hs	13.9	22	1
144	West-South 1	18 Apr 85	1210	1	hs	14.5	26	1
145	South 1	18 Apr 85	1230	1	hs	13.1	10	1
146	Whiskey Creek	18 Apr 85	1245	1	hs	13.0	23	2
147	Mud Paradise	18 Apr 85	1300	1	hs	13.5	26	2
148	Four High	18 Apr 85	1318	1	hs	11.7	28	1
149	Three High	18 Apr 85	1330	1	0	10.8	28	1
150	Two Low	18 Apr 85	1350	1	he	12.2	29	1
151	One High	18 Apr 85	1400	1	he	11.2	28	1
152	One High	18 Apr 85	1415	1	ls	11.2	28	1
152a	One Low	22 Apr 85	845	1	ls	9.5	25	1
152b	Two Low	23 Apr 85	855	1	ls	10.0	25	1
153	Willow Bush Low	22 Apr 85	915	1	le	10.1	26	1
154	Opposite Lagoon	22 Apr 85	920	1	le	10.3	25	1
155	Thirteen Low	22 Apr 85	950	1	le	10.6	24	1
156	South-33	22 Apr 85	1007	1	ls	11.4	25	1
157	Snag Point	22 Apr 85	1050	1	lf	11.0	24	1
158	Two Stake Point	22 Apr 85	1100	1	lf	10.9	22	1
159	Lagoon	22 Apr 85	1115	1	lf	10.4	24	1
160	One High	22 Apr 85	1350	1	hf	10.6	25	2
161	One High	22 Apr 85	1400	1	hf	10.7	23	1
162	Four High	22 Apr 85	1440	1	hf	10.8	21	2
163	Picnic Point	22 Apr 85	1520	1	he	11.4	25	2
164	West-South 1	22 Apr 85	1545	3	he	10.7	20	2
165	South 1	22 Apr 85	1600	1	he	11.0	7	2
166	Whiskey Creek	22 Apr 85	1630	1	he	11.3	20	2
167	Mud Paradise	22 Apr 85	1645	1	he	10.8	20	2
168	Willow Bush High	22 Apr 85	1710	1	he	10.7	20	2
169	One Low	23 Apr 85	920	1	le	9.3	23	2
170	One Low	23 Apr 85	940	1	le	9.5	24	1
171	Three Low	23 Apr 85	1000	1	ls	9.7	14	2
172	Willow Bush Low	23 Apr 85	1030	1	le	10.3	17	2
173	Willow Bush Low	23 Apr 85	1050	1	le	9.2	18	2

Table 2. (continued)

Haul	Station	Date	Time	Perf	Tide	Temp (C)	Salinity (ppt)	Turbidity
174	South-33	23 Apr 85	1112	1	ls	9.9	22	1
175	South-33	23 Apr 85	1130	1	ls	10.7	23	1
176	Three High	23 Apr 85	1450	1	hf	11.2	21	1
177	Two High	23 Apr 85	1510	1	hf	11.8	24	1
178	Two High	23 Apr 85	1518	1	hf	11.8	24	1
179	West-South 1	23 Apr 85	1545	1	hf	12.7	23	1
180	West-South 1	23 Apr 85	1555	1	hf	12.7	23	1
181	Unnamed Creek	23 Apr 85	1630	1	he	15.2	16	2
182	Three Low	3 May 85	630	1	le	10.4	24	1
183	One Low	3 May 85	710	1	le	10.4	27	1
184	One Low	3 May 85	735	2	lf	10.4	27	1
185	Two Low	3 May 85	750	1	lf	11.0	26	1
186	Willow Bush Low	3 May 85	815	1	le	11.0	24	1
187	Opposite Lagoon	3 May 85	830	1	le	10.9	23	1
188	Thirteen Low	3 May 85	850	1	ls	10.8	22	1
189	Two Stake Point	3 May 85	900	1	lf	11.0	22	1
190	Snag Point	3 May 85	930	1	lf	11.1	22	1
191	South-33	3 May 85	940	1	lf	11.2	22	1
192	South-33	3 May 85	1000	1	lf	11.2	22	1
193	Four High	3 May 85	1215	1	hf	12.3	28	1
194	Picnic Point	3 May 85	1300	1	hs	14.0	21	1
195	Picnic Point	3 May 85	1315	1	hs	14.0	21	1
196	West-South 1	3 May 85	1330	1	hs	14.4	26	1
197	South 1	3 May 85	1350	1	hs	13.8	21	1
198	Whiskey Creek	3 May 85	1410	1	he	15.0	27	2
199	Mud Paradise	3 May 85	1425	1	he	14.5	24	2
200	Willow Bush High	3 May 85	1438	1	he	15.1	26	2
201	Unnamed Creek	3 May 85	1500	1	he	14.4	23	2
202	South 1	4 May 85	30	1	hs	--	-	-
203	South 1	4 May 85	45	1	hs	--	-	-
204	Whiskey Creek	4 May 85	115	1	hs	--	-	-
205	One High	4 May 85	1220	1	hf	12.2	29	1
206	One High	4 May 85	1235	1	hf	12.2	29	1
207	Three High	4 May 85	1300	1	hf	12.2	20	1
208	Four High	4 May 85	1320	1	hf	13.3	18	1
209	Two High	4 May 85	1350	1	hf	13.4	32	1
210	One Low	7 May 85	930	1	le	11.0	28	1
211	Two Low	7 May 85	1015	2	le	13.0	29	1
212	Willow Bush Low	7 May 85	1045	1	le	14.3	28	1
212a	Opposite Lagoon	7 May 85	1115	1	le	15.5	29	1
213	Thirteen Low	7 May 85	1140	1	le	15.2	27	1
214	South-33	7 May 85	1220	1	ls	16.8	30	1
215	Snag Point	7 May 85	1240	1	ls	16.2	28	1
216	Two Stake Point	7 May 85	1310	1	lf	16.3	29	1



Table 2. (continued)

Haul	Station	Date	Time	Perf	Tide	Temp (C)	Salinity (ppt)	Turbidity
217	Lagoon	7 May 85	1325	1	lf	15.3	30	1
218	Four High	7 May 85	1545	1	hf	18.5	21	1
219	Willow Bush High	7 May 85	1600	1	hf	20.1	30	1
220	Picnic Point	7 May 85	1640	1	hf	20.1	23	1
221	Picnic Point	7 May 85	1650	1	hf	20.1	23	1
222	West-South 1	7 May 85	1720	1	hs	21.0	28	1
223	South 1	7 May 85	1740	2	he	18.3	14	2
224	Whiskey Creek	7 May 85	1750	1	he	19.4	25	2
225	Mud Paradise	7 May 85	1815	1	he	17.9	23	2
226	Three Low	8 May 85	915	1	le	13.5	26	1
227	Two Low	8 May 85	940	1	le	11.6	28	1
228	One High	8 May 85	1540	1	hf	13.6	30	1
229	One High	8 May 85	1600	1	hf	13.6	30	1
230	Three High	8 May 85	1620	1	hf	14.4	24	2
231	Two High	8 May 85	1650	1	hf	15.1	28	1
232	Two Low	15 May 85	1715	1	ls	14.7	34	1
233	Two Low	15 May 85	1730	1	ls	14.7	34	1
234	One Low	15 May 85	2015	1	lf	11.6	33	1
235	One High	15 May 85	2150	1	hf	10.2	32	1
236	One High	15 May 85	2320	1	hf	10.8	30	1
237	One High	15 May 85	2350	1	hf	10.8	30	1
238	One Low	16 May 85	220	1	he	9.6	32	1
239	One Low	16 May 85	515	1	le	10.1	31	1
240	Two Low	16 May 85	550	1	le	11.6	30	1
241	Three Low	16 May 85	600	1	le	11.5	30	1
242	Willow Bush Low	16 May 85	625	1	le	14.6	27	1
244	Thirteen Low	16 May 85	700	1	le	14.9	27	1
245	Two Stake Point	16 May 85	715	1	le	15.1	26	1
246	Two Stake Point	16 May 85	725	1	le	15.5	26	1
247	South-33	16 May 85	740	1	lf	15.3	27	1
248	South-33	16 May 85	730	1	lf	0.0	0	1
249	Lagoon	16 May 85	810	1	lf	14.8	28	1
250	One Low	16 May 85	825	1	lf	12.2	32	1
251	One High	16 May 85	1115	1	hf	11.7	35	1
252	Two High	16 May 85	1140	1	hf	12.5	34	1
253	Willow Bush High	16 May 85	1205	1	hf	22.0	32	1
254	Picnic Point	16 May 85	1240	1	hf	22.6	27	1
255	West-South 1	16 May 85	1250	1	hs	24.0	30	1
256	South 1	16 May 85	120	2	hs	22.5	27	1
257	One High	16 May 85	230	1	he	18.6	35	1
258	One High	17 May 85	1205	1	hf	12.4	36	1
259	Three High	17 May 85	1230	1	hf	14.5	33	1
260	Four High	17 May 85	1245	1	hf	18.7	21	1
261	One Low	21 May 85	830	1	le	11.8	30	1

Table 2. (continued)

Haul	Station	Date	Time	Perf	Tide	Temp (C)	Salinity (ppt)	Turbidity
262	Two Low	21 May 85	910	2	le	14.5	30	1
263	Willow Bush Low	21 May 85	940	1	le	15.7	29	1
264	Thirteen Low	21 May 85	1000	2	le	16.8	28	1
265	Opposite Lagoon	21 May 85	1015	2	ls	17.4	30	1
266	Snag Point	21 May 85	1055	1	le	18.0	29	1
267	South-33	21 May 85	1050	2	ls	18.8	28	1
268	Two Stake Point	21 May 85	1120	1	ls	18.1	29	1
269	Lagoon	21 May 85	1205	1	lf	17.9	30	1
270	One High	22 May 85	1420	1	hf	14.2	33	1
271	Two High	22 May 85	1445	1	hf	15.2	32	1
272	Three High	22 May 85	1500	1	hf	17.1	32	1
273	Willow Bush High	22 May 85	1535	1	hf	19.9	32	1
274	South 1	22 May 85	1630	1	hs	26.2	20	2
275	One High	30 May 85	1000	1	hf	14.2	25	1
276	One High	30 May 85	1015	1	hf	14.2	25	1
277	Two High	30 May 85	1030	1	hf	14.4	25	1
278	Three High	30 May 85	1100	2	hs	14.4	25	1
279	Willow Bush High	30 May 85	1115	1	hs	15.0	26	1
280	Mud Paradise	30 May 85	1130	1	he	14.6	27	1
281	South 1	30 May 85	1152	1	he	16.8	20	1
282	West-South 1	30 May 85	1215	1	he	16.3	28	1
283	One High	30 May 85	1545	1	le	16.2	22	1
284	One High	30 May 85	1550	1	le	16.2	22	1
285	Two High	30 May 85	1620	1	le	16.5	25	1
286	Three High	30 May 85	1635	1	le	17.7	26	1
287	Willow Bush Low	30 May 85	1700	1	le	17.7	28	1
288	Opposite Lagoon	30 May 85	1710	1	le	17.0	30	2
289	Thirteen Low	30 May 85	1730	1	lf	17.8	28	1
290	Two Stake Point	30 May 85	1750	1	lf	18.1	28	1
291	Snag Point	30 May 85	1800	1	lf	17.4	30	1
292	South-33	30 May 85	1810	1	lf	17.5	30	1
293	Lagoon	30 May 85	1830	1	lf	17.5	28	1
294	One Low	6 Jun 85	1030	1	le	15.2	26	1
295	One Low	6 Jun 85	1045	1	le	15.2	26	1
296	Two Low	6 Jun 85	1100	1	le	15.6	25	1
297	Willow Bush Low	6 Jun 85	1130	2	le	16.1	24	1
298	Opposite Lagoon	6 Jun 85	1145	1	le	16.5	25	1
299	Thirteen Low	6 Jun 85	1223	1	ls	16.8	24	1
300	South-33	6 Jun 85	1242	1	lf	16.7	25	1
301	Snag Point	6 Jun 85	1255	1	lf	16.9	25	1
302	Two Stake Point	6 Jun 85	1304	1	lf	16.9	24	1
303	One High	6 Jun 85	1613	1	hf	15.6	25	1
304	One High	6 Jun 85	1628	1	hf	15.6	25	1
305	Two High	6 Jun 85	1645	1	hf	15.2	25	1

Table 2. (continued)

Haul	Station	Date	Time	Perf	Tide	Temp (C)	Salinity (ppt)	Turbidity
306	Three High	6 Jun 85	1700	1	hf	15.1	26	2
307	Four High	6 Jun 85	1725	1	hs	15.8	24	2
308	Picnic Point	6 Jun 85	1750	1	hs	16.4	21	2
309	West-South 1	6 Jun 85	1810	1	he	16.4	23	2
310	Mud Paradise	6 Jun 85	1810	1	he	15.9	25	2
311	Willow Bush High	6 Jun 85	1845	2	he	16.0	30	2
312	One Low	21 Jun 85	915	1	le	11.7	33	1
313	One Low	21 Jun 85	930	1	le	11.7	33	1
314	Two Low	21 Jun 85	945	1	le	14.4	32	1
315	Willow Bush Low	21 Jun 85	1015	2	le	16.8	30	1
316	Opposite Lagoon	21 Jun 85	1035	2	le	17.6	30	1
317	Thirteen Low	21 Jun 85	1050	1	ls	18.2	30	1
318	South-33	21 Jun 85	1125	1	le	18.6	31	1
319	Snag Point	21 Jun 85	1140	1	le	18.9	31	1
320	Two Stake Point	21 Jun 85	1200	1	ls	18.8	30	1
321	One High	21 Jun 85	1615	1	hf	10.9	33	1
322	One High	21 Jun 85	1625	1	hf	10.9	-	1
323	Two High	21 Jun 85	1640	1	hf	14.7	32	1
324	Three High	21 Jun 85	1700	1	hf	15.5	26	1
325	Willow Bush Low	21 Jun 85	1740	1	hs	21.5	31	1
326	One Low	3 Jul 85	915	1	le	15.1	33	1
327	One Low	3 Jul 85	930	1	le	15.1	33	1
328	Two Low	3 Jul 85	945	1	le	17.2	35	1
329	One High	3 Jul 85	1455	1	hf	16.0	35	1
330	One High	3 Jul 85	1515	1	hf	16.0	35	1
331	Two High	3 Jul 85	1535	1	hs	18.6	32	1

Table 3. Mean water temperature (C) from high and low tide stations in the upper bay.

