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Estimation of Total Chinook Mortality Associated with Seine Fishing in Johnstone Strait and Juan de Fuca Strait During 1989

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ESTIMATION OF TOTAL CHINOOK MORTALITY ASSOCIATED WITH SEINE FISHING IN JOHNSTONE STRAIT AND JUAN DE FUCA STRAIT DURING 1989

by

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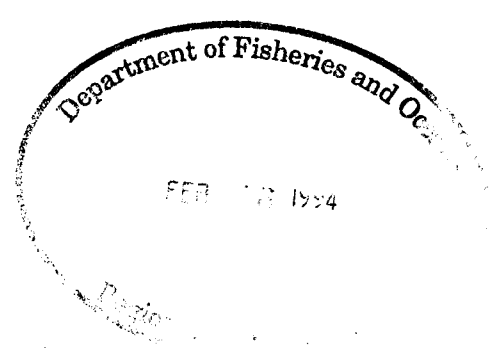
ABSTRACT

Nagtegaal, D. A., P. J. Starr and B. Riddell. 1993. Estimation of total chinook mortality associated with seine fishing in Johnstone Strait and Juan de Fuca Strait during 1989. Can. Manuscr. Rep. Fish. Aquat. Sci. 2214: 79 p.

In 1989 the Biological Sciences Branch, Department of Fisheries and Oceans, conducted a study to assess total chinook (*Oncorhynchus tshawytscha*) mortality in the Johnstone Strait and Juan de Fuca Strait sockeye (*O. nerka*) and pink (*O. gorbuscha*) commercial seine fisheries. Department of Fisheries and Oceans catch statistics are determined from records of salmon sales, and are suspected by some user groups to underestimate the catch of chinook by seine gear. This study independently estimated the total chinook catch in southern British Columbia seine fisheries. Total chinook mortality was estimated to be 24,285 (95% CL: 14,290-32,742) of which 3,256 were recorded as juveniles, 1,193 jacks, and 19,836 adults. Commercial records of sales for the 1989 season reported a catch of 3,348 jack chinook and 20,731 adult chinook. Total mortality in the Juan de Fuca Strait seine fishery was estimated to be 39,768 (95% CL: 26,971-51-678) of which 8,956 were juveniles, 12,019 jacks, and 18,793 adult chinook. Commercial sales slip records for 1989 reported 8,799 jacks and 14,619 adult chinook.



INTRODUCTION

In 1985, the Pacific Salmon Treaty concerning management of Pacific salmon (*Oncorhynchus spp.*) was ratified by the governments of the United States and Canada. A commitment of the treaty was the recording of all sources of chinook (*O. tshawytscha*) mortality, including non-reported mortality during fishing.

To evaluate the impact of seine fisheries on chinook, the Biological Sciences Branch, Department of Fisheries and Oceans, undertook an independent estimation of total chinook catch to more accurately determine total mortality. This estimate could then be compared with the observed sales slip data. This was the fourth year of study in Johnstone Strait and the third year in Juan de Fuca Strait. The purpose of this report is to present the methodology and results of the chinook mortality studies conducted during the 1989 sockeye (*O. nerka*) and pink (*O. gorbuscha*) seine fisheries in southern B.C.

METHODS

A. GENERAL METHODOLOGY

Information required to calculate total chinook mortality associated with the seine fishery include: i) mean catch per set by species and size category; ii) mean number of sets made in each time/area stratum per vessel; and iii) the numbers of vessels fishing by time and area strata. Chinook catch was recorded for three size categories: i) adults [>2.3 kg (5 lb), >57 cm fork length]; ii) jacks [1.4 - 2.3 kg (3-5 lb), 45-57 cm]; and juveniles [<1.4 kg (3 lb), <45 cm].

The overall concept of the program was to extrapolate the estimated mean catch per seine set over all sets made. The Monte-Carlo simulations (Efron 1982) involved resampling with replacement the data for catch per set and sets per day per vessel within each time and area stratum, and determining the average of these resampled data prior to each calculation of total catch. A detailed description of data collection methods, treatment of missing data cells, and catch estimation procedures are presented in Nagtegaal et al. (1990).

Table 1 lists the commercial fishing and survey dates in Johnstone Strait and Juan de Fuca Strait.

B. DATA COLLECTION

i) Johnstone Strait:

Johnstone Strait was split into five sub-areas corresponding to the management stratification presently used (Fig. 1). Field staff consisted of five teams (one boat driver and one biological observer per team), one assigned to each sub-area. One set of observers was stationed in Port Hardy to monitor the Gordon Group area. Two sets of observers were stationed in Port McNeill to cover the North Shore area of Malcolm Island and the Upper Johnstone Strait area. Two sets of observers were stationed at Kelsey Bay. One group monitored the area above Kelsey Bay to Robson Bight and the second group covered the area below Kelsey Bay to Discovery Passage.

In 1989, the data collected from the Lower Johnstone Strait and Discovery Passage sub-areas were combined and treated as one unit. The catch per set and sets per day data from the Lower Johnstone Strait sub-area were used to calculate catch estimates for Discovery Passage (Nagtegaal et. al.,1990).

ii) Juan de Fuca Strait:

In Juan de Fuca Strait, seine vessels align themselves along imaginary fishing lines perpendicular to the coast from the western border of statistical area 20 (blue line) to Sheringham Point (Fig. 2). Seiners vie for position along these fishing lines (approximately one nautical mile apart, and during intense fishing periods, vessels will queue to make a set at a particular fishing line and depth location. Sampling effort was stratified by fishing line. Three survey teams (2 biological observers and 1 boat driver per team) were stationed in Port Renfrew. One team was assigned to monitor the first few lines and the other two teams monitored all other fishing lines. The teams worked well when the weather was good, but during foggy weather, it was difficult for the driver to keep track of both observers. In this situation, both observers were placed on one vessel at a time.

Data were stratified by grouping fishing lines 1-2 and 3-12. This stratification was based on the results that the average sockeye catch per set was considerably higher in the first two fishing lines compared to subsequent lines.

RESULTS

A. JOHNSTONE STRAIT

In total, 1,540 observer boardings were made between July 16 and Sept. 5 in the Johnstone Strait seine fishery. A total of 579 adult, 37 jack, and 133 juvenile chinook were recorded by the observers who boarded 404 different vessels (Table 2). Because of frequent denials of permission to board vessels in the Lower Johnstone Strait sub-area fewer samples were obtained from that area than in previous years.

i) Catch per set:

In Johnstone Strait, catch per set for adult chinook ranged from 0 to 30, for jacks from 0 to 5, and for juvenile chinook from 0 to 10 (Table 3). The overall mean catch per set during the seine fishery was 0.38 for adult chinook, 0.03 for jacks, and 0.10 for juveniles. Distribution of catch per set was highly skewed in all sub-areas of Johnstone Strait (Figs. 3-6). The proportion of null sets observed was 96% for juveniles, 98% for jacks, 84% for adult chinook, and 28% for sockeye.

A two factor analysis of variance (Zar, 1984) was used to examine the effect of area and week on catch per set (Table 4). Area and week had a significant effect on sockeye, adult, and juvenile chinook catch per set. Catch per set tended to be higher at the beginning of the fishing season for juveniles. Catch per set for adults peaked during the first two weeks of August. Catch rate for adults was highest in the Lower Johnstone Strait sub-area. The highest catch rate for jacks was recorded in the Gordon Group sub-area and the Upper Johnstone Strait sub-area recorded the highest catch rate for juveniles. Area and week effects accounted for, on average, less than 10% of the total variance in catch per set.

Mean chinook catch per set was compared to the type of set (open or beach) by study area in Johnstone Strait (Table 5). Comparisons were based on data from Upper and Lower Johnstone Strait sub-areas only since few beach sets were made in other areas. Only minor differences between open and beach set catch rates were recorded for jack and juvenile chinook and sockeye. Adult chinook catch per set was considerably higher in beach sets than in open sets.

ii) Biological sampling:

In Johnstone Strait, 405 adult chinook, 31 jacks, and 21 juveniles were sampled for length/sex/maturity/scale data (Table 6). Sampled fish were assigned to the appropriate category (adult, jack, juvenile) on the basis of length (length/weight relationship from Argue et al. 1967). A summary of age data are contained in Table 7.

Biological data collected independently at processing plants (cannery sample) are listed in Table 8. Size ranges and modes for both the survey and cannery data were similar. The results of the Kolmogorov-Smirnov test (Zar, 1984) indicated that cumulative distributions of cannery and survey data were not significantly different ($D_{obs}<D_{alpha}$).

iii) Number of sets per day per vessel:

The average number of sets per day in Johnstone Strait ranged from 3.2 to 24.3 depending on the length of day and area (Tables 9 and 10). In Johnstone Strait seiners choose between open and beach set strategy (Ledbetter 1977). Choices are made to either wait in a lineup for a preferred spot, or to make sets in areas where no lineups exist but likely with lower catch success. The geography of the area and traditional fishery patterns are important in determining the proportion of beach or open sets made (Hilborn and Ledbetter 1979).

iv) Gear count:

In Johnstone Strait the number of seiners active in the fishery ranged from 27 to 429 (Table 11). Overflights were made in statistical area 12 only. Fishery officers recorded the gear count on the fishing grounds on most days and for most study areas. Vessel count was consistently highest in the Upper Johnstone Strait sub-area during the entire seine fishery. Comparison of the overflight data with a gear count made from the sales slip data (Table 12) revealed only minor differences.

v) Total catch estimate:

A summary of total catch estimates for the seine fishery in Johnstone Strait and for comparable sales slip information is listed in Tables 13-14. The total catch estimate for sockeye was 3.5% higher than the equivalent sales slip estimate, 4.3% lower for adult chinook, and 64% lower for jack chinook. The catch distribution by week for both the sales slip and bootstrap catch estimates were comparable for adult chinook and sockeye although considerable differences were recorded for jack chinook. When these estimates were examined by statistical

area (Table 14) differences were only recorded for jack chinook. In most cases the sales slip catch estimates were within the confidence range of the bootstrap estimates.

Catch estimates were compiled by sub-area, but are not presented in this report since no comparable sales slip data were recorded. The Upper Johnstone Strait sub-area accounted for 44% of the adult chinook catch and 54% of the juvenile catch. The Gordon Group sub-area accounted for 54% of the jack catch.

The distribution of bootstrap catch estimates were skewed and the minimum and maximum values asymmetrical (Fig. 7-10). This was not unexpected since the distribution of catch per set was highly skewed.

B. JUAN DE FUCA STRAIT

In total, 574 observer boardings were made on 210 different vessels (Table 2). During the eight openings of this fishery, 565 adult, 418 jack, and 322 juvenile chinook were observed. As in past years, it was difficult to obtain good coverage of all fishing lines when the weather was poor.

i) Catch per set:

Catch per set in the Juan de Fuca Strait fishery ranged from 0 to 11 for adult, 0 to 15 for jack, and from 0 to 18 for juvenile chinook (Table 15). The overall mean catch per set was 0.95 for adults, 0.70 for jacks, and 0.54 for juveniles.

Catch per set was also compiled by fishing line (Table 16). Sockeye catch per set was higher on the first two fishing lines than on subsequent lines. The decreasing trend in catch rates from the blue line (line 1) towards Sheringham Point was not as distinct as in previous years. A similar decreasing trend in catch rates was observed for chinook. Catch rates were also examined by fishing line and time of day (Table 17). Although catch rates in the first three fishing lines were quite similar in the morning and afternoon, catch rates in the subsequent fishing lines decreased substantially in the afternoon.

Distribution of catch per set was highly skewed (Fig. 11-14). The proportion of null sets observed for adult chinook was 51%, for jacks was 70%, and for juveniles was 76%. The proportion of null sets for sockeye was 5%.

A two-way analysis of variance was used to examine the effects of week and fishing line on catch per set (Table 18). The week effect was significant for all chinook categories and

for sockeye. Catch per set for chinook was highest during the first few weeks of the fishery while sockeye catch per set was highest during the first three weeks of August. The effect of fishing line was not significant.

Catch per set was also examined by 10 fathom bottom depth interval (Table 19). Although sample size was small for the shallower depth intervals catch rates for all categories of chinook and sockeye were highest in shallower waters.

ii) Biological sampling:

A total of 500 adult, 337 jack and 146 juvenile chinook were sampled for length/sex/maturity/scale data (Table 20). Sampled fish were assigned to the appropriate category (adult, jack, juvenile) on the basis of length (length/weight relationship from Argue et al. 1967). A summary of age data are contained in Table 7.

Biological data collected independently at processing plants (cannery sample) are listed in Table 21. Size ranges and modes for both cannery and survey data were similar. No significant differences between cumulative distributions of cannery and survey biological data were detected (Kolmogorov-Smirnov test; $D_{obs} < D_{alpha}$).

iii) Number of sets per day per vessel:

The average number of sets per day ranged from 6.1 to 7.7 depending on the length of day (Table 22) and fishing line (Table 9). In Juan de Fuca Strait, seiners may choose to lineup in the first few, presumably more productive, fishing lines or make sets in the less intense subsequent fishing lines (Table 23). The fishing fleet is usually quite spread out during the first part of the day but tend to move up to the first few fishing lines towards the end of the day. The number of sets that a vessel can make in a day is dependent on the strategy adopted.

iv) Gear count:

Only three overflights were conducted by the Pacific Salmon Commission in Juan de Fuca Strait. In addition, the Commission estimated gear counts based on landings at the major fishing plants in Vancouver and cash buyers. Fishery officers also estimated the number of vessels as they patrolled their area (Table 24). Gear counts were compiled from radar counts of seine gear and were recorded by time of day and four geographic areas that corresponded to fishing lines (Table 25). These were; a)

Bonilla Pt. (lines 1-2), b) Owen Pt. (lines 3-9), c) Owen Pt. to Sombrio (lines 10-12, and d) Sombrio to Sheringham Pt. (lines > 12). Seiners generally tended to move towards the first few fishing lines as the day progressed. Since gear count data by fishing line was not available for each week of the fishery, the percent breakdown of gear by line from data collected on Aug. 14, 20 and Sept. 5 was applied to the total gear count recorded during the other weeks in the fishery. A potential source of error in this gear count was the fact that the gillnet fleet was present on the fishing grounds when the radar counts were taken. According to the fishery officers, it was sometimes difficult to distinguish between a seiner and a gillnetter on a radar screen. Comparison of the overflight and ground count data with a gear count made from the sales slip data (Table 24) revealed only minor differences.

v) Total catch estimate:

Catch estimates were determined on the basis of catch per set and sets per day data stratified by fishery line (grouping lines 1-2 and 3-12) and time of day (before noon/after noon). The intent was to incorporate both the changes in fishing effort and the distribution of the fleet during a given day. The total catch estimate for sockeye was 2% lower than sales slip data, 28% higher for adult chinook, and 36% higher for jacks (Table 26). Although the bootstrap and sales slip catch distribution by week varied considerably, no trend was evident. Poor gear count data may have had a considerable effect on the accuracy of the catch estimates. Recalculation of the data without stratifying the gear count by fishing line reduced the catch estimates in all categories but did not alter the catch distribution by week. In all cases the sales slip catch estimates were within the confidence limits of the bootstrap estimates.