Date	High Tide Stations			Low Tide Stations		
	Water temp	Std dev	Number	Water temp	Std dev	Number
25 Feb 85	--	--	-	10.8	0.29	3
3-4 Mar 85	8.3	0.46	8	8.8	0.45	5
10 Mar 85	12.6	0.95	7	11.2	0.81	7
17 Mar 85	9.4	0.23	8	11.2	0.20	6
24-25 Mar 85	10.3	0.42	6	9.2	0.65	8
4 Apr 85	13.9	0.45	7	12.9	0.24	5
12-13 Apr 85	11.3	0.41	7	17.0	0.69	7
18 Apr 85	13.5	0.54	7	11.2	0.19	7
22-23 Apr 85	11.8	1.49	9	10.4	0.59	11
3-4 May 85	14.4	0.47	8	11.0	0.15	7
7-8 May 85	19.6	1.10	7	15.7	0.84	7
15-17 May 85	22.8	0.89	4	15.0	0.33	6
21-22 May 85	23.1	4.46	2	17.5	1.02	7
30 May 85	15.7	1.04	4	17.6	0.35	7
6 Jun 85	16.2	0.26	4	16.7	0.31	6
21 Jun 85	--	--	-	18.6	1.47	7
3 Jul 85	--	--	-	--	--	-

Table 4. Mean water temperature (C) from high and low tide stations in the lower bay.

Date	High Tide Sites			Low Tide sites		
	Water temp	Std dev	Number	Water temp	Std dev	Number
25 Feb 85	--	--	-	--	--	-
3-4 Mar 85	8.3	0.29	4	9.0	0.00	2
10 Mar 85	9.7	0.57	5	9.5	0.00	2
17 Mar 85	10.0	0.37	4	10.8	0.35	2
24-25 Mar 85	9.3	0.45	5	8.4	0.25	4
4 Apr 85	11.9	1.42	4	12.6	0.60	3
12-13 Apr 85	11.3	1.40	7	13.3	0.57	2
18 Apr 85	11.2	0.37	4	10.7	1.10	4
22-23 Apr 85	11.2	0.54	6	9.6	0.27	5
3-4 May 85	12.6	0.58	6	10.6	0.30	4
7-8 May 85	15.0	2.03	5	12.3	1.17	4
15-17 May 85	13.4	3.26	9	12.0	1.87	8
21-22 May 85	15.5	1.47	3	13.2	1.91	2
30 May 85	15.5	1.34	8	--	--	-
6 Jun 85	15.5	0.30	5	15.3	0.23	3
21 Jun 85	13.0	2.45	4	12.6	1.56	3
3 Jul 85	16.9	1.50	3	15.8	1.21	3

Table 5. Number of chum salmon caught at each beach seine station. total: number of fish subsampled from catch; Adj-Total: subsample expanded to represent total fish caught; L-Clip: left ventral fin-clipped fish; R-Clip: right ventral fin-clipped fish; B-clip: both ventral fin-clipped fish.

Haul	Station	Date	Total	L-Clip	R-Clip	B-Clip	Adj-Total
1	Willow Bush Low	25 Feb 85	0	0	0	0	0
2	Opposite Lagoon	25 Feb 85	0	0	0	0	0
3	Two Stake Point	25 Feb 85	0	0	0	0	0
4	Whiskey Creek	3 Mar 85	0	0	0	0	0
5	Picnic Point	3 Mar 85	0	0	0	0	0
6	West-South 1	3 Mar 85	0	0	0	0	0
7	South 1	3 Mar 85	1	0	0	0	1
7a	South 1	3 Mar 85	0	0	0	0	0
8	One Low	3 Mar 85	1	0	0	0	1
9	Two Low	3 Mar 85	0	0	0	0	0
10	Willow Bush Low	3 Mar 85	0	0	0	0	0
11	Opposite Lagoon	3 Mar 85	0	0	0	0	0
12	Thirteen Low	3 Mar 85	0	0	0	0	0
13	Two Stake Point	3 Mar 85	0	0	0	0	0
14	Snag Point	3 Mar 85	0	0	0	0	0
16	One High	4 Mar 85	0	0	0	0	0
17	Two High	4 Mar 85	3	0	0	0	3
18	Three High	4 Mar 85	0	0	0	0	0
19	Four High	4 Mar 85	3	0	0	0	3
20	Unnamed Creek	4 Mar 85	0	0	0	0	0
21	Mud Paradise	4 Mar 85	1	0	0	0	1
22	Willow Bush High	4 Mar 85	1	0	0	0	1
23	Three High	10 Mar 85	0	0	0	0	0
24	One Low	10 Mar 85	0	0	0	0	0
25	Two Low	10 Mar 85	0	0	0	0	0
26	Willow Bush Low	10 Mar 85	0	0	0	0	0
27	Opposite Lagoon	10 Mar 85	0	0	0	0	0
28	Lagoon	10 Mar 85	0	0	0	0	0
29	Thirteen Low	10 Mar 85	1	0	0	0	1
30	Two Stake Point	10 Mar 85	0	0	0	0	0
31	Snag Point	10 Mar 85	0	0	0	0	0
32	South-33	10 Mar 85	0	0	0	0	0
33	Whiskey Creek	10 Mar 85	0	0	0	0	0
34	Picnic Point	10 Mar 85	3	0	0	0	3
35	West-South 1	10 Mar 85	0	0	0	0	0
36	South 1	10 Mar 85	5	0	0	0	5
37	Mud Paradise	10 Mar 85	1	0	0	0	1
38	Willow Bush High	10 Mar 85	0	0	0	0	0
39	Unnamed Creek	10 Mar 85	1	0	0	0	1
40	Four High	10 Mar 85	0	0	0	0	0
41	Three High	10 Mar 85	0	0	0	0	0
42	Two High	10 Mar 85	0	0	0	0	0
43	One High	10 Mar 85	0	0	0	0	0
44	Whiskey Creek	17 Mar 85	3	0	0	0	3

Table 5. (continued)

Haul	Station	Date	Total	L-Clip	R-Clip	B-Clip	Adj-Total
45	Picnic Point	17 Mar 85	0	0	0	0	0
46	West-South 1	17 Mar 85	0	0	0	0	0
47	Picnic Point	17 Mar 85	0	0	0	0	0
48	Mud Paradise	17 Mar 85	3	0	0	0	3
49	Willow Bush High	17 Mar 85	0	0	0	0	0
50	Willow Bush High	17 Mar 85	0	0	0	0	0
51	Unnamed Creek	17 Mar 85	0	0	0	0	0
52	Four High	17 Mar 85	0	0	0	0	0
53	Three High	17 Mar 85	0	0	0	0	0
54	Two High	17 Mar 85	2	0	0	0	2
55	One High	17 Mar 85	2	0	0	0	2
56	One Low	17 Mar 85	0	0	0	0	0
57	Two Low	17 Mar 85	0	0	0	0	0
58	Willow Bush Low	17 Mar 85	1	0	0	0	1
59	Opposite Lagoon	17 Mar 85	0	0	0	0	0
60	Thirteen Low	17 Mar 85	0	0	0	0	0
61	Two Stake Point	17 Mar 85	0	0	0	0	0
62	Snag Point	17 Mar 85	0	0	0	0	0
63	South-33	17 Mar 85	0	0	0	0	0
64	Two Low	24 Mar 85	0	0	0	0	0
65	One Low	24 Mar 85	1	0	0	0	1
66	One Low	24 Mar 85	0	0	0	0	0
67	Three Low	24 Mar 85	1	0	0	0	1
68	Willow Bush Low	24 Mar 85	0	0	0	0	0
69	Opposite Lagoon	24 Mar 85	24	0	0	0	24
70	Thirteen Low	24 Mar 85	12	0	0	0	12
71	Two Stake Point	24 Mar 85	0	0	0	0	0
72	Snag Point	24 Mar 85	1	0	0	0	1
73	Four High	24 Mar 85	4	0	0	0	4
74	Two High	24 Mar 85	6	0	0	0	6
75	Picnic Point	24 Mar 85	16	0	0	0	16
76	West-South 1	24 Mar 85	1	0	0	0	1
77	West-South 1	24 Mar 85	2	0	0	0	2
78	Whiskey Creek	24 Mar 85	4	0	0	0	4
79	Mud Paradise	24 Mar 85	8	0	0	0	8
80	Willow Bush High	24 Mar 85	4	0	0	0	4
81	Three High	24 Mar 85	1	0	0	0	1
82	Two High	24 Mar 85	0	0	0	0	0
83	One High	24 Mar 85	1	0	0	0	1
84	South-33	25 Mar 85	0	0	0	0	0
85	South-33	25 Mar 85	1	0	0	0	1
86	Lagoon	25 Mar 85	0	0	0	0	0
87	One High	4 Apr 85	25	0	0	0	25
88	Four High	4 Apr 85	108	0	0	0	108
89	Picnic Point	4 Apr 85	50	0	0	0	54

Table 5. (continued)

Haul	Station	Date	Total	L-Clip	R-Clip	B-Clip	Adj-Total
90	West-South 1	4 Apr 85	60	0	0	0	82
91	South 1	4 Apr 85	0	0	0	0	0
92	Whiskey Creek	4 Apr 85	34	0	0	0	34
93	Mud Paradise	4 Apr 85	61	0	0	0	61
94	Willow Bush High	4 Apr 85	23	0	0	0	23
95	Unnamed Creek	4 Apr 85	13	0	0	0	13
96	Three High	4 Apr 85	0	0	0	0	0
97	Two High	4 Apr 85	2	0	0	0	2
98	One Low	4 Apr 85	0	0	0	0	0
99	Two Low	4 Apr 85	13	0	0	0	13
100	Three Low	4 Apr 85	0	0	0	0	0
101	Willow Bush Low	4 Apr 85	1	0	0	0	1
102	Opposite Lagoon	4 Apr 85	1	0	0	0	1
103	Thirteen Low	4 Apr 85	1	0	0	0	1
104	South-33	4 Apr 85	0	0	0	0	0
105	Snag Point	4 Apr 85	1	0	0	0	1
106	Picnic Point	12 Apr 85	12	0	0	0	12
107	West-South 1	12 Apr 85	13	0	0	0	13
108	South 1	12 Apr 85	151	0	0	0	189
109	Whiskey Creek	12 Apr 85	7	0	0	0	7
110	Mud Paradise	12 Apr 85	24	0	0	0	24
111	Willow Bush High	12 Apr 85	122	0	0	0	125
112	Three High	12 Apr 85	0	0	0	0	0
113	One High	12 Apr 85	0	0	0	0	0
114	Two High	12 Apr 85	0	0	0	0	0
115	Three High	12 Apr 85	1	0	0	0	1
116	Two High	12 Apr 85	11	0	0	0	11
117	Unnamed Creek	13 Apr 85	16	0	0	0	16
118	Four High	13 Apr 85	22	0	0	0	22
119	One High	13 Apr 85	0	0	0	0	0
120	One High	13 Apr 85	0	0	0	0	0
121	Three High	13 Apr 85	0	0	0	0	0
122	One Low	13 Apr 85	9	0	0	0	9
123	Two Low	13 Apr 85	0	0	0	0	0
124	Willow Bush Low	13 Apr 85	26	0	0	0	26
125	Opposite Lagoon	13 Apr 85	0	0	0	0	0
126	Thirteen Low	13 Apr 85	38	0	0	0	38
127	South-33	13 Apr 85	0	0	0	0	0
128	Snag Point	13 Apr 85	0	0	0	0	0
129	Snag Point	13 Apr 85	55	0	0	0	55
130	Two Stake Point	13 Apr 85	0	0	0	0	0
131	One Low	18 Apr 85	0	0	0	0	0
132	Two Low	18 Apr 85	10	0	0	0	10
133	Three Low	18 Apr 85	4	0	0	0	4
134	Willow Bush Low	18 Apr 85	25	0	0	0	25



Table 5. (continued)

Haul	Station	Date	Total	L-Clip	R-Clip	B-Clip	Adj-Total
135	Opposite Lagoon	18 Apr 85	2	0	0	0	2
136	Lagoon	18 Apr 85	81	0	0	0	81
137	Thirteen Low	18 Apr 85	42	0	0	0	42
138	Two Stake Point	18 Apr 85	0	0	0	0	0
139	Snag Point	18 Apr 85	88	0	0	0	88
140	South-33	18 Apr 85	0	0	0	0	0
141	Willow Bush High	18 Apr 85	24	0	0	0	24
142	Unnamed Creek	18 Apr 85	23	0	0	0	23
143	Picnic Point	18 Apr 85	0	0	0	0	0
144	West-South 1	18 Apr 85	43	0	0	0	43
145	South 1	18 Apr 85	18	0	0	0	18
146	Whiskey Creek	18 Apr 85	30	0	0	0	30
147	Mud Paradise	18 Apr 85	17	0	0	0	17
148	Four High	18 Apr 85	4	0	0	0	4
149	Three High	18 Apr 85	15	0	0	0	15
150	Two Low	18 Apr 85	4	0	0	0	4
151	One High	18 Apr 85	52	0	0	0	52
152	One High	18 Apr 85	4	0	0	0	4
152a	One Low	22 Apr 85	4	0	0	0	4
152b	Two Low	23 Apr 85	0	0	0	0	0
153	Willow Bush Low	22 Apr 85	45	0	3	0	48
154	Opposite Lagoon	22 Apr 85	37	0	1	0	38
155	Thirteen Low	22 Apr 85	0	0	0	0	0
156	South-33	22 Apr 85	216	1	18	0	235
157	Snag Point	22 Apr 85	0	0	0	0	0
158	Two Stake Point	22 Apr 85	0	0	0	0	0
159	Lagoon	22 Apr 85	0	0	0	0	0
160	One High	22 Apr 85	2	0	0	0	2
161	One High	22 Apr 85	0	0	0	0	0
162	Four High	22 Apr 85	518	0	31	3	552
163	Picnic Point	22 Apr 85	27	0	4	1	32
164	West-South 1	22 Apr 85	57	0	6	2	65
165	South 1	22 Apr 85	24	0	8	0	32
166	Whiskey Creek	22 Apr 85	64	0	3	0	67
167	Mud Paradise	22 Apr 85	77	0	10	0	87
168	Willow Bush High	22 Apr 85	465	0	33	1	1223
169	One Low	23 Apr 85	12	0	0	0	12
170	One Low	23 Apr 85	33	0	0	0	33
171	Three Low	23 Apr 85	1	0	0	0	1
172	Willow Bush Low	23 Apr 85	3	0	2	0	5
173	Willow Bush Low	23 Apr 85	11	0	1	0	12
174	South-33	23 Apr 85	1	0	0	0	1
175	South-33	23 Apr 85	0	0	0	0	0
176	Three High	23 Apr 85	209	0	12	0	221
177	Two High	23 Apr 85	0	0	0	0	0

Table 5. (continued)

Haul	Station	Date	Total	L-Clip	R-Clip	B-Clip	Adj-Total
178	Two High	23 Apr 85	7	0	0	0	7
179	West-South 1	23 Apr 85	45	0	2	0	47
180	West-South 1	23 Apr 85	47	0	4	0	51
181	Unnamed Creek	23 Apr 85	138	0	13	2	153
182	Three Low	3 May 85	1	0	0	0	1
183	One Low	3 May 85	653	4	15	3	675
184	One Low	3 May 85	73	0	1	0	74
185	Two Low	3 May 85	32	0	0	0	32
186	Willow Bush Low	3 May 85	0	0	0	0	0
187	Opposite Lagoon	3 May 85	23	2	2	0	27
188	Thirteen Low	3 May 85	61	2	6	0	69
189	Two Stake Point	3 May 85	0	0	0	0	0
190	Snag Point	3 May 85	314	9	10	2	335
191	South-33	3 May 85	149	7	5	0	161
192	South-33	3 May 85	268	0	0	0	268
193	Four High	3 May 85	480	31	18	7	536
194	Picnic Point	3 May 85	7	0	0	0	7
195	Picnic Point	3 May 85	19	0	0	0	19
196	West-South 1	3 May 85	64	2	9	2	77
197	South 1	3 May 85	12	0	0	0	12
198	Whiskey Creek	3 May 85	6	0	0	0	6
199	Mud Paradise	3 May 85	69	7	1	0	77
200	Willow Bush High	3 May 85	124	12	1	1	138
201	Unnamed Creek	3 May 85	6	0	0	0	6
202	South 1	4 May 85	1	0	0	0	1
203	South 1	4 May 85	2	0	0	0	2
204	Whiskey Creek	4 May 85	5	0	0	0	5
205	One High	4 May 85	41	0	1	0	42
206	One High	4 May 85	50	1	2	0	53
207	Three High	4 May 85	14	1	2	0	17
208	Four High	4 May 85	202	6	2	1	211
209	Two High	4 May 85	9	0	0	0	9
210	One Low	7 May 85	779	4	8	0	826
211	Two Low	7 May 85	21	1	1	3	26
212	Willow Bush Low	7 May 85	37	2	0	0	39
212a	Opposite Lagoon	7 May 85	0	0	0	0	0
213	Thirteen Low	7 May 85	103	12	0	0	115
214	South-33	7 May 85	151	7	4	2	164
215	Snag Point	7 May 85	487	25	7	2	521
216	Two Stake Point	7 May 85	171	9	7	2	189
217	Lagoon	7 May 85	48	2	2	0	52
218	Four High	7 May 85	22	2	0	0	24
219	Willow Bush High	7 May 85	2	0	0	0	2
220	Picnic Point	7 May 85	0	0	0	0	0

Table 5. (continued)

Haul	Station	Date	Total	L-Clip	R-Clip	B-Clip	Adj-Total
222	West-South 1	7 May 85	4	0	0	0	4
223	South 1	7 May 85	0	0	0	0	0
224	Whiskey Creek	7 May 85	0	0	0	0	0
225	Mud Paradise	7 May 85	12	3	0	0	15
226	Three Low	8 May 85	0	0	0	0	0
227	Two Low	8 May 85	39	2	1	0	42
228	One High	8 May 85	151	1	3	0	155
229	One High	8 May 85	82	1	1	0	84
230	Three High	8 May 85	3	0	0	1	4
231	Two High	8 May 85	58	2	3	0	63
232	Two Low	15 May 85	99	3	2	0	104
233	Two Low	15 May 85	20	0	0	0	20
234	One Low	15 May 85	23	0	0	1	24
235	One High	15 May 85	15	0	0	0	15
236	One High	15 May 85	4	0	1	0	5
237	One High	15 May 85	8	0	0	0	8
238	One Low	16 May 85	72	3	3	0	78
239	One Low	16 May 85	135	0	1	0	136
240	Two Low	16 May 85	2	0	0	0	2
241	Three Low	16 May 85	0	0	0	0	0
242	Willow Bush Low	16 May 85	2	0	0	0	2
244	Thirteen Low	16 May 85	0	0	0	0	0
245	Two Stake Point	16 May 85	0	0	0	0	0
246	Two Stake Point	16 May 85	7	0	0	0	7
247	South-33	16 May 85	0	0	0	0	0
248	South-33	16 May 85	9	0	0	0	9
249	Lagoon	16 May 85	0	0	0	0	0
250	One Low	16 May 85	156	4	3	0	163
251	One High	16 May 85	13	0	0	0	13
252	Two High	16 May 85	1	0	0	0	1
253	Willow Bush High	16 May 85	0	0	0	0	0
254	Picnic Point	16 May 85	0	0	0	0	0
255	West-South 1	16 May 85	0	0	0	0	0
256	South 1	16 May 85	0	0	0	0	0
257	One High	16 May 85	319	8	1	1	329
258	One High	17 May 85	22	1	0	0	23
259	Three High	17 May 85	4	1	0	0	5
260	Four High	17 May 85	0	0	0	0	0
261	One Low	21 May 85	305	3	1	1	310
262	Two Low	21 May 85	28	0	1	0	29
263	Willow Bush Low	21 May 85	1	0	0	0	1
264	Thirteen Low	21 May 85	0	0	0	0	0
265	Opposite Lagoon	21 May 85	0	0	0	0	0
266	Snag Point	21 May 85	7	0	0	0	7
267	South-33	21 May 85	4	0	0	0	4

Table 5. (continued)

Haul	Station	Date	Total	L-Clip	R-Clip	B-Clip	Adj-Total
268	Two Stake Point	21 May 85	3	0	0	0	3
269	Lagoon	21 May 85	1	0	0	0	1
270	One High	22 May 85	26	1	1	0	28
271	Two High	22 May 85	0	0	0	0	0
272	Three High	22 May 85	1	0	0	0	1
273	Willow Bush High	22 May 85	0	0	0	0	0
274	South 1	22 May 85	0	0	0	0	0
275	One High	30 May 85	14	0	0	0	14
276	One High	30 May 85	2	0	0	0	2
277	Two High	30 May 85	3	0	0	0	3
278	Three High	30 May 85	1	0	0	0	1
279	Willow Bush High	30 May 85	1	0	0	0	1
280	Mud Paradise	30 May 85	0	0	0	0	0
281	South 1	30 May 85	0	0	0	0	0
282	West-South 1	30 May 85	0	0	0	0	0
283	One High	30 May 85	7	0	0	0	7
284	One High	30 May 85	1	0	0	0	1
285	Two High	30 May 85	0	0	0	0	0
286	Three High	30 May 85	0	0	0	0	0
287	Willow Bush Low	30 May 85	0	0	0	0	0
288	Opposite Lagoon	30 May 85	0	0	0	0	0
289	Thirteen Low	30 May 85	0	0	0	0	0
290	Two Stake Point	30 May 85	1	0	0	0	1
291	Snag Point	30 May 85	0	0	0	0	0
292	South-33	30 May 85	0	0	0	0	0
293	Lagoon	30 May 85	0	0	0	0	0
294	One Low	6 Jun 85	0	0	0	0	0
295	One Low	6 Jun 85	0	0	0	0	0
296	Two Low	6 Jun 85	0	0	0	0	0
297	Willow Bush Low	6 Jun 85	0	0	0	0	0
298	Opposite Lagoon	6 Jun 85	0	0	0	0	0
299	Thirteen Low	6 Jun 85	0	0	0	0	0
300	South-33	6 Jun 85	14	0	0	0	14
301	Snag Point	6 Jun 85	0	0	0	0	0
302	Two Stake Point	6 Jun 85	0	0	0	0	0
303	One High	6 Jun 85	5	0	0	0	5
304	One High	6 Jun 85	3	0	0	0	3
305	Two High	6 Jun 85	0	0	0	0	0
306	Three High	6 Jun 85	0	0	0	0	0
307	Four High	6 Jun 85	0	0	0	0	0
308	Picnic Point	6 Jun 85	0	0	0	0	0
309	West-South 1	6 Jun 85	0	0	0	0	0
310	Mud Paradise	6 Jun 85	0	0	0	0	0
311	Willow Bush High	6 Jun 85	0	0	0	0	0
312	One Low	21 Jun 85	3	0	0	0	3

Table 5. (continued)

Haul	Station	Date	Total	L-Clip	R-Clip	B-Clip	Adj-Total
313	One Low	21 Jun 85	0	0	0	0	0
314	Two Low	21 Jun 85	0	0	0	0	0
315	Willow Bush Low	21 Jun 85	0	0	0	0	0
316	Opposite Lagoon	21 Jun 85	0	0	0	0	0
317	Thirteen Low	21 Jun 85	0	0	0	0	0
318	South-33	21 Jun 85	0	0	0	0	0
319	Snag Point	21 Jun 85	0	0	0	0	0
320	Two Stake Point	21 Jun 85	0	0	0	0	0
321	One High	21 Jun 85	0	0	0	0	0
322	One High	21 Jun 85	0	0	0	0	0
323	Two High	21 Jun 85	0	0	0	0	0
324	Three High	21 Jun 85	0	0	0	0	0
325	Willow Bush Low	21 Jun 85	0	0	0	0	0
326	One Low	3 Jul 85	0	0	0	0	0
327	One Low	3 Jul 85	0	0	0	0	0
328	Two Low	3 Jul 85	0	0	0	0	0
329	One High	3 Jul 85	0	0	0	0	0
330	One High	3 Jul 85	0	0	0	0	0
331	Two High	3 Jul 85	0	0	0	0	0

Table 6. Mean number and standard deviation of chum salmon per beach seine set, all stations combined.

Date	Mean num/ set	Num hauls	Std dev
25 Feb 85	0.00	3	0.00
3-4 Mar 85	0.53	19	0.96
10 Mar 85	0.52	21	1.25
17 Mar 85	0.55	20	1.05
24-25 Mar 85	3.78	23	6.05
4 Apr 85	22.05	19	32.01
12-13 Apr 85	21.92	25	43.95
18 Apr 85	22.09	22	25.38
22-23 Apr 85	94.42	31	236.56
3-4 May 85	102.14	28	167.09
7-8 May 85	101.09	23	195.06
15-17 May 85	34.63	27	73.35
21-22 May 85	27.43	14	81.93
30 May 85	1.58	19	3.45
6 Jun 85	1.22	18	3.46
21 Jun 85	0.21	14	0.80
3 Jul 85	0.00	6	0.00

Table 7. Number of chum salmon taken from repeated beach seine hauls. Adj-Total: estimated number of chum salmon from beach seine catch.