The distribution of bootstrap catch estimates were skewed and the minimum and maximum values asymmetrical (Fig. 15-18). This was not unexpected since the distribution of catch per set was highly skewed.

DISCUSSION

The estimate of total chinook mortality in Johnstone Strait during the sockeye and pink seine fisheries in 1989 was determined to be 24,285 of which 3,256 were recorded as juveniles, 1,193 as jacks, and 19,836 as adults. Although the catch estimates for both sockeye and adult chinook were within 5% of the sales slip recorded catch, estimates for jack chinook were approximately one-third of the sales slip data. The total chinook mortality in Juan de Fuca Strait was determined to be 39,768 of which 8,956 were recorded as juveniles, 12,019 as jacks, and 18,793 as adults. While the estimate for sockeye was within 2% of the sales slip records, estimates for adult and jack chinook were one-third higher than the catch recorded from the sales slip data.

In Johnstone Strait the catch of chinook less than 2.3 kg (5 lb) was calculated to be 1.3 times (95% confidence limits: 1.0-2.1) greater than the number of jacks recorded in the sales slip data. This expansion factor was considered to be somewhat low due to the discrepancy between the catch estimate for jacks and the sales slip data. Assuming the sales slip catch recorded for jack chinook to be the best estimate, the expansion factor would be 1.97. In Juan de Fuca Strait, the chinook catch was calculated to be 2.4 times greater (95% confidence limits: 1.5-3.2) than the number of jacks recorded in the sales slip data.

Best estimates of total catch were calculated based on catch per set, sets made per day, and gear count data. In most cases, the sales slip catch estimates were within the confidence range of the bootstrap estimates. Some considerations of the data collected and potential sources of error are discussed by Nagtegaal (1990) and apply here as well. A preliminary test of the accuracy of species identification by the field crew was accomplished by examining the scale data. Ageing technicians can quite readily identify the species from the scale patterns (Bilton et al. 1964). Out of 738 scales read only 5 (.7%) were incorrectly identified as coho.

The results of the 1989 survey support the hypothesis suggested by Nagtegaal et al. (1988) that the jack category in the sales slip data represents a subset of the total jack and juvenile catch recorded in the survey data. These results also compare favourably with the data from surveys conducted in 1987 and 1988 (Nagtegaal et. al, 1990, 1993).

The fate of chinook caught but not sold and/or recorded is uncertain. The consistency of biological samples from the surveys and canneries indicates that small chinook that are

caught are not sorted by size. Under-reporting of small chinook could result from some fishers discarding/releasing all small chinook or mis-identification of small chinooks during sale. It is unknown to what extent each of these two factors contribute to the problem of under-reporting.

To determine the proportion of mature males in the jack and juvenile categories, the sex ratio and percent maturity values from the biological sampling survey data (Tables 10 and 21) were applied to the total bootstrap estimates. Application of the values for Johnstone Strait yielded a total of 1,625 mature males and 303 mature females (jacks and juveniles combined). For Juan de Fuca Strait 1,389 mature males and 1,585 mature females were recorded. Subtracting these values from the total catch estimates yielded 2,521 chinook (jacks and juveniles combined) from Johnstone Strait and 15,816 chinook from Juan de Fuca Strait, representing the numbers of fish that could have contributed to future production.

In summary, this study provides us with an independent estimate of the chinook mortality during the Johnstone Strait and Juan de Fuca Strait sockeye and pink seine fisheries. Further work will be required to refine the catch estimation techniques, compare the chinook mortality rates with factors such as total fishing effort and chinook stock size, and examine the changes in these variables over time.

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Table 1. Seine fishery openings by area for 1989.

SOCKEYE FISHERY

Area	Dates of survey	Scheduled fishing dates
Johnstone Strait (Stat. area: 12,13)	July 16-17[a]	July 16-17
	23-25	23-25
	30-31	30-31
	Aug. 1-2	Aug. 1-2
	7-9	7-9
	13-16	13-16
	20-22	20-22
	27-29	27-29
	Sept. 4-5	Sept. 4-5
Juan de Fuca Strait (Stat. area: 20)	July 17	July 17
	31	31
	Aug. 1	1
	8-9	8-9
	14-17	14-17
	20-22	20-22
	27-29	27-29
	Sept. 5	Sept. 5

[a]Only sub-areas 12-1, 12-3, 12-4, 13-7, 13-9, 13-28 and 13-32 were open to fishing during this week.

Table 2. Number of different vessels boarded and total boardings made (in parentheses) by study area and date.

		AREA					
		Gordon Group	North Shore	Upper Johnstone Strait	Lower Johnstone Strait	Johnstone Strait (total)*	Juan de Fuca Strait
July	16	0(0)	0(0)	16(20)	6(7)	69(90)	
	17	0(0)	0(0)	44(67)	5(5)	49(72)	26(27)
	23	2(2)	0(0)	6(8)	1(1)	9(11)	
	24	6(6)	4(10)	19(20)	7(7)	36(52)	
	25	0(0)	1(1)	0(0)	0(0)	1(1)	
	30	7(7)	0(0)	16(17)	2(3)	25(27)	
	31	24(24)	9(14)	43(51)	20(21)	96(110)	22(30)
Aug.	1	10(11)	17(25)	28(38)	14(16)	69(90)	27(39)
	2	30(30)	9(9)	17(19)	12(12)	68(70)	
	7	5(6)	0(0)	13(13)	8(8)	26(27)	
	8	19(21)	16(16)	45(49)	19(21)	99(107)	16(18)
	9	10(10)	4(4)	19(22)	2(2)	35(38)	31(32)
	13	6(6)	8(8)	16(16)	10(10)	40(40)	
	14	32(32)	19(21)	49(54)	29(29)	129(136)	38(44)
	15	22(22)	20(22)	45(56)	23(23)	110(127)	39(44)
	16	19(19)	9(12)	12(12)	7(7)	47(50)	38(38)
	17						29(30)
	20	13(13)	6(6)	25(26)	9(9)	53(54)	26(27)
	21	29(33)	24(26)	22(23)	35(35)	110(117)	16(22)
	22	23(26)	15(20)	25(28)	18(18)	81(92)	62(69)
	27						39(45)
	28	17(17)	15(19)	47(52)	24(24)	103(112)	59(68)
	29	23(28)	16(20)	33(34)	23(23)	95(105)	37(40)
Sept.	4	0(0)	0(0)	11(11)	4(4)	15(15)	
	5	0(0)	0(0)	39(42)	14(14)	53(56)	

* includes boardings made in Discovery Pass

Table 3. Average catch per set by category compiled from data collected during the Johnstone Strait seine fishery.

Gordon Group	Chinook			
	Adult	Jack	Juvenile	Sockeye
July 16		NO DATA		
17		NO DATA		
23	0.00(0.00)[a]	0.00(0.00)	0.00(0.00)	120.0(113.1)
24	0.00(0.00)	0.17(0.41)	0.00(0.00)	15.0(13.8)
30	0.29(0.76)	0.00(0.00)	0.57(1.13)	73.6(55.6)
31	0.25(0.61)	0.08(0.41)	0.00(0.00)	179.5(408.5)
Aug. 1	0.00(0.00)	0.00(0.00)	0.00(0.00)	20.4(10.5)
2	0.03(0.18)	0.17(0.53)	0.00(0.00)	208.0(446.0)
7	1.17(1.60)	0.00(0.00)	0.00(0.00)	73.3(160.0)
8	0.57(1.40)	0.00(0.00)	0.10(0.30)	13.0(13.4)
9	0.00(0.00)	0.20(0.42)	0.00(0.00)	25.1(22.3)
13	0.33(0.52)	0.00(0.00)	0.00(0.00)	116.3(150.0)
14	0.66(1.12)	0.03(0.18)	0.03(0.18)	94.5(118.0)
15	0.45(0.96)	0.05(0.21)	0.05(0.21)	408.5(526.0)
16	0.26(0.93)	0.00(0.00)	0.00(0.00)	14.8(17.3)
20	0.00(0.00)	0.00(0.00)	0.00(0.00)	52.3(54.6)
21	0.00(0.00)	0.00(0.00)	0.00(0.00)	21.3(26.7)
22	0.00(0.00)	0.00(0.00)	0.00(0.00)	12.7(15.2)
27		NO DATA		
28	0.29(0.77)	0.00(0.00)	0.00(0.00)	16.4(24.4)
29	0.00(0.00)	0.00(0.00)	0.00(0.00)	12.3(14.5)
Sept. 4		NO DATA		
5		NO DATA		
Mean[b]	0.23(0.74)	0.04(0.24)	0.03(0.21)	89.2(253.3)

Table 3 (cont'd)

North Shore	Chinook Adult	Chinook Jack	Chinook Juvenile	Sockeye
July 16		NO DATA		
17		NO DATA		
23		NO DATA		
24	0.90(1.45)	0.00(0.00)	1.30(1.95)	128.9(135.9)
30		NO DATA		
31	0.07(0.27)	0.00(0.00)	0.00(0.00)	173.9(269.6)
Aug. 1	0.20(0.65)	0.00(0.00)	0.00(0.00)	117.9(395.0)
2	0.00(0.00)	0.00(0.00)	0.44(0.88)	118.8(319.9)
7		NO DATA		
8	0.19(0.54)	0.06(0.24)	0.31(0.37)	137.9(159.1)
9	0.75(0.96)	0.00(0.00)	0.00(0.00)	56.3(50.9)
13	0.00(0.00)	0.00(0.00)	0.13(0.35)	338.0(365.7)
14	0.05(0.22)	0.00(0.00)	0.05(0.22)	503.8(645.9)
15	0.14(0.35)	0.00(0.00)	0.09(0.43)	28.9(18.8)
16	0.42(0.79)	0.00(0.00)	0.17(0.58)	81.8(75.3)
20	0.00(0.00)	0.00(0.00)	0.00(0.00)	35.8(15.7)
21	0.12(0.43)	0.04(0.20)	0.04(0.20)	41.3(44.8)
22	0.60(1.50)	0.00(0.00)	0.00(0.00)	84.9(112.1)
27		NO DATA		
28	0.00(0.00)	0.00(0.00)	0.00(0.00)	8.9(7.3)
29	0.00(0.00)	0.00(0.00)	0.00(0.00)	16.1(22.7)
Sept. 4		NO DATA		
5		NO DATA		
Mean[b]	0.19(0.68)	0.01(0.09)	0.12(0.58)	119.4(289.2)

Table 3 (cont'd)

Upper Johnstone Strait	Chinook Adult	Chinook Jack	Chinook Juvenile	Sockeye
July 16	0.25(0.72)	0.00(0.00)	0.95(2.42)	9.9(11.4)
17	0.22(0.62)	0.01(0.12)	0.30(0.89)	19.9(52.0)
23	0.38(0.74)	0.00(0.00)	0.00(0.00)	70.1(100.7)
24	0.21(0.62)	0.21(0.62)	0.07(0.26)	102.5(186.8)
30	0.24(0.97)	0.00(0.00)	0.24(0.56)	31.1(57.7)
31	0.41(0.80)	0.02(0.14)	0.14(0.53)	45.4(67.5)
Aug. 1	0.18(0.79)	0.00(0.00)	0.23(0.96)	48.3(78.4)
2	0.11(0.32)	0.00(0.00)	0.05(0.23)	74.9(117.0)
7	0.43(1.34)	0.00(0.00)	0.00(0.00)	78.0(92.2)
8	0.88(2.15)	0.06(0.24)	0.18(0.88)	58.9(99.0)
9	1.05(3.06)	0.00(0.00)	0.00(0.00)	44.0(79.8)
13	0.31(0.79)	0.00(0.00)	0.00(0.00)	306.2(475.5)
14	0.39(0.86)	0.07(0.33)	0.11(0.57)	188.0(265.6)
15	0.95(2.63)	0.05(0.40)	0.09(0.44)	80.7(152.0)
16	0.15(0.55)	0.00(0.00)	0.00(0.00)	26.6(43.1)
20	0.08(0.27)	0.00(0.00)	0.00(0.00)	346.3(635.9)
21	0.26(0.75)	0.04(0.21)	0.04(0.21)	15.3(33.7)
22	1.96(5.89)	0.00(0.00)	0.00(0.00)	51.3(113.4)
27		NO DATA		
28	0.06(0.24)	0.00(0.00)	0.00(0.00)	15.8(35.5)
29	0.29(0.63)	0.03(0.17)	0.06(0.24)	6.0(9.3)
Sept. 4	0.00(0.00)	0.00(0.00)	0.00(0.00)	9.1(30.2)
5	0.19(0.55)	0.00(0.00)	0.05(0.22)	2.4(8.3)
Mean[b]	0.43(1.74)	0.03(0.26)	0.13(0.67)	69.6(194.9)

Table 3 (cont'd)

Lower Johnstone Strait	Chinook			Sockeye
	Adult	Jack	Juvenile	
July 16	0.00(0.00)	0.00(0.00)	0.00(0.00)	2.1(3.6)
17	0.40(0.55)	0.20(0.45)	0.00(0.00)	12.0(18.0)
23	0.00(0.00)	0.00(0.00)	0.00(0.00)	120.0(0.00)
24	0.71(1.25)	0.00(0.00)	0.00(0.00)	432.0(625.2)
30	0.00(0.00)	0.00(0.00)	0.00(0.00)	96.7(111.4)
31	0.29(1.10)	0.00(0.00)	0.00(0.00)	126.5(155.0)
Aug. 1	0.19(0.54)	0.00(0.00)	0.06(0.25)	45.1(78.8)
2	0.50(1.00)	0.00(0.00)	0.00(0.00)	86.1(137.1)
7	2.25(5.60)	0.00(0.00)	0.00(0.00)	303.1(305.1)
8	0.38(1.07)	0.00(0.00)	0.00(0.00)	52.1(90.0)
9	0.00(0.00)	0.00(0.00)	0.00(0.00)	21.0(26.9)
13	0.40(0.97)	0.00(0.00)	0.00(0.00)	171.7(199.4)
14	0.21(0.56)	0.00(0.00)	0.00(0.00)	337.5(465.3)
15	1.00(2.47)	0.00(0.00)	0.09(0.29)	56.5(76.7)
16	1.29(1.98)	0.00(0.00)	0.14(0.38)	172.1(133.3)
20	0.44(0.88)	0.00(0.00)	0.22(0.67)	28.7(46.5)
21	0.66(1.68)	0.03(0.17)	0.06(0.24)	67.9(107.4)
22	0.94(2.26)	0.00(0.00)	0.00(0.00)	12.1(29.4)
27		NO DATA		
28	0.25(0.74)	0.04(0.20)	0.00(0.00)	49.6(61.6)
29	0.52(1.08)	0.00(0.00)	0.00(0.00)	17.1(19.6)
Sept. 4	1.00(1.41)	0.00(0.00)	0.00(0.00)	60.0(50.7)
5	0.43(1.34)	0.00(0.00)	0.00(0.00)	13.9(25.3)
Mean[b]	0.54(1.34)	0.01(0.10)	0.03(0.18)	101.5(222.9)

Table 3 (cont'd)

Johnstone Strait (all areas combined)

Chinook			
Adult	Jack	Juvenile	Sockeye
0.38(0.06)	0.03(0.01)	0.10(0.02)	92.3(9.1)

[a]Standard deviation in parentheses.
[b]Weighted mean catch per set, all weeks combined.