Haul Station	Date	Time	Adj-Total
A7 South 1	3 Mar 85	1130	0
7 South 1	3 Mar 85	1140	1
49 Willow Bush High	17 Mar 85	1100	0
50 Willow Bush High	17 Mar 85	1110	0
65 One Low	24 Mar 85	1010	1
66 One Low	24 Mar 85	1025	0
76 West-South 1	24 Mar 85	1545	1
77 West-South 1	24 Mar 85	1555	2
84 South-33	25 Mar 85	1125	0
85 South-33	25 Mar 85	1130	1
119 One High	13 Apr 85	830	0
120 One High	13 Apr 85	845	0
128 Snag Point	13 Apr 85	1503	0
129 Snag Point	13 Apr 85	1515	55
151 One High	18 Apr 85	1400	52
152 One High	18 Apr 85	1415	4
169 One Low	23 Apr 85	920	12
170 One Low	23 Apr 85	940	33
172 Willow Bush Low	23 Apr 85	1030	5
173 Willow Bush Low	23 Apr 85	1050	12
174 South-33	23 Apr 85	1112	1
175 South-33	23 Apr 85	1130	0
177 Two High	23 Apr 85	1510	0
178 Two High	23 Apr 85	1518	7
179 West-South 1	23 Apr 85	1545	47
180 West-South 1	23 Apr 85	1555	51
183 One Low	3 May 85	710	675
184 One Low	3 May 85	735	74
191 South-33	3 May 85	940	161
192 South-33	3 May 85	1000	268

Table 7. (continued)

Haul Station	Date	Time	Adj-Total
194 Picnic Point	3 May 85	1300	7
195 Picnic Point	3 May 85	1315	19
202 South 1	4 May 85	30	1
203 South 1	4 May 85	45	2
220 Picnic Point	7 May 85	1640	0
221 Picnic Point	7 May 85	1650	0
228 One High	8 May 85	1540	155
229 One High	8 May 85	1600	84
232 Two Low	15 May 85	1715	104
233 Two Low	15 May 85	1730	20
236 One High	15 May 85	2320	5
237 One High	15 May 85	2350	8
247 South-33	16 May 85	740	0
248 South-33	16 May 85	750	9
275 One High	30 May 85	1000	14
276 One High	30 May 85	1015	2
283 One High	30 May 85	1545	7
284 One High	30 May 85	1550	1
294 One Low	6 Jun 85	1030	0
295 One Low	6 Jun 85	1045	0
303 One High	6 Jun 85	1613	5
304 One High	6 Jun 85	1628	3
312 One Low	21 Jun 85	915	3
313 One Low	21 Jun 85	930	0
321 One High	21 Jun 85	1615	0
322 One High	21 Jun 85	1625	0
326 One Low	3 Jul 85	915	0
327 One Low	3 Jul 85	930	0
329 One High	3 Jul 85	1455	0
330 One High	3 Jul 85	1515	0



Table 8. Mean number of chum salmon per beach seine set for high and low tide stations. Asterisks indicate significance at  $P < 0.05$ .

Date	High Tide Stations			Low Tide Stations		
	Mean num/ set	Num hauls	Std dev	Mean num/ set	Num hauls	Std dev
25 Feb 85	--	-	--	0.00	3	0.00
3-4 Mar 85	0.75	12	1.14	0.14	7	0.38
10 Mar 85	0.83	12	1.59	0.11	9	0.33
17 Mar 85	0.83	12	1.27	0.12	8	0.35
24-25 Mar 85	4.27*	11	4.58	3.33	12	7.33
4 Apr 85	36.55*	11	35.80	2.12	8	4.42
12-13 Apr 85	26.25	16	52.99	14.22	9	20.63
18 Apr 85	20.91	11	16.18	23.27	11	32.97
22-23 Apr 85	169.27*	15	323.61	24.31	16	58.27
3-4 May 85	71.65	17	132.54	149.27	11	207.97
7-8 May 85	29.25	12	48.26	179.45*	11	261.15
15-17 May 85	30.69	13	89.92	38.29	14	57.16
21-22 May 85	5.80	5	12.42	39.44	9	101.87
30 May 85	2.42	12	4.17	0.14	7	0.38
6 Jun 85	0.89	9	1.83	1.56	9	4.67
21 Jun 85	0.00	4	0.00	0.30	10	0.95
3 Jul 85	0.00	3	0.00	0.00	3	0.00

Table 9. Mean number of chum salmon per beach seine set for high and low tide stations in upper bay. Asterisks indicate significance at  $P < 0.05$ .

Date	High Tide Stations			Low Tide Stations		
	Mean num/ set	Num hauls	Std dev	Mean num/ set	Num hauls	Std dev
25 Feb 85	--	-	--	0.00	3	0.00
3-4 Mar 85	0.38	8	0.52	0.00	5	0.00
10 Mar 85	1.43	7	1.90	0.14	7	0.38
17 Mar 85	0.75	8	1.39	0.17	6	0.41
24-25 Mar 85	5.83	6	5.53	4.75	8	8.80
4 Apr 85	38.14*	7	28.96	0.80	5	0.45
12-13 Apr 85	55.14	7	72.17	17.00	7	22.81
18 Apr 85	22.14	7	13.13	34.00	7	37.87
22-23 Apr 85	195.22*	9	387.18	30.82	11	69.78
3-4 May 85	31.82	11	45.19	122.86	7	135.28
7-8 May 85	3.00	7	5.51	154.29*	7	175.54
15-17 May 85	0.00	4	0.00	1.50	6	2.81
21-22 May 85	0.00	2	0.00	2.29	7	2.56
30 May 85	0.25	4	0.50	0.14	7	0.38
6 Jun 85	0.00	4	0.00	2.33	6	5.72
21 Jun 85	--	-	--	0.00	7	0.00
3 Jul 85	--	-	--	--	-	--

Table 10. Mean number of chum salmon per beach seine set for high and low tide stations in lower bay. Asterisks indicate significance at  $P < 0.05$ .

Date	High Tide Stations				Low Tide Stations			
	Mean num/ set	Num hauls	Std dev	Std dev	Mean num/ set	Num hauls	Std dev	Std dev
25 Feb 85	--	-	--	--	--	-	--	--
3-4 Mar 85	1.50	4	1.73	1.73	0.50	2	0.71	0.71
10 Mar 85	0.00	5	0.00	0.00	0.00	2	0.00	0.00
17 Mar 85	1.00	4	1.15	1.15	0.00	2	0.00	0.00
24-25 Mar 85	2.40	5	2.51	2.51	0.50	4	0.58	0.58
4 Apr 85	33.75	4	50.78	50.78	4.33	3	7.51	7.51
12-13 Apr 85	3.78	9	7.73	7.73	4.50	2	6.36	6.36
18 Apr 85	18.75	4	22.77	22.77	4.50	4	4.12	4.12
22-23 Apr 85	130.33	6	224.36	224.36	10.00	5	13.69	13.69
3-4 May 85	144.67	6	205.52	205.52	195.50	4	321.06	321.06
7-8 May 85	66.00	5	58.87	58.87	223.50	4	402.04	402.04
15-17 May 85	44.33	9	107.00	107.00	65.88	8	63.50	63.50
21-22 May 85	9.67	3	15.89	15.89	169.50	2	198.70	198.70
30 May 85	3.50	8	4.81	4.81	--	-	--	--
6 Jun 85	1.60	5	2.30	2.30	0.00	3	0.00	0.00
21 Jun 85	0.00	4	0.00	0.00	1.00	3	1.73	1.73
3 Jul 85	0.00	3	0.00	0.00	0.00	3	0.00	0.00

Table 11. Mean number of chum salmon per beach seine set for upper and lower bay stations. Asterisks indicate significance at  $P < 0.05$ .

Date	Upper Bay Stations				Lower Bay Stations			
	Mean num/ set	Num hauls	Std dev	Mean num/ set	Mean num/ set	Num hauls	Std dev	
25 Feb 85	0.00	3	0.00	--	--	--	--	
3-4 Mar 85	0.23	13	0.44	1.17	6	1.47	0.00	
10 Mar 85	0.79	14	1.48	0.00	7	0.00	1.03	
17 Mar 85	0.50	14	1.09	0.67	6	1.03	2.07	
24-25 Mar 85	5.21	14	7.33	1.56	9	2.07	39.44	
4 Apr 85	22.58	12	28.76	21.14	7	39.44	7.20	
12-13 Apr 85	36.07*	14	55.10	3.91	11	7.20	16.95	
18 Apr 85	28.07	14	27.92	11.62	8	16.95	170.86	
22-23 Apr 85	104.80	20	269.67	75.64	11	170.86	241.90	
3-4 May 85	67.22	18	98.72	165.00	10	241.90	263.13	
7-8 May 85	78.64	14	142.82	136.00	9	263.13	87.24	
15-17 May 85	0.90	10	2.23	54.47*	17	87.24	132.89	
21-22 May 85	1.78	9	2.44	73.60	5	132.89	4.81	
30 May 85	0.18	11	0.40	3.50*	8	4.81	1.93	
6 Jun 85	1.40	10	4.43	1.00	8	1.93	1.13	
21 Jun 85	0.00	7	0.00	0.43	7	1.13	0.00	
3 Jul 85	--	--	--	0.00	6	0.00		

Table 12. Mean fork lengths (mm) for upper and lower bay beach seine stations at high tide. Asterisks indicate significance at  $P < 0.05$ .

Date	Upper Bay Stations			Lower Bay Stations		
	Mean length	Std dev	Number	Mean length	Std dev	Number
25 Feb 85	0.00	0.00	0	0.00	0.00	0
3-4 Mar 85	38.50	2.12	2	39.17	2.32	6
10 Mar 85	38.90	1.20	10	0.00	0.00	0
17 Mar 85	44.50*	2.74	6	41.50	1.73	4
24-25 Mar 85	40.74*	2.32	35	39.11	1.76	9
4 Apr 85	41.31	2.17	206	43.09*	4.59	109
12-13 Apr 85	42.38	2.76	345	49.56*	8.66	34
18 Apr 85	43.21	3.90	156	43.85	3.46	79
22-23 Apr 85	54.28	5.11	603	58.59*	8.44	181
3-4 May 85	56.69	7.25	274	57.04	7.87	520
7-8 May 85	58.95	6.45	21	62.44*	6.39	249
15-17 May 85	0.00	0.00	0	65.05	5.55	283
21-22 May 85	0.00	0.00	0	48.00	0.00	1
30 May 85	48.00	0.00	1	62.00	5.28	27
6 Jun 85	0.00	0.00	0	63.25	2.92	8
21 Jun 85	0.00	0.00	0	0.00	0.00	0
3 Jul 85	0.00	0.00	0	0.00	0.00	0

Table 13. Mean fork lengths (mm) for upper and lower bay beach seine stations at low tide. Asterisks indicate significance at  $P < 0.05$ .

Date	Upper Bay Stations				Lower Bay Stations			
	Mean length	Std dev	Number	Mean length	Std dev	Number		
25 Feb 85	0.00	0.00	0	0.00	0.00	0		
3-4 Mar 85	0.00	0.00	0	41.00	0.00	1		
10 Mar 85	38.00	0.00	1	0.00	0.00	0		
17 Mar 85	0.00	0.00	0	0.00	0.00	0		
24-25 Mar 85	40.15*	2.18	20	41.26	1.57	23		
4 Apr 85	41.14	2.05	28	44.00*	1.26	6		
12-13 Apr 85	47.61	7.04	119	44.00	3.35	9		
18 Apr 85	46.58	4.73	238	47.07	8.52	14		
22-23 Apr 85	51.86*	6.61	326	46.54	6.39	52		
3-4 May 85	60.71*	4.86	294	56.56	9.27	252		
7-8 May 85	58.42*	5.26	812	54.03	8.58	299		
15-17 May 85	53.11	6.17	18	61.11*	7.59	281		
21-22 May 85	58.38	5.99	48	60.50*	5.86	105		
30 May 85	70.00	0.00	1	59.00	0.00	1		
6 Jun 85	60.57	6.11	14	0.00	0.00	0		
21 Jun 85	0.00	0.00	0	67.33	4.51	3		
3 Jul 85	0.00	0.00	0	0.00	0.00	0		

Table 14. Mean fork lengths (mm) for high and low tide beach seine stations in the upper bay. Asterisks indicate significance at  $P < 0.05$ .

Date	High Tide Stations			Low Tide Stations		
	Mean length	Std dev	Number	Mean length	Std dev	Number
25 Feb 85	0.00	0.00	0	0.00	0.00	0
3-4 Mar 85	38.50	2.12	2	0.00	0.00	0
10 Mar 85	38.90	1.20	10	38.00	0.00	1
17 Mar 85	44.50	2.74	6	0.00	0.00	0
24-25 Mar 85	40.74	2.32	35	40.15	2.18	20
4 Apr 85	41.31	2.17	206	41.14	2.05	28
12-13 Apr 85	42.38	2.76	345	47.61*	7.04	119
18 Apr 85	43.21	3.90	156	46.58*	4.73	238
22-23 Apr 85	54.28*	5.11	603	51.86	6.61	326
3-4 May 85	56.69	7.25	274	60.71*	4.86	294
7-8 May 85	58.95	6.45	21	58.42	5.26	812
15-17 May 85	0.00	0.00	0	53.11	6.17	18
21-22 May 85	0.00	0.00	0	58.38	5.99	48
30 May 85	48.00	0.00	1	70.00	0.00	1
6 Jun 85	0.00	0.00	0	60.57	6.11	14
21 Jun 85	0.00	0.00	0	0.00	0.00	0
3 Jul 85	0.00	0.00	0	0.00	0.00	0

Table 15. Mean fork lengths (mm) for high and low tide beach seine stations in the lower bay. Asterisks indicate significance at  $P < 0.05$ .