Table 4. Two-way analysis of variance of catch per set vs area and week for the Johnstone Strait sockeye fishery.

	Source of Variation	DF	SS	MS	F_{obs}	$F_{0.05}$
Jacks	Total	1539	70.11			
	Model	27	1.74	.06	1.43	
	Error	1512	68.37	.04		
	Area	3	.19		1.43	2.96
	Week	7	.61		1.95	2.37
	Area and Week	17	.93		1.21	2.02
Juveniles	Total	1539	421.51			
	Model	27	31.62	1.17	4.54	
	Error	1512	389.89	.26		
	Area	3	3.68		4.76	2.96*
	Week	7	12.12		6.72	2.37*
	Area and Week	17	15.81		3.61	2.02*
Adults	Total	1539	3187.31			
	Model	27	106.17	3.93	1.93	
	Error	1512	3081.14	2.04		
	Area	3	25.24		4.13	2.96*
	Week	7	51.90		3.64	2.37*
	Area and Week	17	29.01		0.84	2.02
Sockeye	Total	1539	81102435			
	Model	27	7555964	279850	5.75	
	Error	1512	73546470	48641		
	Area	3	520148		3.56	2.96*
	Week	7	4859793		14.27	2.37*
	Area and Week	17	2176022		2.63	2.02*

*Denotes significance

Table 5. Comparison between type of set and catch per set by study area for the seine fishery.

		Chinook			
Johnstone Strait:	N	Adults	Jacks	Juveniles	Sockeye
Gordon Group					
Open	153	.16(.05)[a]	.04(.02)	.01(.01)	99.1(23.0)
Beach	4	1.00(.58)	.50(.50)	-	52.5(27.6)
North Shore					
Open	100	.23(.08)	.01(.01)	.14(.05)	123.5(27.2)
Beach	0				
Upper Johnstone Strait					
Open	153	.21(.08)	.01(.01)	.17(.08)	64.1(13.2)
Beach	189	.70(.19)	.05(.03)	.16(.05)	85.1(19.8)
Lower Johnstone Strait					
Open	60	.08(.04)	-	.02(.02)	118.9(39.8)
Beach	89	.77(.17)	.01(.01)	.03(.02)	100.0(24.6)
Total[b]					
Open	466	.18(.36)	.02(.01)	.09(.03)	95.4(11.7)
Beach	282	.73(.14)	.04(.02)	.12(.03)	89.3(15.3)
Juan de Fuca Strait					
Open	576	.96(.06)	.71(.07)	.55(.06)	144.8(12.6)
Beach	-	-	-	-	-

[a]Standard error of the mean.
[b]All areas combined (Johnstone Strait).

Table 6. Summary of chinook biological samples collected during the seine fishery in Johnstone Strait.

Juveniles				Jacks				Adults			
Length (cm)	M	F	U[a]	Length (cm)	M	F	U	Length (cm)	M	F	U
26			1	43	1(6)	1(14)		58			1
27			0	44	2(14)	0	1	59	1(1)	1(2)	5
28			0	45	1(6)	0	0	60	3(3)	0	3
29			0	46	1(6)	0	0	61	1(1)	0	1
30			0	47	1(6)	0	0	62	3(3)	2(4)	1
31			0	48	1(6)	0	0	63	0	0	2
32			0	49	1(6)	1(14)	0	64	1(1)	1(2)	1
33			0	50	2(14)	0	1	65	0	0	6
34		1(20)	0	51	1(6)	0	0	66	3(3)	0	3
35		0	0	52	0	0	1	67	1(1)	1(2)	5
36	3(30)	0	0	53	1(6)	2(28)	0	68	4(4)	1(2)	6
37	1(10)	0	0	54	1(6)	1(14)	0	69	5(5)	0	3
38	0	0	0	55	0	1(14)	1	70	1(1)	1(2)	4
39	2(20)	2(40)	2	56	1(6)	1(14)	4	71	2(2)	2(4)	1
40	3(30)	2(40)	1	57	1(6)		1	72	2(2)	0	3
41	0		0					73	9(10)	0	4
42	1(10)		2					74	5(5)	1(2)	4
								75	5(5)	2(4)	8
								76	3(3)	0	6
								77	2(2)	2(4)	3
								78	6(6)	0	12
								79	4(4)	2(4)	10
								80	3(3)	3(6)	18
								81	4(4)	0	11
								82	6(6)	1(2)	7
								83	2(2)	1(2)	7
								84	2(2)	2(4)	3
								85	1(1)	0	4
								86	0	1(2)	10
								87	2(2)	0	4
								88	1(1)	0	2
								89	0	0	3
								90	0	0	18
								91	0	1(2)	4
								92	1(1)	0	6
								93	0	2(4)	6
								94	0	2(4)	2

Table 6 (cont'd)

Juveniles			Jacks			Adults		
					95	3(3)	2(4)	3
					96	0	3(6)	5
					97	0	2(4)	1
					98	0	3(6)	4
					99	1(1)	1(2)	4
					100	2(2)	4(8)	10
					101	1(1)	1(2)	3
					102	0	1(2)	6
					103	0	0	5
					104	0	1(2)	3
					105	0	2(4)	1
					106	1(1)	0	0
					107	0	0	0
					108	1(1)	0	1
					109	0	1(2)	1
					110	0	0	5
					111	0	0	1
					112	0	0	2
					113	2(2)	1(2)	3
					114			2
					115			1
					116			0
					117			0
					118			1
					119			1
Total	10	5	6	15	7	9	94	51	260
Weighted Mean Length	38.5	38.4		49.1	51.8		77.8	87.4	
Percent Mature	50%	20%	-	66%	23%	-	-	-	-
Sex Ratio (%Males)		67%			68%			65%	

[a]Fish could not be sampled for sex and maturity
[b]Percent frequency in parenthesis

Table 7. Summary of chinook age samples collected during the seine fishery.

Johnstone Strait

Age[1]	Male	Female	Unk[2]	Total
0.1	7	1	5	13
0.2	46	14	52	112
0.3	10	4	34	48
0.4	3	11	19	33
1.2	-	-	6	6
1.3	1	-	-	1
Total	67	30	117	214

Unknown[3]: 133

Juan de Fuca Strait

Age[1]	Male	Female	Unk[2]	Total
0.1	105	85	10	200
0.2	82	57	75	214
0.3	9	12	38	59
0.4	2	9	30	41
1.1	3	1	-	4
1.2	2	-	3	5
1.3	-	-	1	1
Total	203	164	157	524

Unknown[3]: 354

[1]European notation: the first digit indicates the number of annuli formed in fresh water and the second digit indicates the number of annuli formed in the ocean.
[2]Unknown sex: fish were not sampled because the skipper did not want the fish to be mutilated.
[3]Unknown age: scales were unreadable.

Table 8. Summary of chinook biological samples collected at the canneries in Vancouver during the seine fishery in Johnstone Strait.

Length	Juveniles[c]			Length	Jacks		
(cm)	M	F	U[a]	(cm)	M	F	U
32	1(2)[b]			43	16(9)	4(5)	
33	1(2)			44	15(8)	1(1)	
34	0	1(5)		45	11(6)	4(5)	
35	2(4)	1(5)		46	10(5)	8(11)	
36	1(2)	0		47	15(8)	8(11)	
37	3(6)	2(10)		48	18(10)	6(8)	
38	7(13)	2(10)		49	16(9)	6(8)	
39	5(9)	1(5)		50	9(5)	3(4)	
40	9(17)	4(21)		51	11(6)	4(5)	
41	15(28)	3(15)		52	7(4)	7(9)	
42	10(18)	5(26)		53	13(7)	3(4)	
				54	11(6)	3(4)	
				55	10(5)	4(5)	
				56	5(3)	8(11)	
				57	14(8)	6(8)	
Total	54	19			181	75	
Weighted Mean Length	39.9	38.4			48.9	49.8	
Percent Immature	33%	100%			41%	92%	
Sex Ratio (%males)	74%				71%		

[a]Fish not sampled for sex and maturity.
[b]Percent frequency in parentheses.
[c]For purposes of comparison with the survey data the cannery sample data was assigned to the jack and juvenile categories according to the criteria used for the survey data.

Table 9. Average number of sets made per vessel by day for Johnstone Strait and Juan de Fuca Strait sockeye fishery.

	July						August				
Study Area	16	17	23	24	30	31	1	2	7	8	9
Gordon Group	-	-	-	28.0 (1.8)[a]	5.3 (1.3)	15.3 (1.0)	19.4 (1.2)	15.3 (1.3)	5.8 (1.7)	20.1 (1.3)	22.3 (1.8)
North Shore	-	-	-	13.5 (0.9)	-	15.1 (1.0)	13.7 (0.9)	15.6 (1.2)	-	19.3 (1.3)	14.0 (1.2)
Upper Johnstone Strait	5.5 (1.2)	12.2 (1.0)	5.7 (1.6)	12.8 (0.8)	4.3 (1.3)	14.9 (1.0)	12.7 (0.8)	12.0 (1.0)	4.7 (1.3)	14.6 (1.0)	12.2 (1.0)
Lower Johnstone Strait	4.0 (1.3)	5.0 (0.4)	-	10.6 (0.7)	3.3 (1.0)	15.5 (1.0)	14.3 (1.0)	10.6 (0.8)	3.4 (1.1)	19.3 (1.3)	13.0 (1.1)
Juan de Fuca	-	7.3 (0.8)	-	-	-	6.1 (0.7)	7.0 (0.7)	-	-	6.1 (0.7)	6.5 (0.7)

	August										Sept.	
Study Area	13	14	15	16	20	21	22	27	28	29	4	5
Gordon Group	6.2 (1.5)	17.3 (1.2)	20.1 (1.4)	22.8 (1.3)	10.3 (1.6)	24.3 (1.5)	21.7 (1.2)	-	18.8 (1.2)	13.6 (1.2)	-	-
North Shore	7.5 (1.3)	14.2 (0.9)	20.7 (1.4)	15.4 (1.3)	13.0 (1.1)	17.0 (1.3)	14.6 (1.3)	-	11.9 (0.8)	9.4 (0.8)	-	-
Upper Johnstone Strait	4.8 (1.3)	14.0 (1.0)	17.7 (1.2)	11.0 (1.0)	9.2 (1.0)	15.2 (1.0)	11.4 (1.0)	-	9.8 (0.7)	7.1 (0.6)	3.8 (1.1)	10.4 (0.9)
Lower Johnstone Strait	4.3 (1.3)	13.5 (0.9)	12.6 (0.8)	11.1 (0.9)	9.2 (1.5)	14.8 (1.0)	10.0 (0.8)	-	8.6 (0.6)	7.6 (0.7)	3.2 (1.0)	1.8 (1.0)
Juan de Fuca	-	6.3 (0.7)	6.7 (0.8)	6.9 (0.7)	7.4 (0.7)	7.7 (0.9)	6.7 (0.9)	6.8 (0.7)	6.2 (0.7)	6.2 (0.7)	-	-

[a]Average number of sets per hour

Table 10. Available fishing time by fishery opening for Johnstone Strait.

SOCKEYE FISHERY

Date		Statistical area[a]	Time of opening[b]	Available fishing hours
July	16	12, 13	1800	3.5
	17	12, 13	0600	12.0
	23	12, 13	1800	3.5
	24	12, 13	0600	15.5
	25	12, 13	0600	12.0
	30	12, 13	1800	3.5
	31	12, 13	0600	15.5
Aug.	1	12, 13	1800	15.5
	2	12, 13	0600	12.0
	7	12, 13	0600	3.5
	8	12, 13	1800	15.5
	9	12, 13	0600	12.0
	13	12, 13	0600	3.5
	14	12, 13	1800	15.5
	15	12, 13	1800	15.5
	16	12, 13	0600	12.0
	20	12, 13	1800	3.5
	21	12, 13	0600	15.5
	22	12, 13	0600	12.0
	27	12, 13	1800	3.5
	28	12, 13	0600	15.5
	29	12, 13	0600	12.0
Sept.	4	12, 13	1800	3.5
	5	12, 13	0600	12.0

[a]Areas 12 and 13: Johnstone Strait
[b]Universal time

Table 11. Gear count of seiners by day for Johnstone Strait sockeye[a] fishery.

	July						August					
Study Area	16[b]	17[c]	23	24[c]	30	31	1	2[c]	7	8	9[c]	13
Gordon Group	-	-	5(16)	-	27(47)	(61)	(57)	-	45(45)	(62)	-	34(185)
North Shore	-	-	1(3)	-	31(19)	(25)	(15)	-	28(28)	(44)	-	30(30)
Upper Johnstone Strait	99	-	28(39)	-	108(60)	(54)	(47)	-	160(160)	(83)	-	155(155)
Lower Johnstone Strait	23	(27)	5(7)	(4)	27(27)	(10)	(3)	-	33(54)	(22)	-	52(47)
Discovery Pass	7	-	(7)	(4)	0(0)	(0)	(0)	-	32(25)	(32)	-	7(12)

	August									Sept.	
Study Area	14	15	16[c]	20	21	22[c]	27	28	29[c]	4	5[c]
Gordon Group	61(149)	(75)	-	60(52)	(60)	-	39(40)	(62)	-	30(33)	-
North Shore	45(45)	(45)	-	53(35)	(53)	-	27(27)	(30)	-	44(41)	-
Upper Johnstone Strait	104(104)	(30)	-	107(107)	(107)	-	123(123)	(94)	-	130(130)	-
Lower Johnstone Strait	(35)	(18)	-	57(57)	(45)	-	50(50)	(30)	-	63(60)	-
Discovery Pass	(13)	(14)	-	25(25)	(16)	-	55(55)	(45)	-	40(50)	-

[a]Overflight gear count recorded in statistical area 12 only, fishery officers recorded gear count on fishing grounds for stat. area 13 (in parenthesis).
[b]Statistical areas 12-5 to 12-11 closed to fishing on July 16 and 17.
[c]Overflight not routinely made on second day of a 24 Hr. fishery or third day of a 48 Hr. fishery.

Table 12. Number of vessels that reported catch by week from sales slip data compared with overflight and fishery officers gear counts for Johnstone Strait seine fishery.

Area	Date	Sales slip count[a]	DFO overflight[b]	Ground count[c]
Johnstone Strait	July 16-17[d]	118	129	
	23	41	39	
	24			72
	30	174	193	
	31			153
	Aug. 1			150
	2			122
	7	289	298	
	8			312
	9			243
	13	279	278	
	14			429
	15		269	346
	16			182
	20	285	302	
	21			276
	22			281
	27	287	294	
	28			295
	29			261
	Sept. 4	295	307	
	5			314

[a]Unique CFV licences delivering catch by stat. area, weekly totals only.
[b]Regular Dept. of Fisheries and Oceans overflights were taken for stat. area 13 only, so this number represents a combination of overflight data for stat. area 13 and a fishery officer ground count for stat. area 12.
[c]Gear count taken by fishery officers on fishing grounds.
[d]statistical areas 12-5 to 12-11 were closed to fishing July 16 and 17.

Table 13. Comparison of bootstrap estimates and sales slip data (Numbers caught) by week for Johnstone Strait.

	CHINOOK			
WEEK	ADULT	JACK	JUVENILE	SOCKEYE
July 16-17	457[a]	51	838	28,798
	(61-974)[b]	(0-159)	(81-2251)	(10,790-65,925)
	547[c]	73	d	27,951
July 23-24	266	159	82	104,567
	(60-588)	(0-730)	(5-270)	(45,407-203,874)
	606	75	d	86,059
July 30-Aug 2	1060	227	597	620,974
	(527-1672)	(0-654)	(110-1269)	(355,063-1,094,744)
	2039	460	d	544,680
Aug 7-9	5747	383	691	625,251
	(1766-10,234)	(21-1149)	(97-1672)	(344,594-740,400)
	5222	594	d	592,318
Aug 13-16	5303	196	614	1,597,994
	(2911-7688)	(0-574)	(88-1319)	(1,038,262-2,308,415)
	5577	1438	d	1,545,215
Aug 20-22	4875	126	322	555,127
	(1420-10,321)	(0-409)	(0-1132)	(338,350-910,525)
	3573	368	d	496,202
Aug 27-29	1135	51	47	95,164
	(190-1809)	(0-134)	(0-212)	(47,731-111,212)
	1620	269	d	155,176
Sept 4-5	994	-	65	34,848
	(30-1725)		(0-234)	(6959-47,903)
	1166	211	d	44,935
TOTAL	19,836	1193	3256	3,662,724
	(12,317-25,819)	(327-2060)	(1636-4863)	(2,000,000-4,255,837)
	20,731	3348	d	3,539,640

[a]Bootstrap estimates.
[b]Upper and lower 95% confidence limits.
[c]Sales slip data collected by the Dept. of Fisheries and Oceans (Annual Summary, 1989).
[d]No data recorded for juveniles in sales slip data.

Table 14. Comparison of bootstrap estimates and sales slip data (numbers caught) by statistical area for Johnstone Strait.

Statistical Area	Adult	Jack	Juvenile	Sockeye
12	13,888[a]	1109	2925	2,885,502
	(8749-21,109)[b]	(287-1960)	(1409-4438)	(2,000,000-3,716,234)
	15,918[c]	2736	d	2,766,130
13	5947	84	330	777,222
	(2878-9780)	(0-307)	(2-1275)	(540,387-1,094,737)
	4813	612	d	773,510
Total	19,836	1193	3256	3,662,724
	(12,317-25,819)	(327-2060)	(1636-4863)	(2,000,000-4,255,837)
	20,731	3348	d	3,539,640

[a] Bootstrap estimates.
[b] Upper and lower 95% confidence limits.
[c] Sales slip data collected by the Dept. of Fisheries and Oceans (Annual Summary, 1989).
[d] No data recorded for juveniles in sales slip data.

Table 15. Average catch per set by category compiled from data collected during the Juan de Fuca Strait seine fishery.

	CHINOOK			
	ADULT	JACK	JUVENILE	SOCKEYE
JULY 17	1.59(2.17)[a]	2.30(3.29)	0.52(1.12)	24.7(29.4)
31	1.83(1.84)	2.73(2.92)	1.60(2.37)	73.4(67.3)
Aug 1	1.36(2.06)	1.44(1.64)	1.51(2.04)	211.1(131.6)
2	NO DATA			
8	0.44(0.86)	0.83(1.79)	0.56(0.92)	344.4(365.4)
9	1.88(1.72)	1.41(1.78)	1.47(3.31)	251.9(316.6)
14	1.48(1.56)	1.18(2.36)	1.09(2.02)	101.4(90.6)
15	0.59(0.87)	0.50(1.21)	0.61(1.37)	66.3(92.7)
16	0.89(1.62)	0.50(0.76)	0.16(0.55)	183.9(166.1)
17	1.27(1.68)	0.33(0.99)	0.53(1.11)	486.7(919.6)
20	1.59(1.67)	0.52(1.63)	0.44(1.09)	170.4(150.4)
21	0.86(1.04)	0.50(0.60)	0.32(0.84)	161.9(195.6)
22	0.60(0.98)	0.14(0.43)	0.20(0.50)	238.4(385.9)
27	0.24(0.61)	0.04(0.21)	0.07(0.25)	82.9(95.8)
28	0.57(0.82)	0.18(0.52)	0.07(0.26)	33.7(42.3)
29	0.73(0.99)	0.15(0.53)	0.15(0.36)	42.3(40.7)
Sept 5	0.33(0.71)	0.10(0.31)	0.17(0.38)	10.2(8.1)
Mean[b]	0.95(1.43)	0.70(1.62)	0.54(1.44)	144.4(296.6)

[a]Standard deviation in parenthesis
[b]Weighted mean catch per set, all weeks combined

Table 16. Summary of catch per set by fishing line for Juan de Fuca Strait[a].

FISHING LINE	N	CHINOOK			SOCKEYE
		ADULT	JACK	JUVENILE	
1	216	1.2(1.6)[b]	1.0(1.8)	0.8(1.9)	186.1(386.5)
2	84	0.8(1.2)	0.6(1.4)	0.5(1.2)	157.4(337.3)
3	36	0.8(1.0)	0.6(1.6)	0.3(0.7)	116.8(131.2)
4	24	0.6(1.1)	0.6(1.4)	0.5(1.2)	128.2(307.5)
5	28	1.0(1.3)	0.5(0.7)	0.9(1.5)	112.8(120.1)
6	40	0.8(1.5)	0.7(2.6)	0.3(0.7)	110.3(207.1)
7	43	0.6(0.9)	0.3(0.5)	0.2(0.6)	157.3(235.9)
8	56	1.2(1.9)	0.6(1.8)	0.5(1.3)	117.1(219.8)
9	39	0.8(1.0)	0.2(0.6)	0.2(0.7)	77.1(93.5)
10	25	0.5(0.8)	0.4(1.3)	0.2(0.5)	46.7(43.1)
11	6	0.5(0.5)	-	0.2(0.4)	43.5(67.9)
12	6	0.7(1.0)	0.2(0.4)	-	129.3(184.3)
16	1	1.0	-	-	380.0

[a]All weeks combined
[b]Standard deviation

Table 17. Mean catch per set by fishing line in Juan de Fuca Strait[1].

MORNING[2]		CHINOOK			
FISHING LINE	N	ADULT	JACK	JUVENILE	SOCKEYE
1	94	1.1(1.4)	1.1(1.6)	0.8(1.7)	159.3(228.0)
2	21	0.7(0.9)	0.6(0.9)	0.5(0.8)	117.1(118.5)
3	19	1.0(1.2)	0.8(2.1)	0.5(0.9)	131.8(136.0)
4	9	0.3(1.0)	1.0(1.6)	0.3(0.7)	242.5(477.6)
5	16	0.7(1.1)	0.3(0.6)	0.7(1.6)	134.4(119.3)
6	26	1.0(1.5)	0.1(0.4)	0.3(0.7)	163.4(241.7)
7	35	0.6(0.9)	0.3(0.5)	0.2(0.6)	179.6(255.5)
8	46	1.4(2.0)	0.8(1.9)	0.5(1.4)	138.5(237.4)
9	32	0.8(1.1)	0.2(0.7)	0.2(0.8)	89.1(99.4)
10	18	0.7(0.9)	0.6(1.5)	0.2(0.5)	51.9(46.4)
11	4	0.2(0.5)	-	0.2(0.5)	62.2(79.2)
12	1	-	-	-	55.0
AFTERNOON[2]					
1	122	1.2(1.8)	0.9(1.9)	0.7(2.1)	206.7(473.8)
2	63	0.8(1.3)	0.6(1.5)	0.5(1.3)	170.8(383.4)
3	17	0.6(0.8)	0.4(0.8)	0.1(0.3)	100.1(127.7)
4	15	0.8(1.2)	0.4(1.3)	0.7(1.4)	59.6(107.3)
5	12	1.3(1.5)	0.7(0.9)	1.1(1.6)	84.0(120.0)
6	14	0.6(1.4)	1.7(4.4)	0.3(0.8)	11.8(14.5)
7	8	0.5(0.5)	0.4(0.5)	0.2(0.5)	60.0(59.1)
8	10	0.5(0.9)	-	0.1(0.3)	18.3(16.9)
9	7	0.6(0.9)	0.1(0.4)	-	22.1(9.7)
10	7	0.1(0.4)	-	0.3(0.5)	33.4(32.1)
11	2	1.0(0.0)	-	-	6.0(8.4)
12	5	0.8(1.1)	0.2(0.4)	-	144.2(202.4)

[1]Mean catch by fishing line (all weeks combined)
[2]Catch per set was compiled before and after 12:00 noon.

Table 18. Analysis of variance of catch per set vs week and fishing line for Juan de Fuca Strait seine fishery.

	SOURCE OF VARIATION	DF	SS	MS	F_{obs}	$F_{0.05}$
JACKS	TOTAL	603	1589			
	MODEL	70	479	6.8	3.29	
	ERROR	533	1109	2.1		
	WEEK	6	278		22.26	2.23*
	LINE	12	23		0.94	1.89
	WEEK/LINE	52	178		1.65	1.53
JUVENILES	TOTAL	603	1251			
	MODEL	70	203	2.9	1.48	
	ERROR	533	1048	1.9		
	WEEK	6	132		11.24	2.23*
	LINE	12	17		0.74	1.89
	WEEK/LINE	52	53		0.52	1.53
ADULTS	TOTAL	603	1237			
	MODEL	70	254	3.6	1.97	
	ERROR	533	983	1.8		
	WEEK	6	87		7.95	2.23*
	LINE	12	29		1.32	1.89
	WEEK/LINE	52	137		1.43	1.53
SOCKEYE	TOTAL	603	53046307			
	MODEL	70	9921450	141735	1.75	
	ERROR	533	43124857	80909		
	WEEK	6	4033275		8.31	2.23*
	LINE	12	1032315		1.06	1.89
	WEEK/LINE	52	4855859		1.15	1.53

*Denotes significance

Table 19. Comparison of catch per set[1] and bottom depth for Juan de Fuca Strait.

DEPTH[2] (fm)		CHINOOK			
	N	ADULT	JACK	JUVENILE	SOCKEYE
30-35	14	2.1	2.1	1.4	228.6
36-45	51	2.0	1.2	1.1	301.2
46-55	119	0.9	0.9	0.5	179.3
56-65	117	0.9	0.6	0.6	162.4
66-75	74	0.9	0.9	0.6	132.3
76-85	71	0.9	0.4	0.4	114.3
86-95	43	0.6	0.4	0.3	87.6
96-105	46	0.8	0.2	0.4	76.7
106-115	23	0.5	0.6	0.3	64.3
116-125	15	1.0	0.2	0.4	86.1
30-65	301	1.1	0.9	0.7	195.7
66-125	273	0.8	0.5	0.4	102.5

[1]Mean catch per set (all fishing lines combined)

[2]A 30 fm compliance boundary is in effect for the commercial seine fleet in Juan de Fuca Strait.

Table 20. Summary of chinook biological samples collected during the sockeye fishery in Juan de Fuca Strait.