Date	High Tide Stations				Low Tide Stations			
	Mean length	Std dev	Number		Mean length	Std dev	Number	
25 Feb 85	0.00	0.00	0		0.00	0.00	0	
3-4 Mar 85	39.17	2.32	6		41.00	0.00	1	
10 Mar 85	0.00	0.00	0		0.00	0.00	0	
17 Mar 85	41.50	1.73	4		0.00	0.00	0	
24-25 Mar 85	39.11	1.76	9		41.26*	1.57	23	
4 Apr 85	43.09	4.59	109		44.00	1.26	6	
12-13 Apr 85	49.56*	8.66	34		44.00	3.35	9	
18 Apr 85	43.85	3.46	79		47.07*	8.52	14	
22-23 Apr 85	58.59*	8.44	181		46.54	6.39	52	
3-4 May 85	57.04	7.87	520		56.56	9.27	252	
7-8 May 85	62.44*	6.39	249		54.03	8.58	299	
15-17 May 85	65.05*	5.55	283		61.11	7.59	281	
21-22 May 85	48.00	0.00	1		60.50	5.86	105	
30 May 85	62.00	5.28	27		59.00	0.00	1	
6 Jun 85	63.25	2.92	8		0.00	0.00	0	
21 Jun 85	0.00	0.00	0		67.33	4.51	3	
3 Jul 85	0.00	0.00	0		0.00	0.00	0	



Table 16. Number and mean fork lengths (mm) of chum salmon, and environmental data taken from townet hauls.

Haul	Date	Time start	Duration (minutes)	Salinity	Temp (C)	Direction of tow	Tide	Catch	Mean length
1	25 Mar 85	1430	10	28	9.0	n	hf	0	
2	25 Mar 85	1500	13	29	9.0	n	hf	0	
3	25 Mar 85	1330	7	--	-	s	hf	0	
4	25 Mar 85	1548	15	28	9.0	n	hf	0	
5	11 Apr 85	1820	5	30	11.0	s	hf	0	
6	11 Apr 85	1833	15	--	11.0	n	hf	0	
7	11 Apr 85	1915	7	--	-	s	hf	0	
8	11 Apr 85	1936	9	--	-	n	hs	0	
9	24 Apr 85	1545	8	30	11.0	s	hf	0	
10	24 Apr 85	1600	15	30	11.0	s	hf	0	
11	24 Apr 85	1717	8	--	-	n	hs	0	
12	24 Apr 85	1731	18	--	-	s	he	0	
13	8 May 85	1725	12	30	11.8	s	hf	4	63.5
14	8 May 85	1744	19	--	-	n	hs	1	63.0
15	8 May 85	1821	14	30	12.4	s	hs	4	64.5
16	8 May 85	1855	8	31	11.9	n	he	4	67.8
17	21 May 85	1530	8	32	12.8	s	hf	6	57.5
18	21 May 85	1555	19	31	13.0	n	hf	3	56.3
19	21 May 85	1624	16	30	12.7	s	hf	2	62.5
20	21 May 85	1654	10	30	13.2	n	hs	1	53.0
21	22 May 85	0213	8	30	11.5	s	hf	1	62.0
22	22 May 85	0240	11	30	11.3	n	hs	2	66.5
23	22 May 85	0302	23	30	11.3	s	hs	9	59.7
24	22 May 85	0350	5	30	11.3	n	he	1	53.0
25	5 Jun 85	1620	11	26	14.4	s	hf	0	
26	5 Jun 85	1640	17	25	14.3	n	hs	1	72.0
27	5 Jun 85	1711	21	28	14.9	s	he	0	
28	5 Jun 85	1741	9	27	14.4	n	he	0	
29	20 Jun 85	1558	10	--	10.7	s	hf	0	
30	20 Jun 85	1642	16	--	10.3	n	hs	0	
31	20 Jun 85	1713	17	--	10.4	s	he	0	

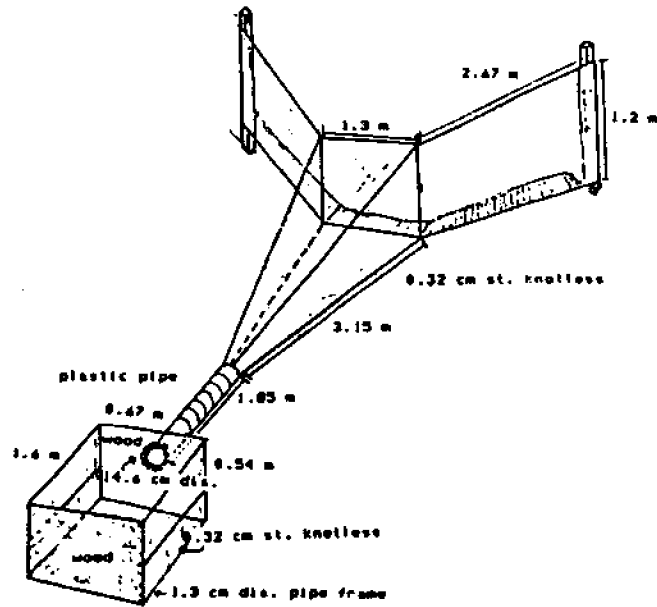
Table 17. Percent occurrence of recaptured marked juvenile chum salmon.  
 L-Clip: left ventral fin-clipped fish. R-Clip: right ventral fin-clipped fish.  
 B-Clip: both ventral fin-clipped fish.

Date	Total Number	L-Clip (% of total)	R-Clip (% of total)	B-Clip (% of total)	Total-Clip (% of total)
25 Feb 85	0	--	--	--	--
3-4 Mar 85	10	--	--	--	--
10 Mar 85	11	--	--	--	--
17 Mar 85	11	--	--	--	--
24-25 Mar 85	86	--	--	--	--
4 Apr 85	393	--	--	--	--
12-13 Apr 85	507	--	--	--	--
18 Apr 85	486	--	--	--	--
22-23 Apr 85	2043	0.05	7.39	0.44	7.88
3-4 May 85	2685	3.13	2.79	0.60	6.52
7-8 May 85	2170	3.36	1.71	0.46	5.53
15-17 May 85	902	2.22	1.22	0.22	3.66
21-22 May 85	376	1.06	0.80	0.27	2.13
30 May 85	30	--	--	--	--
6 Jun 85	22	--	--	--	--
21 Jun 85	3	--	--	--	--

Table 18. Mean fork lengths (mm) of recaptured marked juvenile chum salmon. Right-Clip: right ventral fin-clipped fish. Left-Clip: left ventral fin-clipped fish. Both-Clip: both ventral fin-clipped fish.

Date	Left-Clip			Right-Clip			Both-Clip		
	Mean len	Std dev	Num	Mean len	Std dev	Num	Mean len	Std dev	Num
22-23 Apr 85	49.00	0.00	1	56.21	3.45	151	55.70	2.54	10
3-4 May 85	60.52	3.48	83	60.20	10.71	75	59.31	5.72	16
7-8 May 85	60.96	4.27	81	61.37	4.84	43	59.36	5.26	11
15-17 May 85	67.35	3.07	20	67.64	4.13	11	63.00	0.00	2
21-22 May 85	66.25	3.10	4	69.00	3.61	3	59.00	0.00	1

A



B

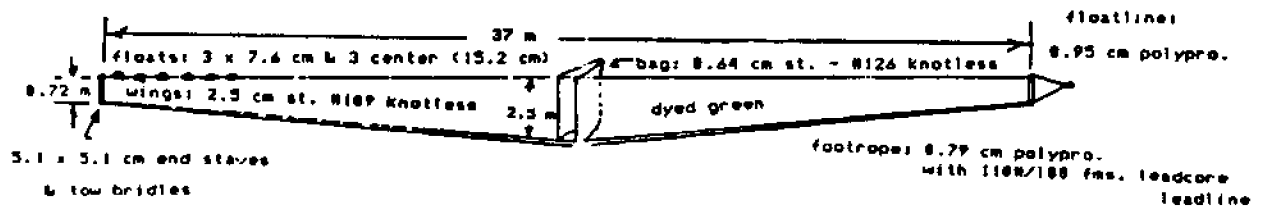


Figure 1. Physical dimensions of the fyke net (A) and beach seine (B).

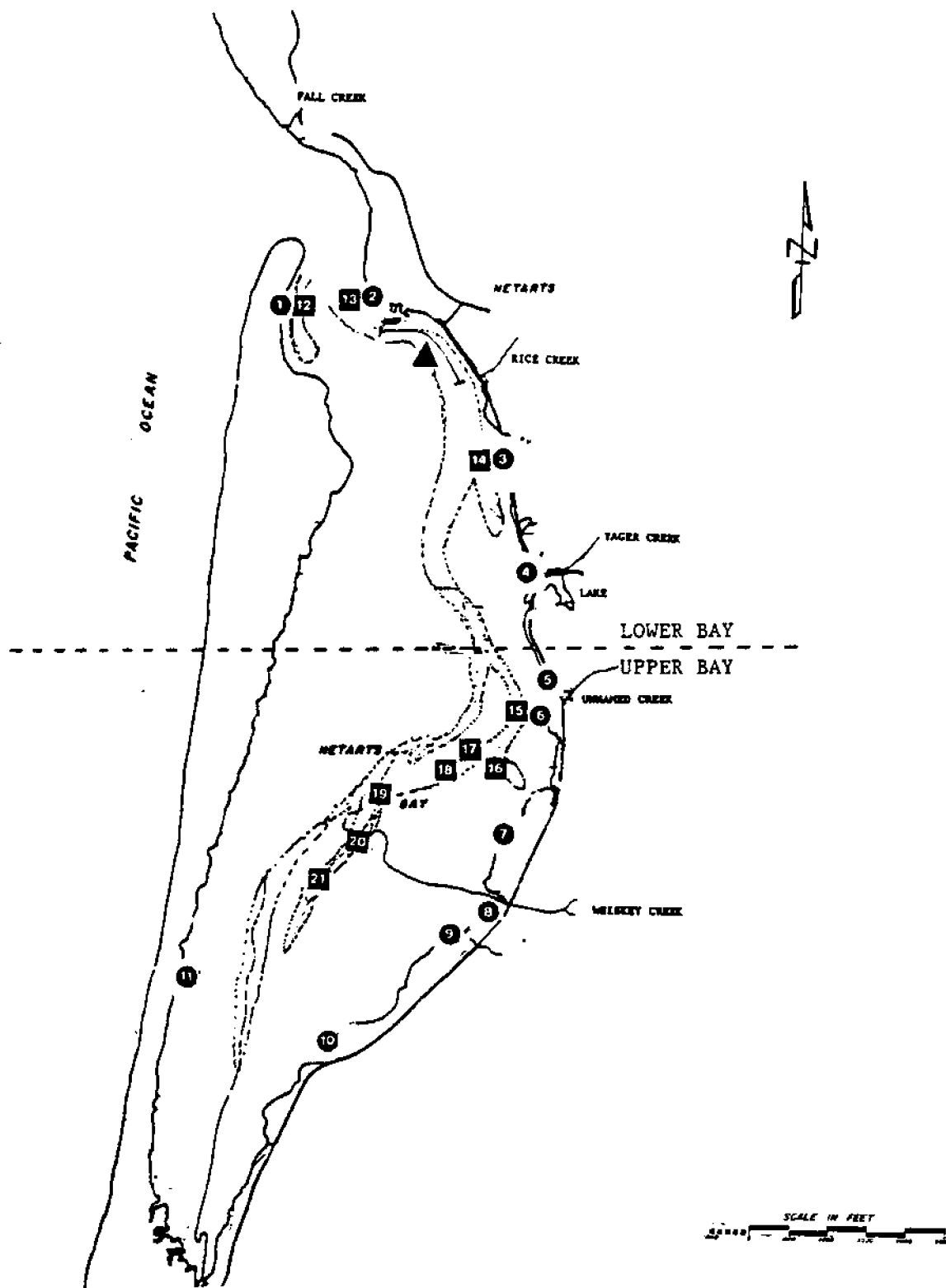


Figure 2. Location of high tide (circles) and low tide (squares) beach seine stations, and tow net transect (triangle).