Juveniles				Jacks				Adults			
Length (cm)	M	F	U[a]	Length (cm)	M	F	U	Length (cm)	M	F	U
31	1(1)[b]			43	18(10)	12(8)	1	58	3(2)	4(4)	3
32	1(1)			44	15(8)	15(10)	0	59	8(6)	8(9)	6
33	0			45	9(5)	8(5)	2	60	6(5)	8(9)	3
34	1(1)			46	17(10)	11(7)	0	61	5(4)	4(4)	3
35	1(1)	2(3)		47	16(9)	9(6)	1	62	3(2)	4(4)	3
36	0	4(6)	1	48	23(13)	9(6)	2	63	5(4)	1(1)	6
37	8(10)	6(9)		49	14(8)	13(9)	0	64	4(3)	1(1)	5
38	5(6)	10(16)		50	16(9)	12(9)	1	65	5(4)	1(1)	5
39	9(11)	10(16)		51	7(4)	9(9)	2	66	4(3)	0	2
40	16(20)	9(14)		52	12(7)	11(7)	1	67	2(2)	3(3)	3
41	11(14)	6(9)	2	53	9(5)	10(7)	0	68	7(6)	2(2)	5
42	26(33)	16(25)	1	54	8(4)	7(5)	1	69	2(2)	0	10
				55	7(4)	9(9)	0	70	2(2)	0	7
				56	2(1)	6(4)	2	71	4(3)	1(1)	8
				57	2(1)	7(5)	1	72	4(3)	1(1)	8
								73	1(1)	2(2)	5
								74	4(3)	1(1)	12
								75	5(4)	0	7
								76	1(1)	2(2)	8
								77	2(1)	3(3)	8
								78	3(2)	1(1)	8
								79	4(3)	1(1)	10
								80	2(1)	3(3)	11
								81	3(2)	1(1)	10
								82	1(1)	0	6
								83	3(2)	2(2)	4
								84	1(1)	1(1)	9
								85	2(1)	6(7)	8
								86	0	4(4)	6
								87	2(1)	2(2)	6
								88	3(2)	0	7
								89	3(2)	1(1)	10
								90	1(1)	6(7)	10
								91	0	1(1)	7
								92	2(1)	2(2)	7
								93	2(1)	2(2)	10

Table 20 (cont'd)

Juveniles				Jacks				Adults			
Length (cm)	M	F	U[a]	Length (cm)	M	F	U	Length (cm)	M	F	U
								94	1(1)	0	2
								95	0	3(3)	6
								96	3(2)	1(1)	4
								97	0	2(2)	4
								98	1(1)	0	5
								99	1(1)	1(1)	4
								100	0	1(1)	2
								101	2(1)	0	0
								102	1(1)	0	2
								103	1(1)	0	3
								104	0	1(1)	2
								105	1(1)	0	1
								106	1(1)	0	0
								107	0	1(1)	0
								108	0		2
								109	0		2
								110	0		1
								111	0		0
								112	1(1)		2
								117	1(1)		
Total	79	63	4		175	148	14		123	89	288
Weighted mean length	39.9	39.4			48.4	49.3			74.9	74.2	
Percent mature	19%	4%			30%	9%					
Sex Ratio (%males)		56%				54%				58%	

[a]Fish could not be sampled for sex and maturity.
[b]Percent frequency in parenthesis.

Table 21. Summary of chinook biological samples collected at the canneries[a] in Vancouver during the seine fishery in Juan de Fuca Strait.

Length	Juveniles			Length	Jacks		
(cm)	M	F	U[b]	(cm)	M	F	U
33	1			43	33(7)	10(5)	
34	0	1(2)		44	50(11)	19(9)	
35	2(1)[c]	0		45	48(10)	19(9)	
36	3(2)	1(2)		46	37(8)	20(10)	
37	13(8)	3(5)		47	31(7)	11(5)	
38	17(11)	9(15)		48	29(6)	21(10)	
39	21(13)	10(16)		49	40(9)	9(4)	
40	34(22)	14(23)		50	36(8)	19(9)	
41	30(19)	7(11)		51	27(6)	23(11)	
42	34(22)	16(26)		52	33(7)	10(5)	
				53	20(4)	9(4)	
				54	20(4)	7(3)	
				55	18(4)	10(5)	
				56	19(4)	10(5)	
				57	20(4)	7(3)	
Total	155	61			461	204	
Weighted Mean Length	39.1	39.8			48.3	47.6	
Percent Immature	46%	98%			39%	85%	
Sex Ratio (%males)	72%				69%		

[a]For purposes of comparison with the survey data the cannery sample data were assigned to the jack and juvenile categories according to the criteria used for the survey data.
[b]Fish not sampled for sex and maturity.
[c]Percent frequency in parentheses.

Table 22. Available fishing time by fishery opening for Juan de Fuca Strait[a].

Date		Time of opening[b]	Available fishing hours
July	17	0700	12.0
	31	0700	12.0
Aug.	1	0700	12.0
	2	0700	12.0
	8	0700	12.0
	9	0700	12.0
	14	0700	12.0
	15	0700	12.0
	16	0700	12.0
	17	0700	12.0
	20	0700	12.0
	21	0700	12.0
	22	0700	12.0
	27	0700	12.0
	28	0700	12.0
	29	0700	12.0
Sept.	5	0700	12.0

[a]Statistical areas 20-1, 20-3, and 20-4.
[b]Universal time

Table 23. Average number of sets made per day per vessel by fishery line in Juan de Fuca Strait[1].

FISHING LINE	N	SETS/DAY[2]
1	199	5.2(1.8)
2	79	7.0(2.1)
3	35	7.6(2.2)
4	24	7.2(2.0)
5	27	7.7(1.9)
6	38	7.9(1.6)
7	41	7.6(1.9)
8	50	6.7(2.2)
9	35	6.9(1.9)
10	23	8.4(1.5)
11	6	9.5(1.9)
12	6	7.7(1.9)

[1]Mean number of sets made per day (all weeks combined)
[2]Standard deviation in parenthesis.

Table 24. Number of vessels that reported catch by week from sales slip data compared with overflight and fishery officers gear counts for Juan de Fuca Strait.

Area	Date	Sales slip count[a]	PSC overflight[b]	Ground count[c]
Juan de	July 17	86		85
Fuca	31	28		30
Strait	Aug. 1			33
	2			32
	8	116		115
	9		145	120
	14	161	145	158
	15			138
	16			158
	17			158
	20	177		179
	21			179
	22			179
	27	172		180
	28			155
	29			175
	Sept. 5	175	154	170

[a]Unique CFV licences delivering catch by stat. area, weekly totals only.
[b]Regular Pacific Salmon Commission overflight gear count.
[c]Gear count taken by fishery officers on fishing grounds.

Table 25. Fleet dynamics in Juan de Fuca Strait seine fishery.

		GEAR COUNT[a]			
DATE	TIME	BONILLA PT. (LINE 1,2)	OWEN PT. (LINE 3-9)	SOMBRIO PT.[c] (LINE 10-12)	SHERINGHAM PT. (LINE 13-20)
Aug. 14[b]	0900	30	60	50	20
	1200	60	40	45	15
	1500	53	76	15	16
	1800	75	45	25	15
Aug. 20	0750	15	57	40	67
	1200	30	49	50	50
	1730	75	80	12	12
Sept. 5	0700	30	50	40	50
	1200	60	30	50	30
	1500	80	45	25	20
	1700	80	30	40	20

[a]Radar gear counts recorded by Fishery officers in Patrol Vessels
[b]Gillnet fleet was present among seine fleet from 10:30 onwards.
[c]Past Owen Pt. vessels do not align along fishing lines as rigidly as in the first lines.

Table 26. Comparison of bootstrap estimates and sales slip data (numbers caught) by week for Juan de Fuca Strait.

WEEK	CHINOOK			SOCKEYE
	ADULT	JACK	JUVENILE	
July 17	1,529[a]	2,676	593	22,221
	(603-4111)[b]	(503-7450)	(83-1851)	(5224-50,010)
	524[c]	2,415	d	12,479
July 31-Aug 2	1,004	925	903	76,236
	(376-1623)	(347-2228)	(281-1819)	(42,853-122,332)
	1,380	604	d	175,644
Aug 8-9	1,982	2,055	1,495	557,783
	(1099-3456)	(695-3457)	(493-3616)	(303,547-1,541,683)
	2,671	1,650	d	458,101
Aug 14-17	5,956	2,988	3,296	1,045,414
	(3304-8496)	(1275-3998)	(1292-4538)	(585,278-1,435,463)
	5,390	1,991	d	1,200,155
Aug 20-22	5,407	2,759	1,919	785,264
	(3221-8136)	(764-4363)	(320-3348)	(578,968-1,214,685)
	2,686	1,102	d	760,038
Aug 27-29	2,390	497	542	228,084
	(1123-3926)	(67-1111)	(133-1186)	(146,746-316,261)
	1,663	802	d	179,537
Sept 5	526	120	207	13,457
	(16-2089)	(0-430)	(0-707)	(7260-26,517)
	305	235	d	7,463
TOTAL	18,793	12,019	8,956	2,728,460
	(14,033-23,107)	(7166-16,618)	(5772-11,953)	(2,000,000-3,810,130)
	14,619	8,799	d	2,793,417

[a]Bootstrap estimates.
[b]Upper and lower 95% confidence limits.
[c]Sales slip data collected by the Dept. of Fisheries and Oceans (Annual Summary, 1989).
[d]No data recorded for juveniles in sales slip data.

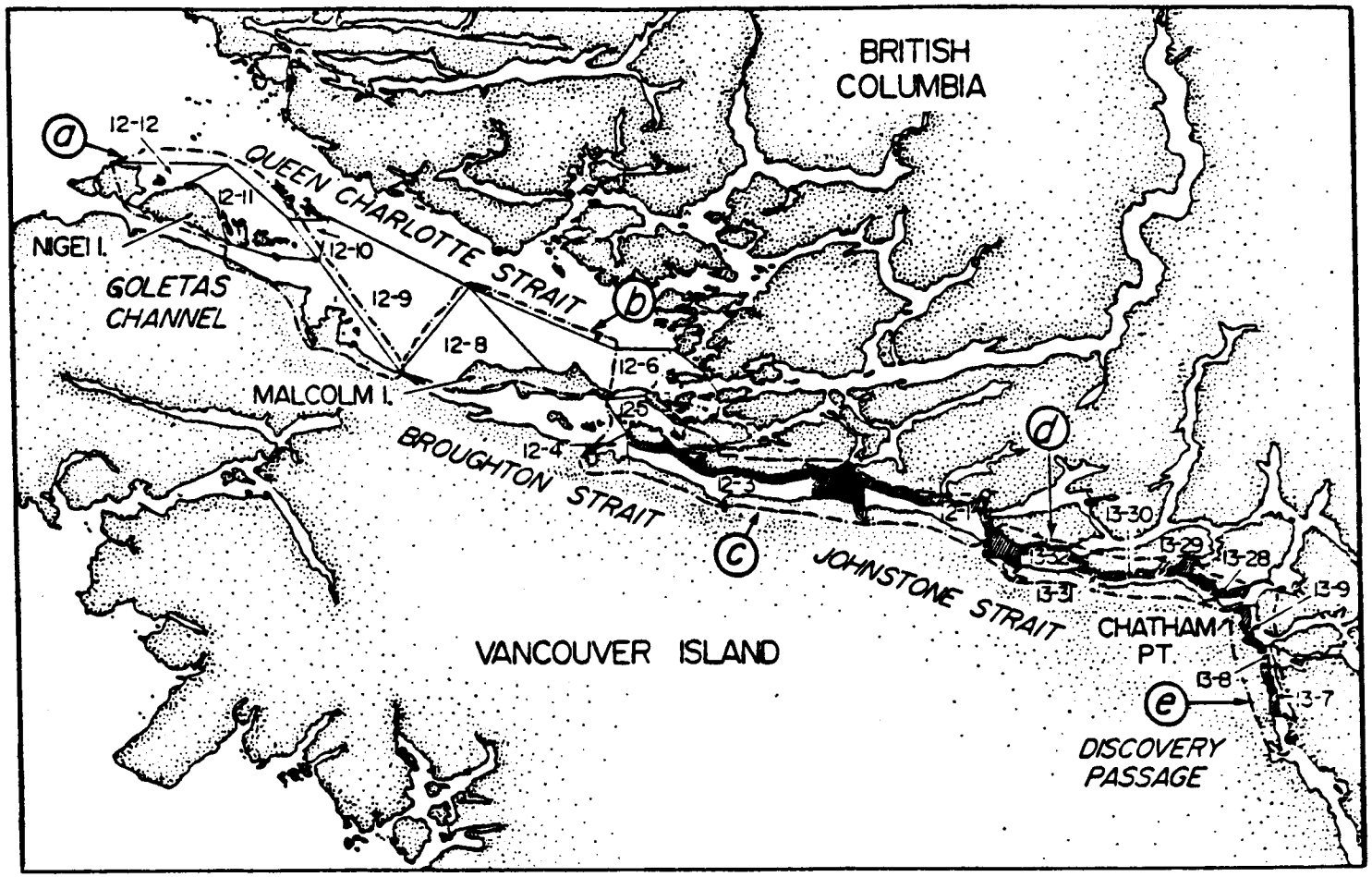


Fig. 1. Locations of management areas and study areas (a - Gordon Group, b - North Shore, c - Upper Johnstone Strait, d - Lower Johnstone Strait, e - Discovery Passage). Hatched sections represent areas closed to commercial fishing.

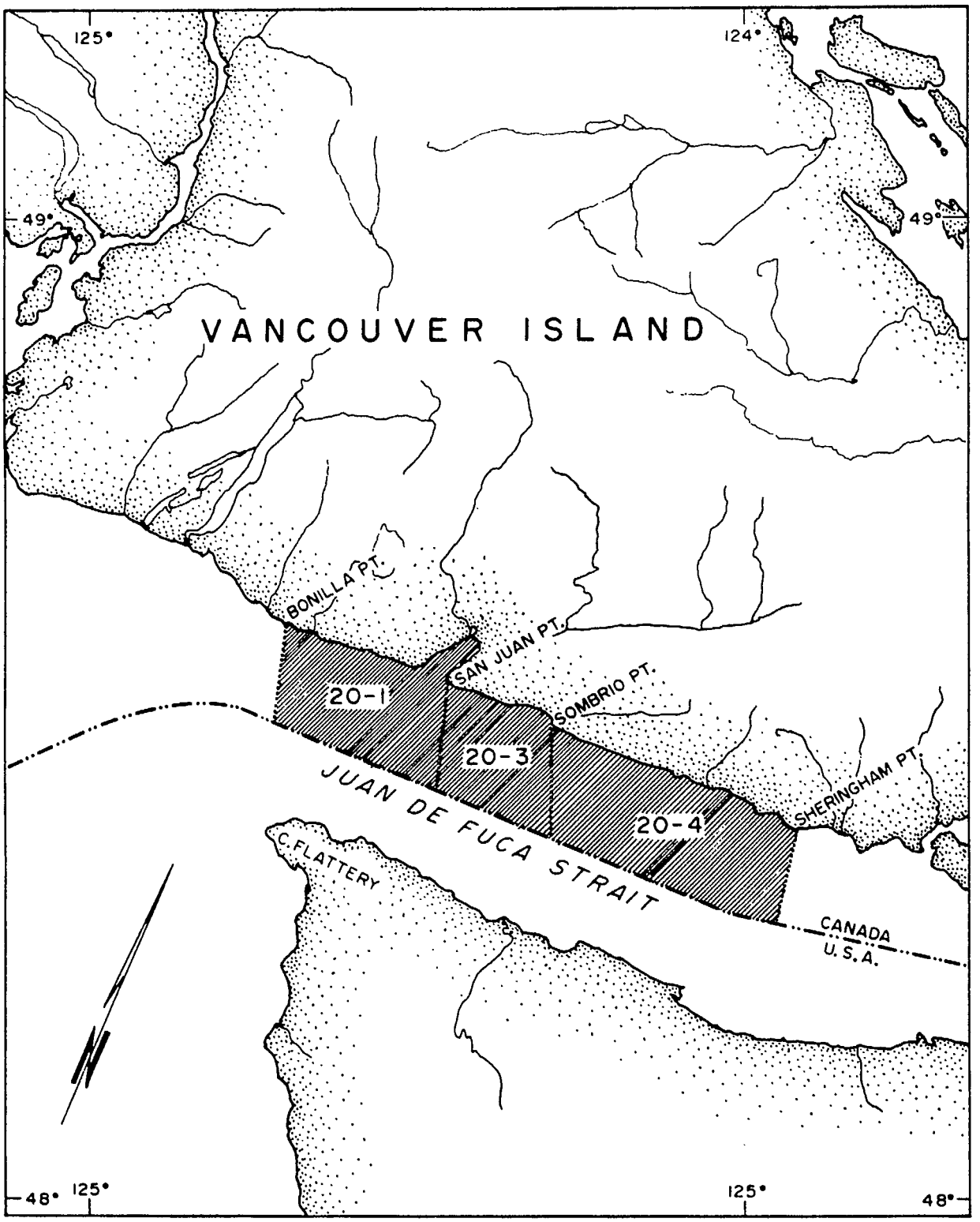
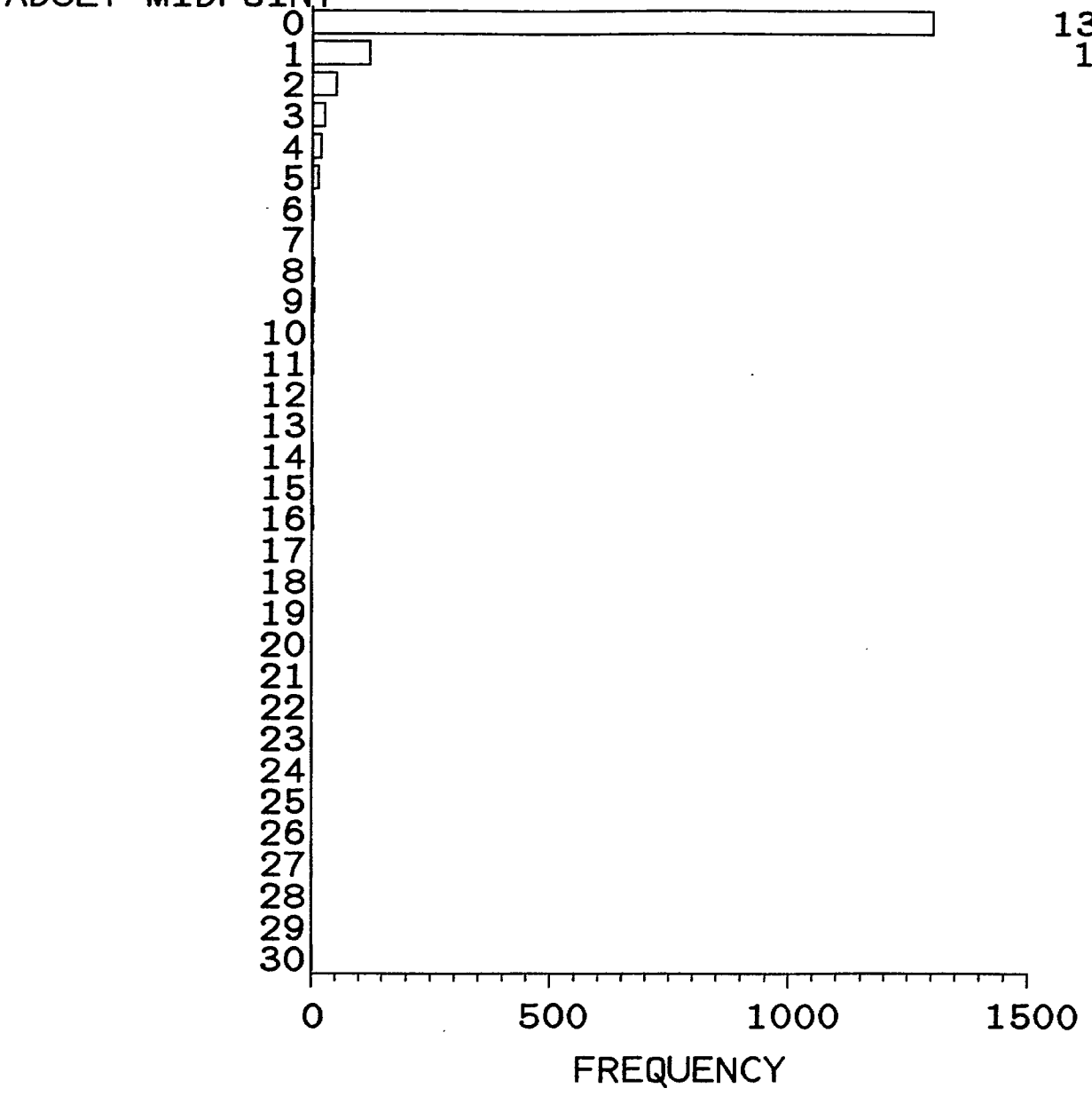
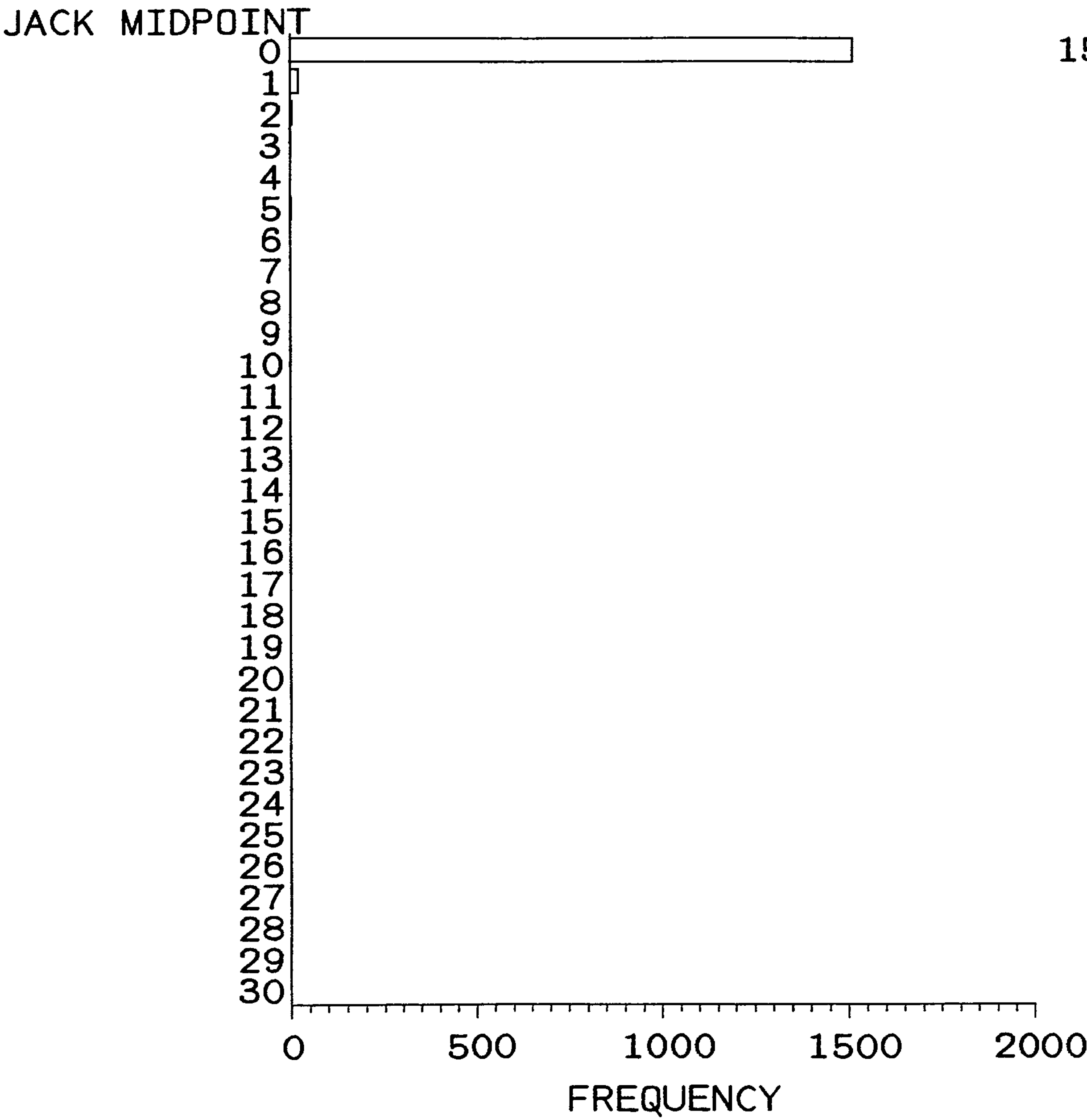


Fig. 2 Study areas in Juan de Fuca Strait sockeye seine fishery.



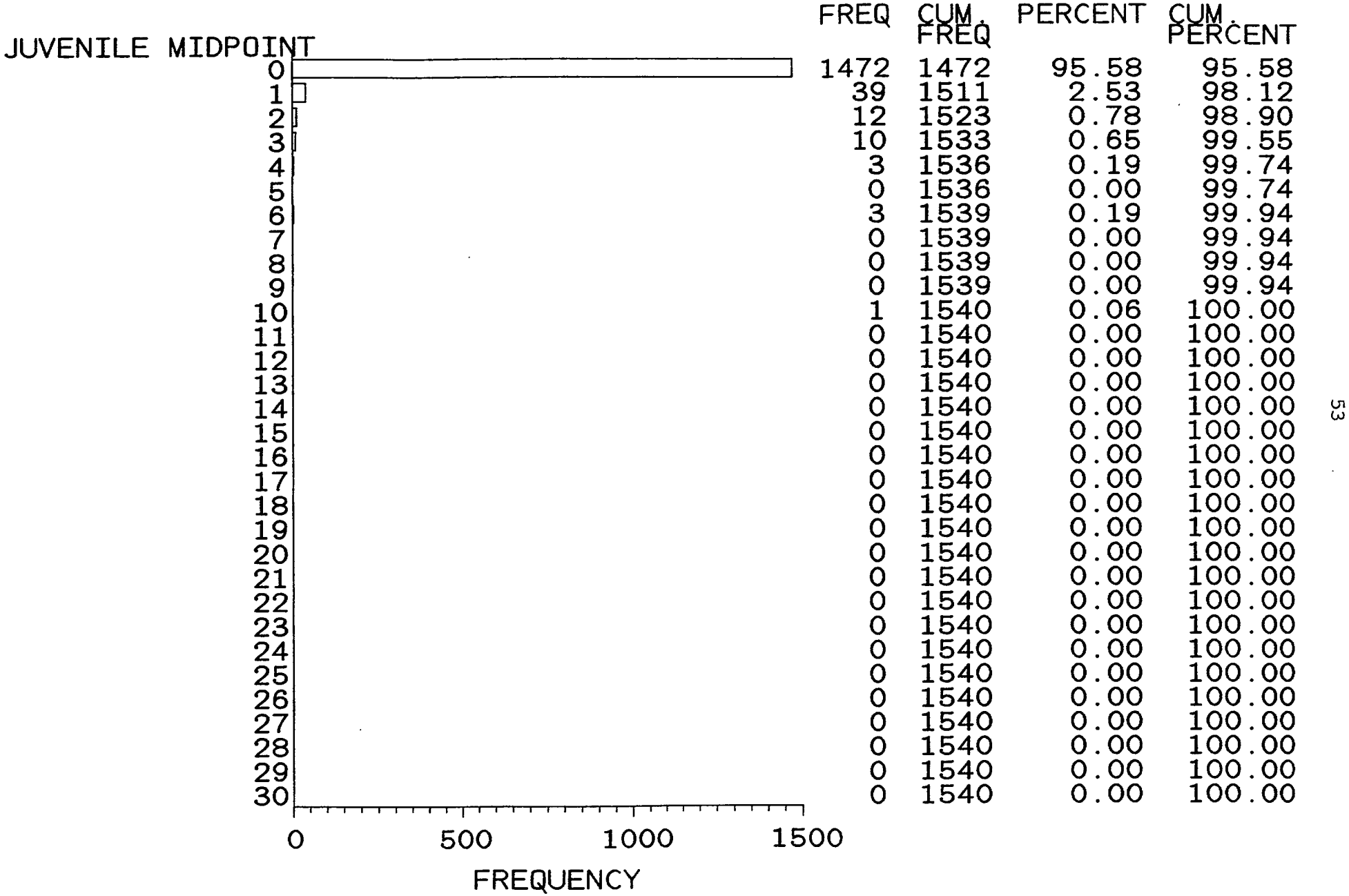
MIDPOINT	FREQ	CUM. FREQ	PERCENT	CUM. PERCENT
0	1302	1302	84.55	84.55
1	120	1422	7.79	92.34
2	50	1472	3.25	95.58
3	25	1497	1.62	97.21
4	18	1515	1.17	98.38
5	12	1527	0.78	99.16
6	2	1529	0.13	99.29
7	0	1529	0.00	99.29
8	2	1531	0.13	99.42
9	3	1534	0.19	99.61
10	1	1535	0.06	99.68
11	1	1536	0.06	99.74
12	0	1536	0.00	99.74
13	0	1536	0.00	99.74
14	1	1537	0.06	99.81
15	0	1537	0.00	99.81
16	2	1539	0.13	99.94
17	0	1539	0.00	99.94
18	0	1539	0.00	99.94
19	0	1539	0.00	99.94
20	0	1539	0.00	99.94
21	0	1539	0.00	99.94
22	0	1539	0.00	99.94
23	0	1539	0.00	99.94
24	0	1539	0.00	99.94
25	0	1539	0.00	99.94
26	0	1539	0.00	99.94
27	0	1539	0.00	99.94
28	0	1539	0.00	99.94
29	0	1539	0.00	99.94
30	1	1540	0.06	100.00