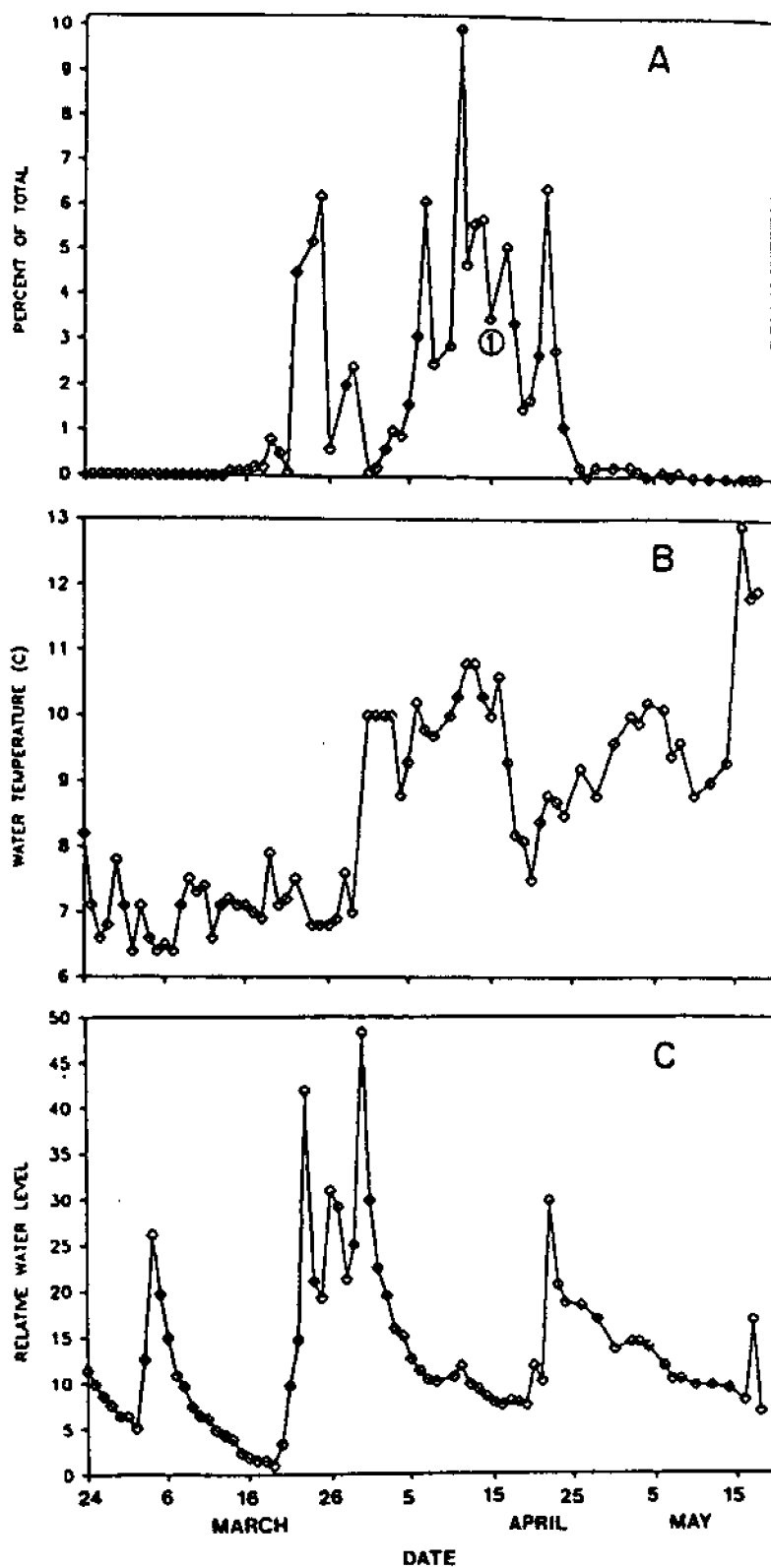


Figure 3. Fyke net catches of chum salmon fry in whiskey Creek (A), water temperature (B) and water level (C).

<sup>1</sup> Underestimated; sample spilled before enumerated.

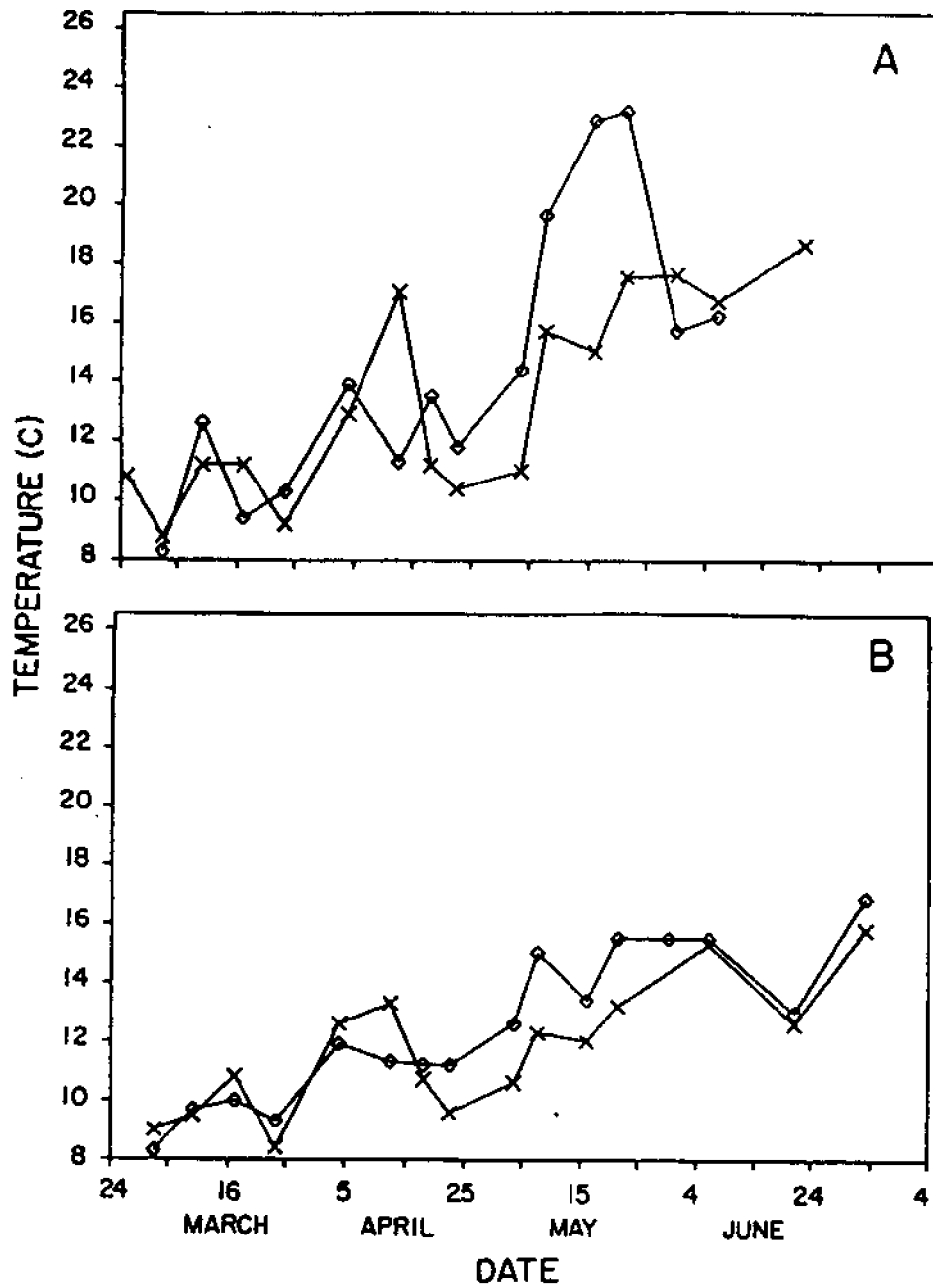


Figure 4. Mean water temperatures from upper bay (A) and lower bay (B) beach seine stations at high tide (diamonds) and low tide (crosses).

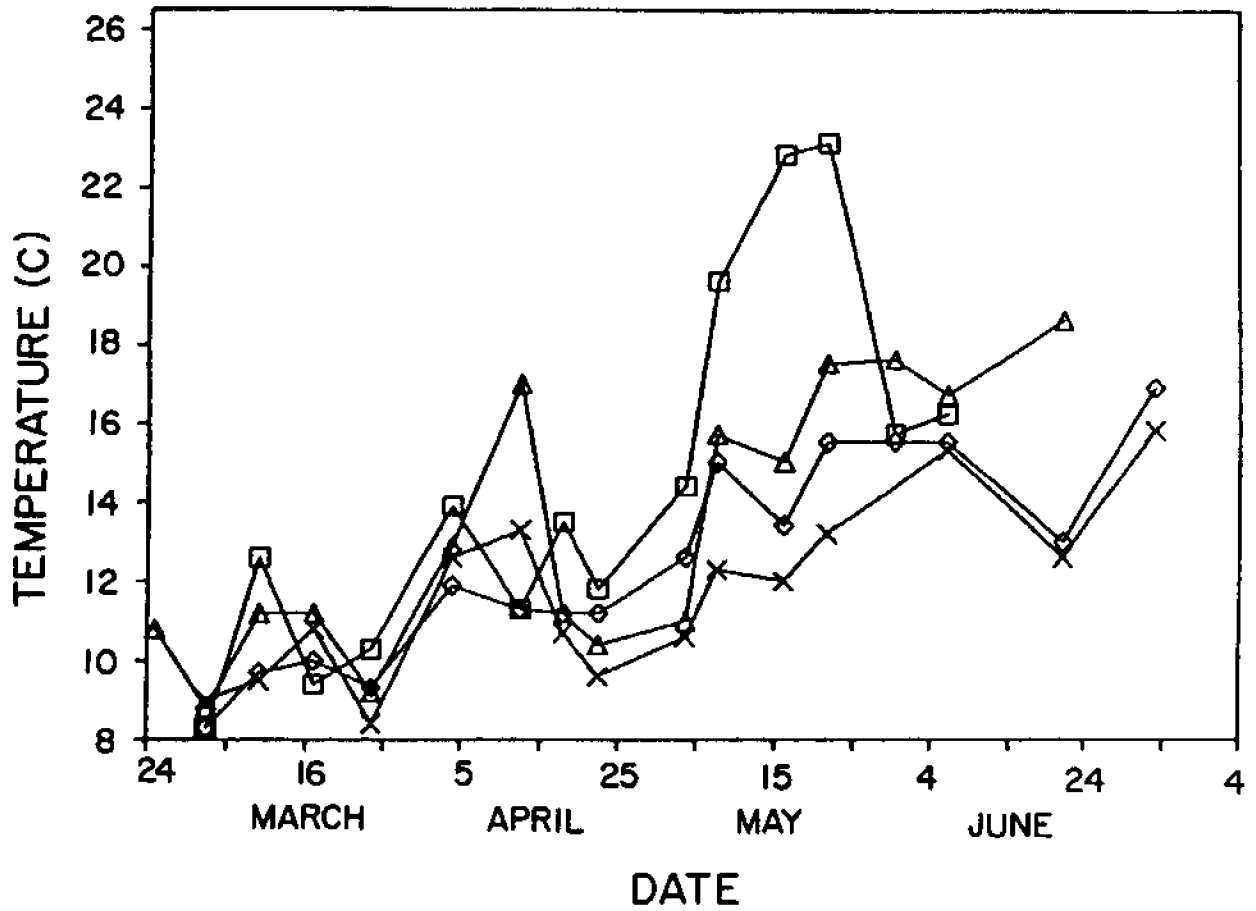


Figure 5. Mean water temperatures from beach seine stations at high tide upper bay (squares), low tide upper bay (triangles), high tide lower bay (diamonds), and low tide lower bay (crosses).



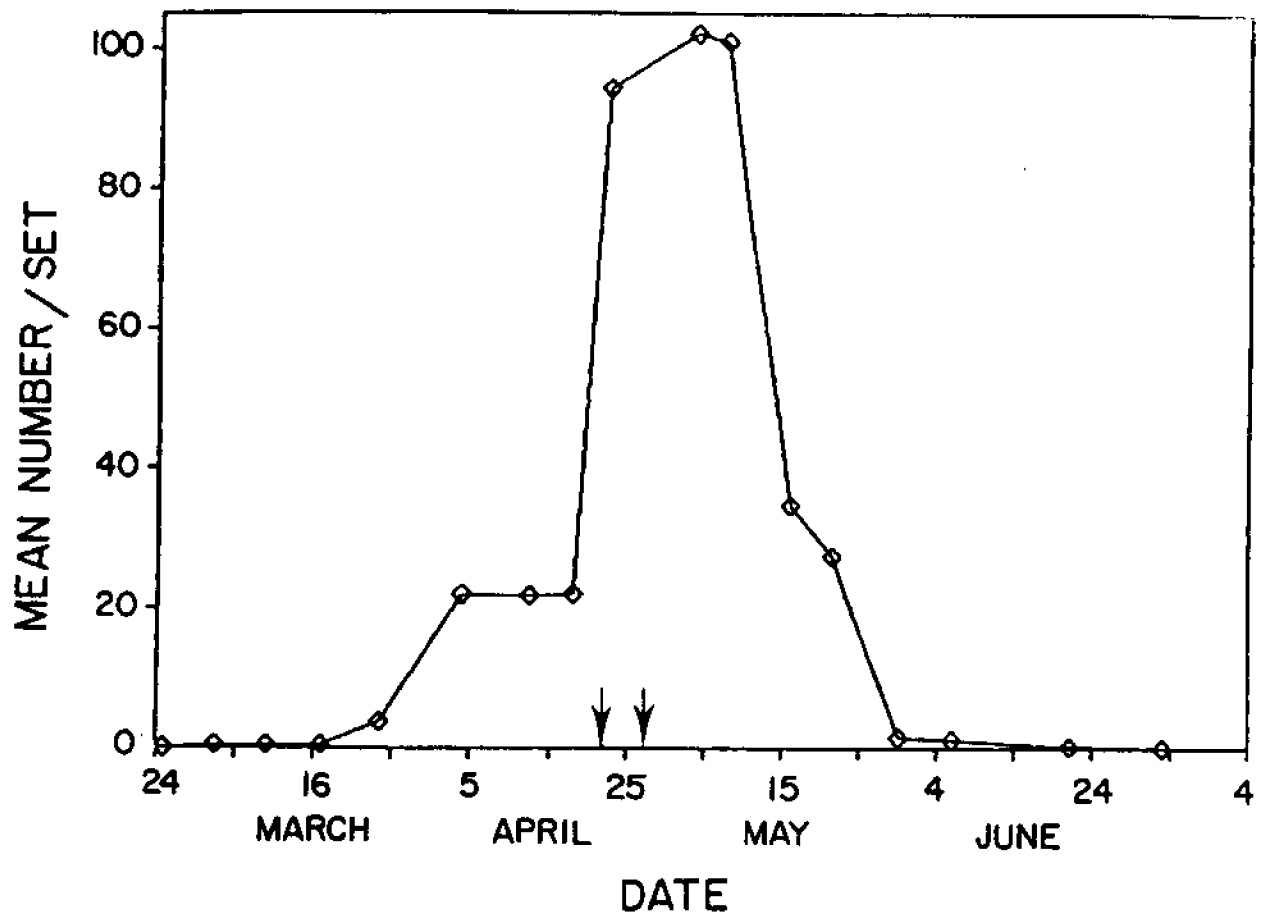


Figure 6. Mean number of chum salmon per beach seine set, all stations combined. Arrows indicate date of first and second hatchery releases.