Fig.3 Catch/set for adult chinook in Johnstone Strait, 1989



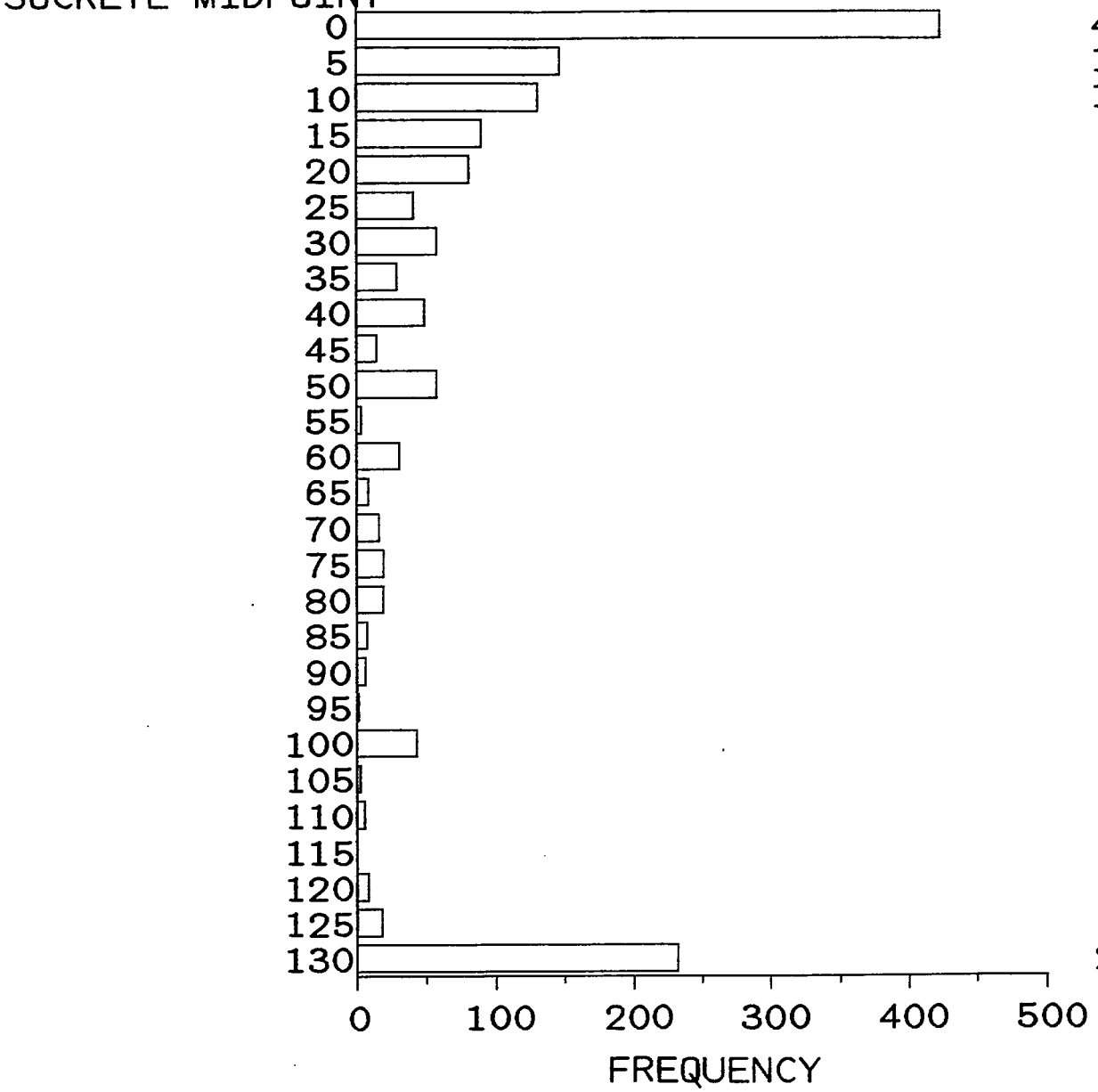
JACK MIDPOINT	FREQ	CUM. FREQ	PERCENT	CUM. PERCENT
0	1513	1513	98.25	98.25
1	21	1534	1.36	99.61
2	4	1538	0.26	99.87
3	1	1539	0.06	99.94
4	0	1539	0.00	99.94
5	1	1540	0.06	100.00
6	0	1540	0.00	100.00
7	0	1540	0.00	100.00
8	0	1540	0.00	100.00
9	0	1540	0.00	100.00
10	0	1540	0.00	100.00
11	0	1540	0.00	100.00
12	0	1540	0.00	100.00
13	0	1540	0.00	100.00
14	0	1540	0.00	100.00
15	0	1540	0.00	100.00
16	0	1540	0.00	100.00
17	0	1540	0.00	100.00
18	0	1540	0.00	100.00
19	0	1540	0.00	100.00
20	0	1540	0.00	100.00
21	0	1540	0.00	100.00
22	0	1540	0.00	100.00
23	0	1540	0.00	100.00
24	0	1540	0.00	100.00
25	0	1540	0.00	100.00
26	0	1540	0.00	100.00
27	0	1540	0.00	100.00
28	0	1540	0.00	100.00
29	0	1540	0.00	100.00
30	0	1540	0.00	100.00

Fig.4 Catch/set for jack chinook in Johnstone Strait, 1989



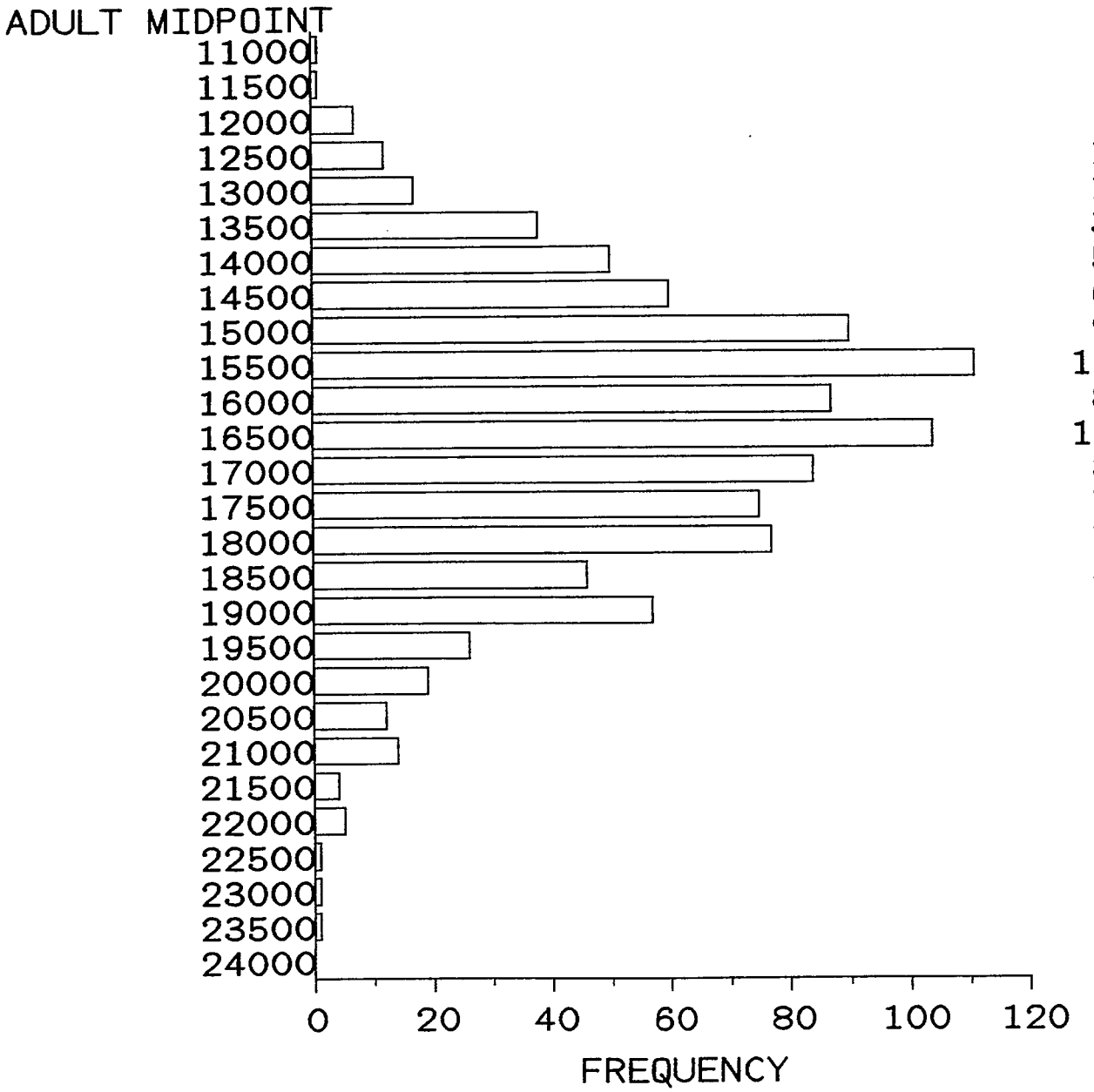
JUVENILE MIDPOINT	FREQ	CUM. FREQ	PERCENT	CUM. PERCENT
0	1472	1472	95.58	95.58
1	39	1511	2.53	98.12
2	12	1523	0.78	98.90
3	10	1533	0.65	99.55
4	3	1536	0.19	99.74
5	0	1536	0.00	99.74
6	3	1539	0.19	99.94
7	0	1539	0.00	99.94
8	0	1539	0.00	99.94
9	0	1539	0.00	99.94
10	1	1540	0.06	100.00
11	0	1540	0.00	100.00
12	0	1540	0.00	100.00
13	0	1540	0.00	100.00
14	0	1540	0.00	100.00
15	0	1540	0.00	100.00
16	0	1540	0.00	100.00
17	0	1540	0.00	100.00
18	0	1540	0.00	100.00
19	0	1540	0.00	100.00
20	0	1540	0.00	100.00
21	0	1540	0.00	100.00
22	0	1540	0.00	100.00
23	0	1540	0.00	100.00
24	0	1540	0.00	100.00
25	0	1540	0.00	100.00
26	0	1540	0.00	100.00
27	0	1540	0.00	100.00
28	0	1540	0.00	100.00
29	0	1540	0.00	100.00
30	0	1540	0.00	100.00

Fig.5 Catch/set for juvenile chinook in Johnstone Strait, 1989



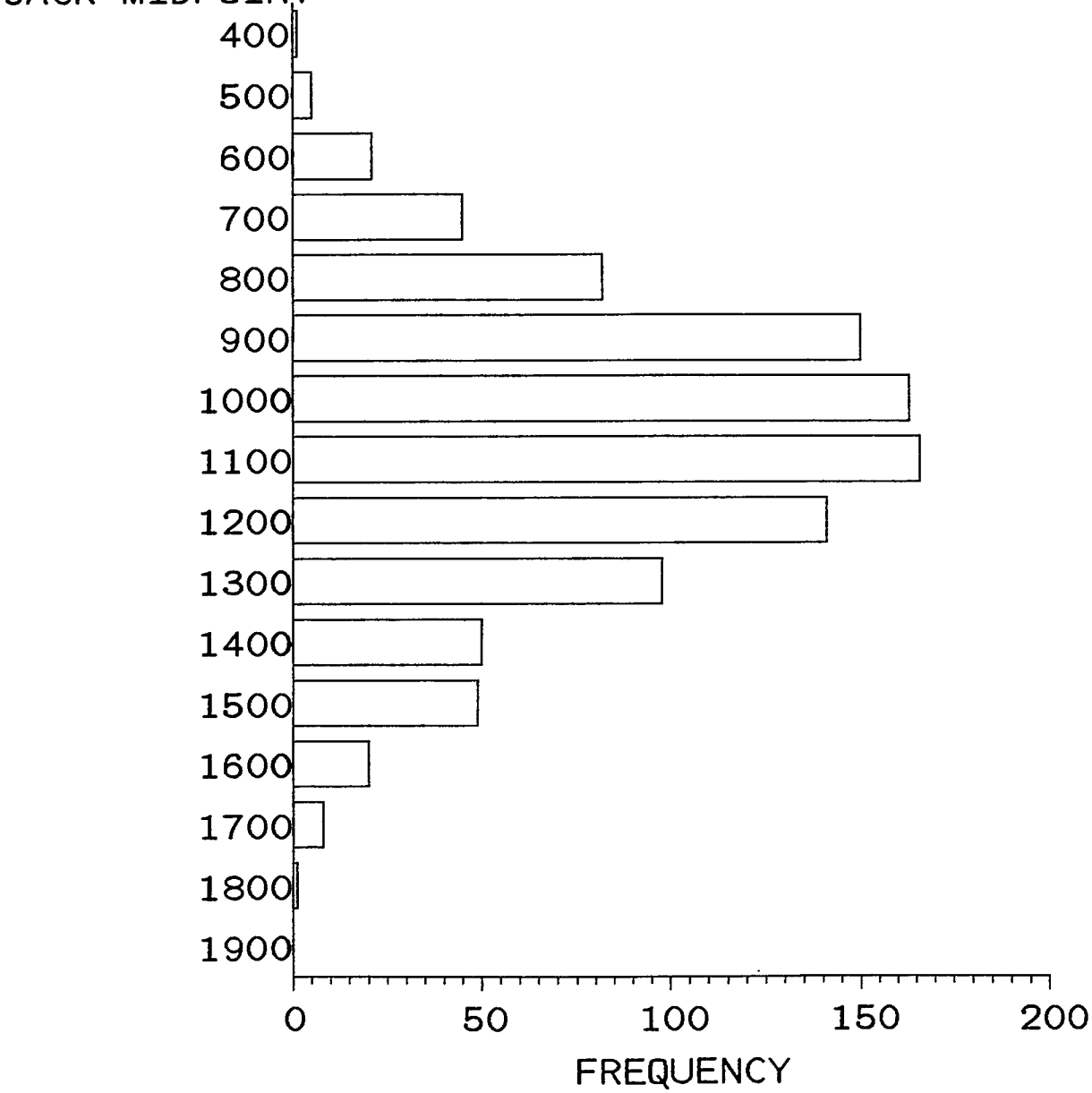
SOCKEYE MIDPOINT	FREQ	CUM. FREQ	PERCENT	CUM. PERCENT
0	424	424	27.53	27.53
5	147	571	9.55	37.08
10	131	702	8.51	45.58
15	90	792	5.84	51.43
20	81	873	5.26	56.69
25	41	914	2.66	59.35
30	58	972	3.77	63.12
35	29	1001	1.88	65.00
40	49	1050	3.18	68.18
45	14	1064	0.91	69.09
50	58	1122	3.77	72.86
55	3	1125	0.19	73.05
60	31	1156	2.01	75.06
65	8	1164	0.52	75.58
70	16	1180	1.04	76.62
75	19	1199	1.23	77.86
80	19	1218	1.23	79.09
85	7	1225	0.45	79.55
90	6	1231	0.39	79.94
95	1	1232	0.06	80.00
100	43	1275	2.79	82.79
105	2	1277	0.13	82.92
110	5	1282	0.32	83.25
115	0	1282	0.00	83.25
120	8	1290	0.52	83.77
125	18	1308	1.17	84.94
130	232	1540	15.06	100.00