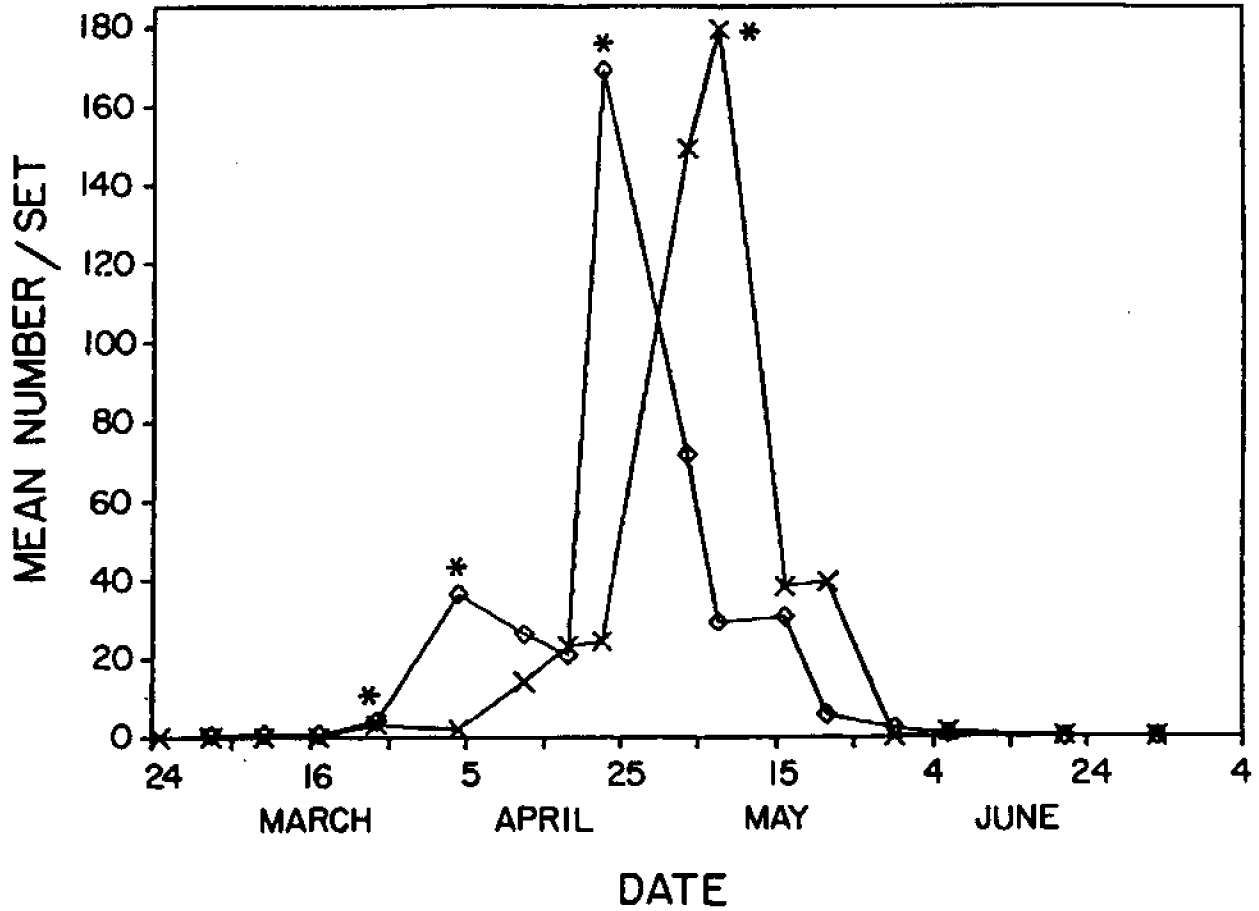


Figure 7. Mean number of chum salmon per beach seine set for all high tide stations (diamonds) and low tide stations (crosses). Asterisks indicate significance at  $P < 0.05$ .

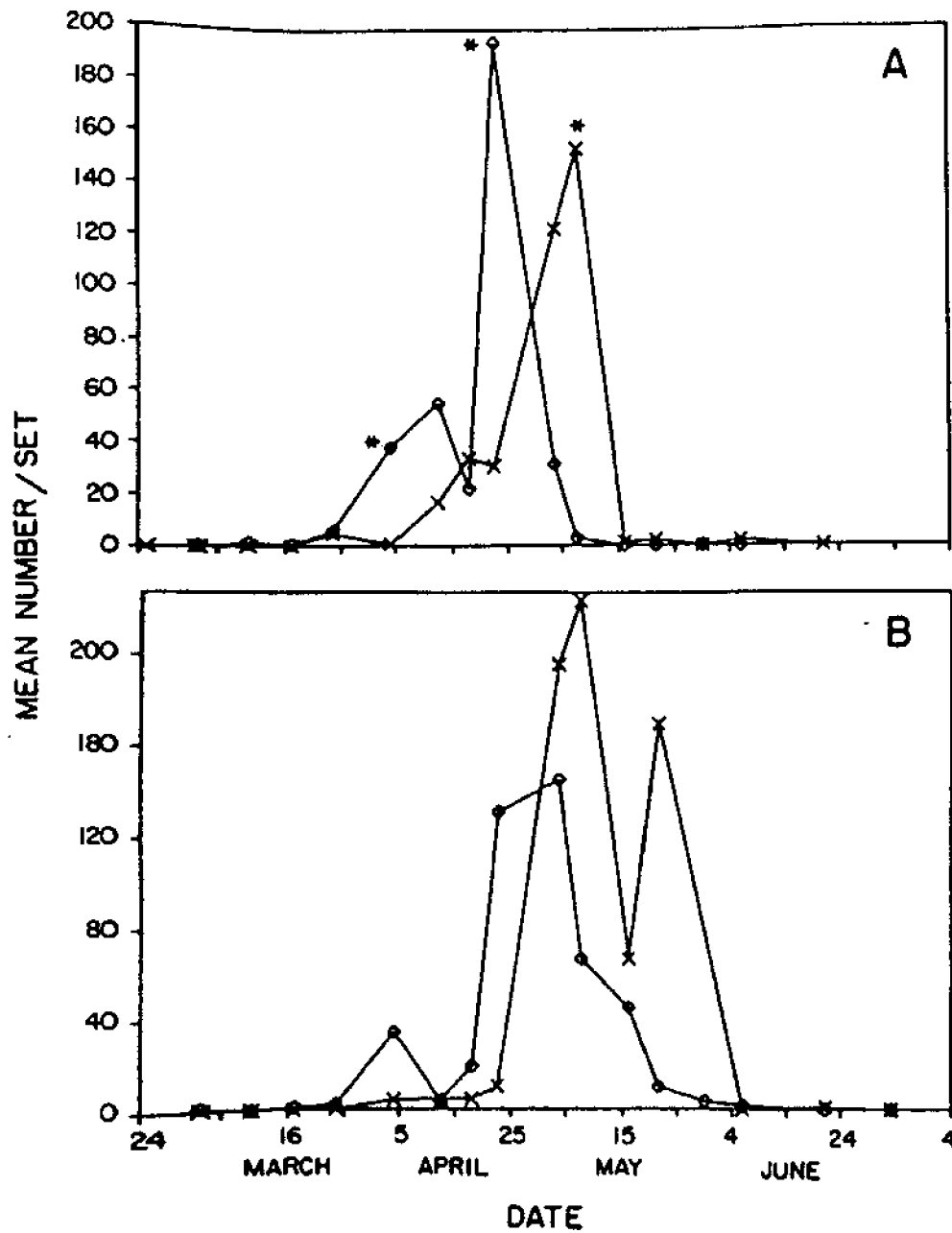


Figure 8. Mean number of chum salmon per beach seine set in the upper (A) and lower bay (B) at high tide stations (diamonds) and low tide stations (crosses). Asterisks indicate significance at  $P < 0.05$ .

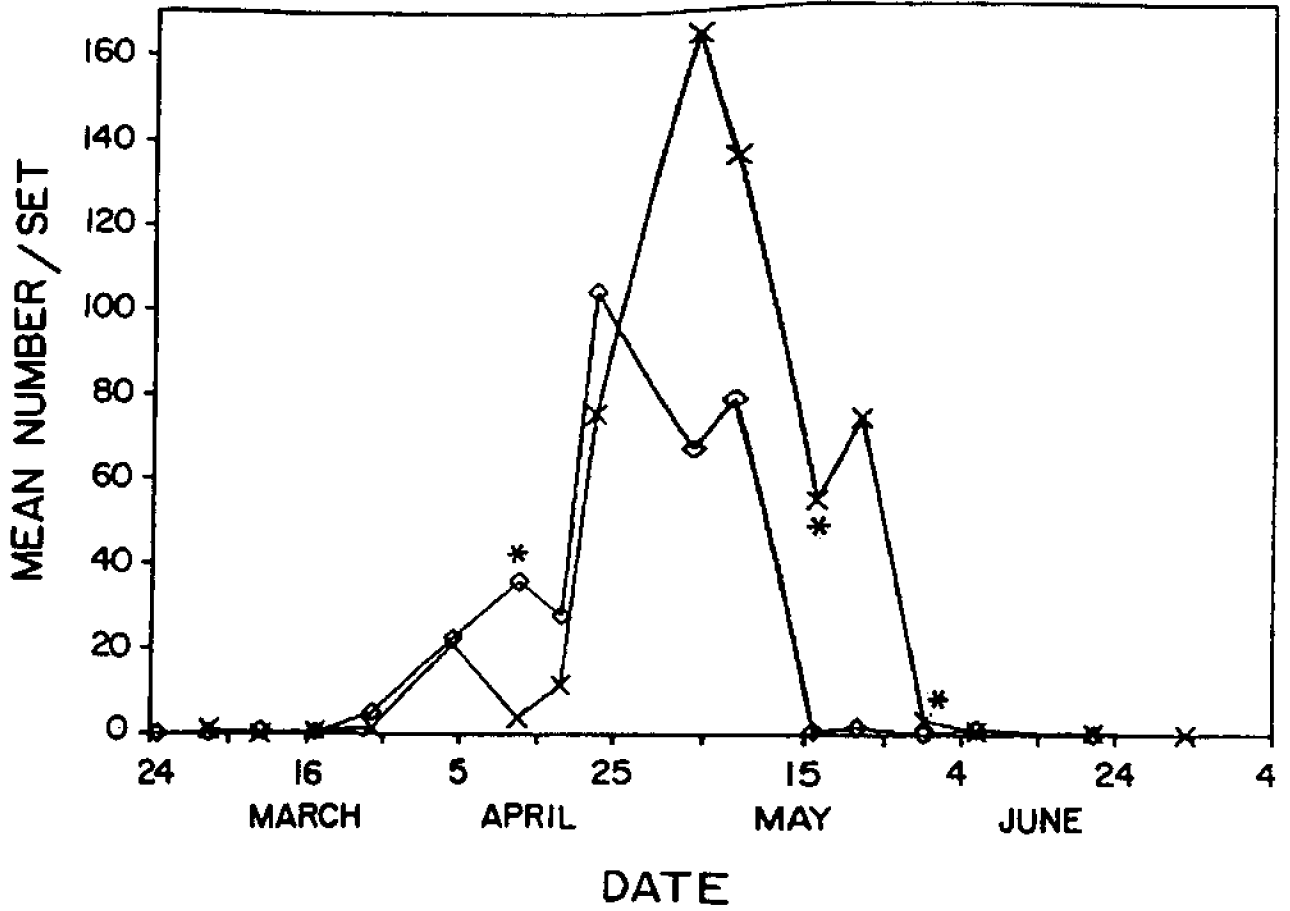


Figure 9. Mean number of chum salmon per beach seine set for all upper bay stations (diamonds) and lower bay stations (crosses). Asterisks indicate significance at  $P < 0.05$ .

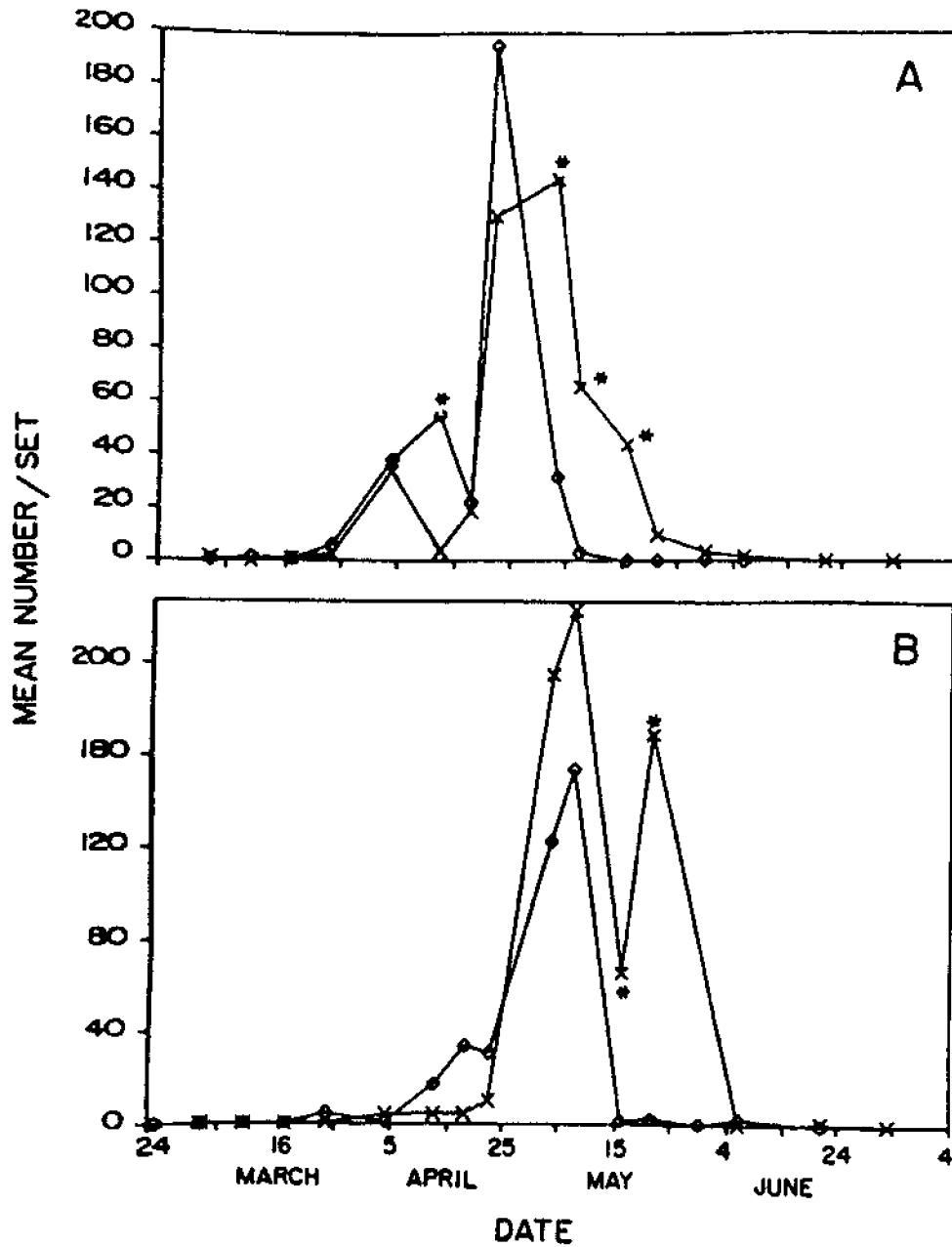


Figure 10. Mean number of chum salmon per beach seine set from upper bay stations (diamonds) and lower bay stations (crosses) at high tide (A) and low tide (B). Asterisks indicate significance at  $P < 0.05$ .

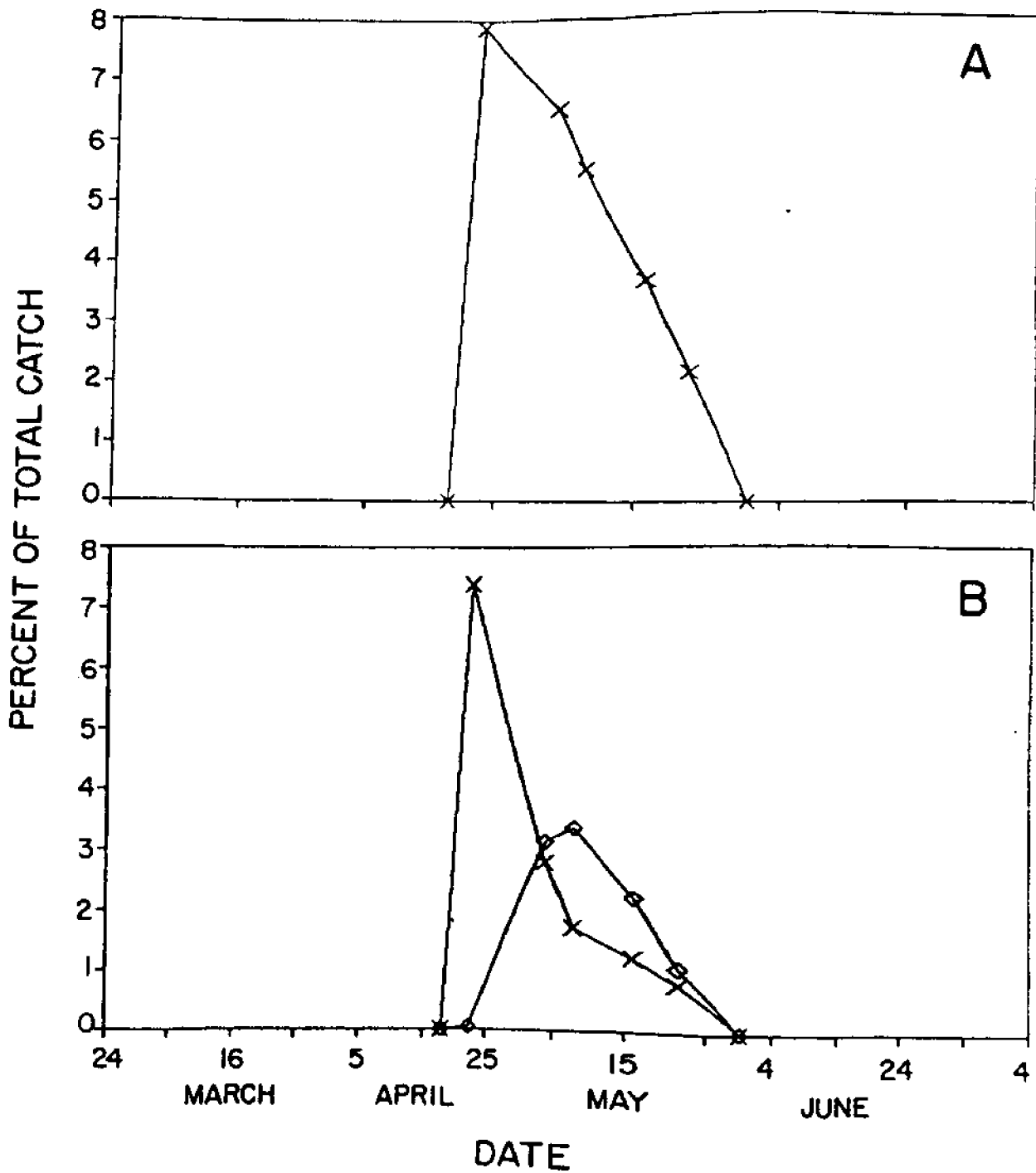


Figure 11. Percent occurrence of all recaptured tagged chum salmon (A), and left ventral fin-clipped fish (diamonds) and right ventral fin-clipped fish (crosses) (B) from all beach seine sets.

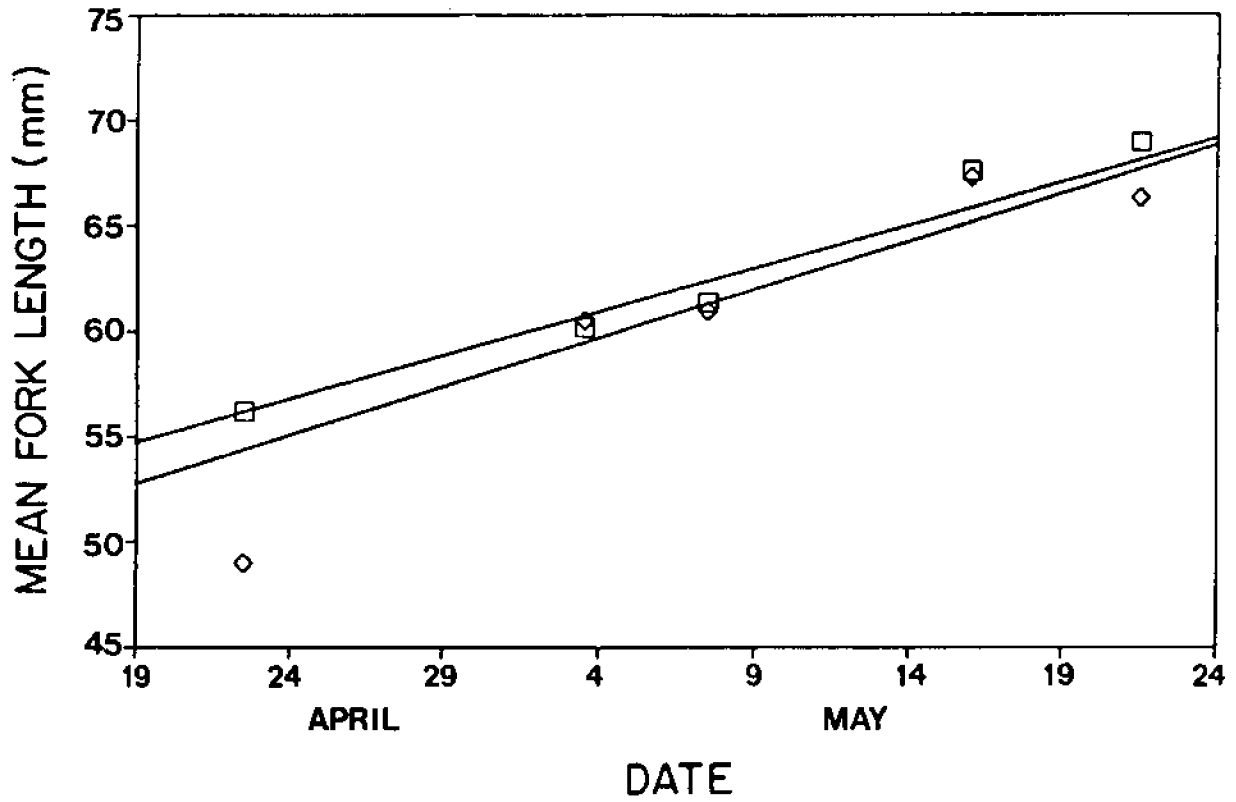


Figure 12. Fitted growth lines and mean fork lengths (mm) for recaptured left ventral fin-clipped fish (diamonds) and right ventral fin-clipped fish (squares) from all beach seine sets.

Appendix 1. Fork lengths (mm) and relationship between juvenile chum salmon measured fresh and after preservation in 10% formalin and 40% isopropanol.

Fresh length (mm)	Preserved length (mm)
38	36,37,37,37,38,37,37,36,37,36
39	37,38,37,37
40	38,38,39,38,39,39,39,38,38,38,39,40,40
41	40,40,40,40,40,39,40,40,40,40,38,38,39,
42	41,41,41,40,40,40,40,40,41,41,40,41,42,41
43	42,42,41,41,42,41,42,41,42,42,42
44	41,42,43,41
45	43,42,42,
46	45,44,45,44,43,46
47	45,46
48	47
49	47
50	50,49,50,49
51	50,50,51,50,51
52	51,50,51
53	53,52,53
54	53,52
55	54,53
56	56,55,55,55,55
57	56,56,58,56,57,56
58	57,57,57,56,57,57,57,58
59	58,59,58
60	58,59,58,60
61	59,60,60,60,60,60,60,61,60,59
62	60,60,62
63	61,61,61
64	61,62,62,63,63,63,62,64,63
65	64,63,63
66	65,65,66
67	65,66,65
68	66

N = 173

0.982 (preserved length) - 2.250 = fresh length

$R^2 = 0.99$



Appendix 2. Fork lengths (mm), weights (g) and relationship between the two, for fresh juvenile chum salmon.

Fresh length (mm)	Fresh weight (g)
36	0.5
37	0.5,0.5,0.4
38	0.5,0.6,0.6,0.6,0.4
39	0.6,0.5,0.6,0.6,0.5,0.5,0.5
40	0.7,0.7,0.7,0.7,0.7,0.7,0.7,0.8,0.6,0.6,
41	0.6,0.6,0.5,0.5,0.5,0.5,0.6,0.5
42	0.7,0.7,0.7,0.7,0.7,0.7,0.6,0.6,0.7,0.6,0.6,0.6
43	0.8,0.7,0.7,0.7,0.8,0.8,0.7,0.7,0.7
44	0.8,0.7,0.8,0.7,0.7,0.9,0.7,0.8,0.7,0.8,0.7
45	0.9,0.8,0.8,0.9,0.8
46	1.1,0.9,0.9,0.9
47	1.1,0.9,1.0,0.9,1.1,0.9
48	0.9,1.0,1.2,0.9
49	--
50	1.0
51	1.2,1.2,1.2,1.1,1.1
52	1.4,1.2,1.2,1.2,1.2
53	1.3,1.5,1.1
54	1.6,1.4,1.3
55	1.5,1.4
56	1.5,1.6
57	1.6,1.7,1.6,1.6,1.6
58	1.8,1.7,1.6,1.5,2.1,2.0
59	1.7,1.7,1.9,1.7,1.9,1.9,1.6,1.9
60	2.1,2.0,1.8
61	2.1,1.9,2.0,2.2
62	1.9,2.0,2.0,2.0,1.7,1.9,2.2,2.0,1.8,2.1
63	2.4,2.1,2.1
64	2.2,2.2,2.3
65	2.5,2.4,2.3,2.5,2.3,2.4,2.5,1.9,1.8
66	2.6,2.5,2.4
67	2.8,2.6,1.5
	2.8,2.3,2.6

N = 166

$\ln(\text{weight}) = 2.82 [\ln(\text{length})] - 10.87$

$R^2 = 0.96$