Fig.6 Catch/set for sockeye in Johnstone Strait, 1989



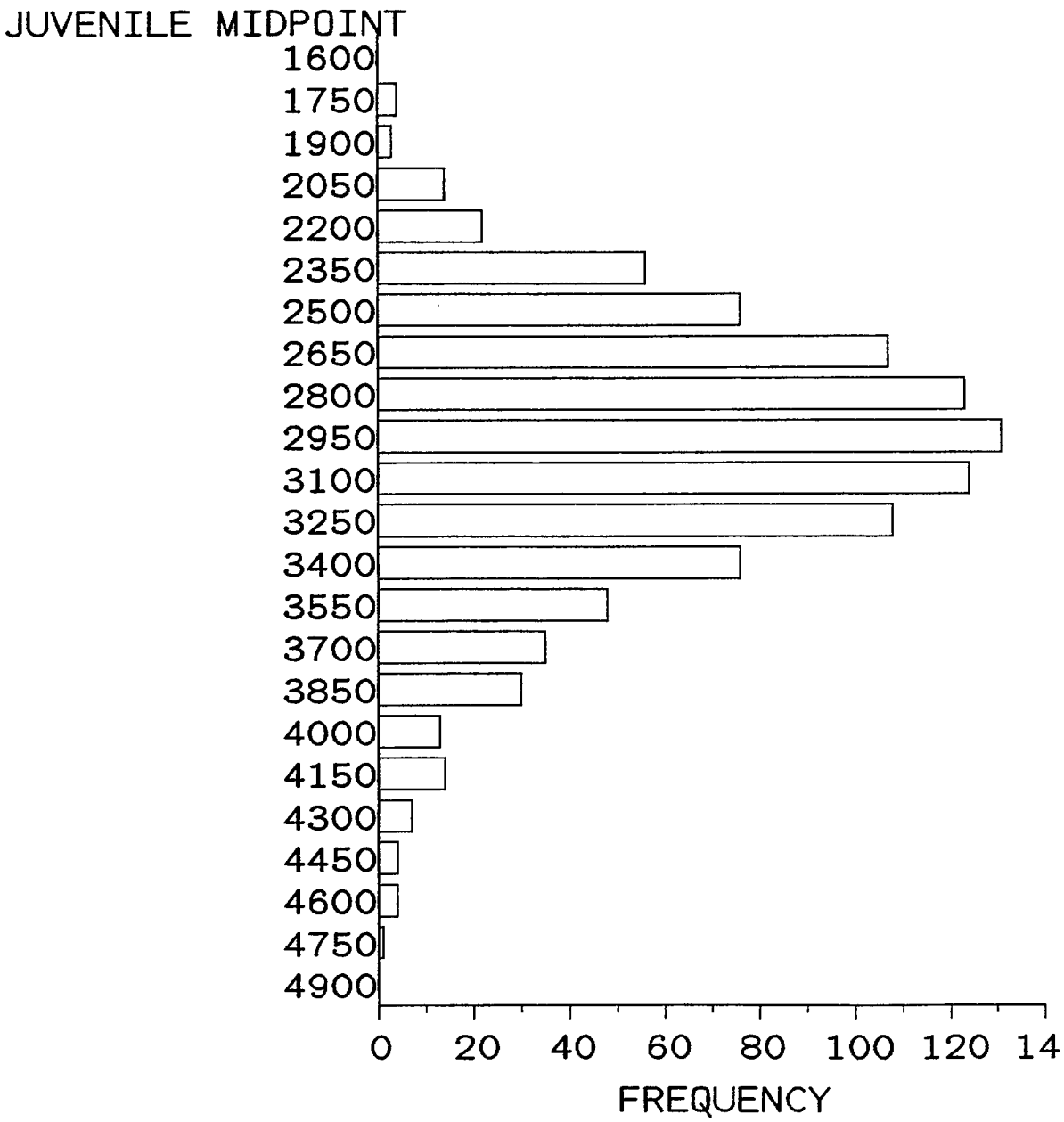
FREQ	CUM. FREQ	PERCENT	CUM. PERCENT
1	1	0.1	0.1
1	2	0.1	0.2
7	9	0.7	0.9
12	21	1.2	2.1
17	38	1.7	3.8
38	76	3.8	7.6
50	126	5.0	12.6
60	186	6.0	18.6
90	276	9.0	27.6
111	387	11.1	38.7
87	474	8.7	47.4
104	578	10.4	57.8
84	662	8.4	66.2
75	737	7.5	73.7
77	814	7.7	81.4
46	860	4.6	86.0
57	917	5.7	91.7
26	943	2.6	94.3
19	962	1.9	96.2
12	974	1.2	97.4
14	988	1.4	98.8
4	992	0.4	99.2
5	997	0.5	99.7
1	998	0.1	99.8
1	999	0.1	99.9
1	1000	0.1	100.0
0	1000	0.0	100.0

Fig.7 Bootstrap estimates for adult chinook in Johnstone Strait, 1989



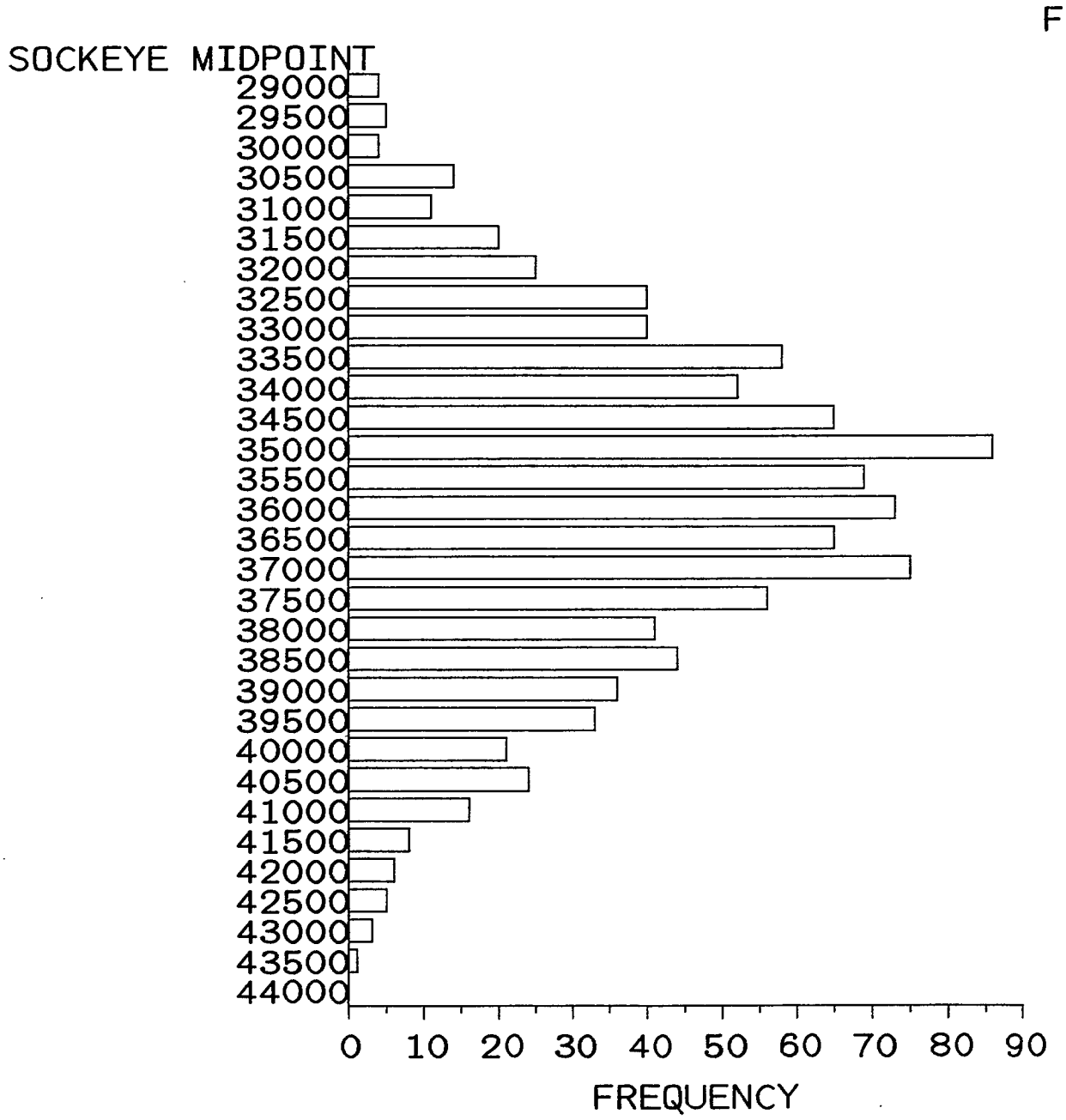
JACK MIDPOINT	FREQ	CUM. FREQ	PERCENT	CUM. PERCENT
400	1	1	0.1	0.1
500	5	6	0.5	0.6
600	21	27	2.1	2.7
700	45	72	4.5	7.2
800	82	154	8.2	15.4
900	150	304	15.0	30.4
1000	163	467	16.3	46.7
1100	166	633	16.6	63.3
1200	141	774	14.1	77.4
1300	98	872	9.8	87.2
1400	50	922	5.0	92.2
1500	49	971	4.9	97.1
1600	20	991	2.0	99.1
1700	8	999	0.8	99.9
1800	1	1000	0.1	100.0
1900	0	1000	0.0	100.0

Fig.8 Bootstrap estimates for jack chinook in Johnstone Strait, 1989



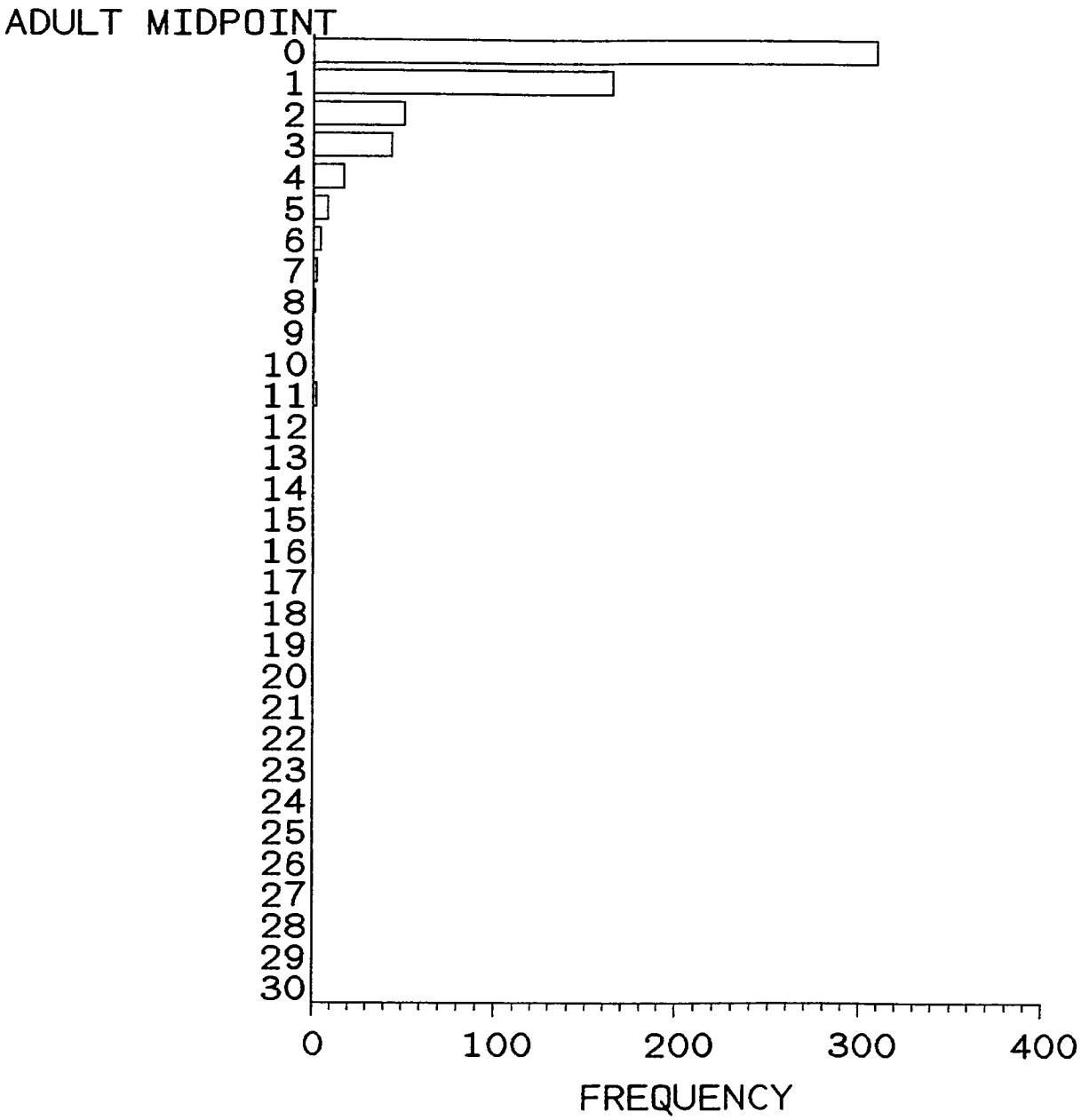
MIDPOINT	FREQ	CUM. FREQ	PERCENT	CUM. PERCENT
1600	0	0	0.0	0
1750	4	4	0.4	0
1900	3	7	0.3	1
2050	14	21	1.4	2
2200	22	43	2.2	4
2350	56	99	5.6	10
2500	76	175	7.6	18
2650	107	282	10.7	28
2800	123	405	12.3	41
2950	131	536	13.1	54
3100	124	660	12.4	66
3250	108	768	10.8	77
3400	76	844	7.6	84
3550	48	892	4.8	89
3700	35	927	3.5	93
3850	30	957	3.0	96
4000	13	970	1.3	97
4150	14	984	1.4	98
4300	7	991	0.7	99
4450	4	995	0.4	100
4600	4	999	0.4	100
4750	1	1000	0.1	100
4900	0	1000	0.0	100

Fig.9 Bootstrap estimates for juvenile chinook in Johnstone Strait, 1989



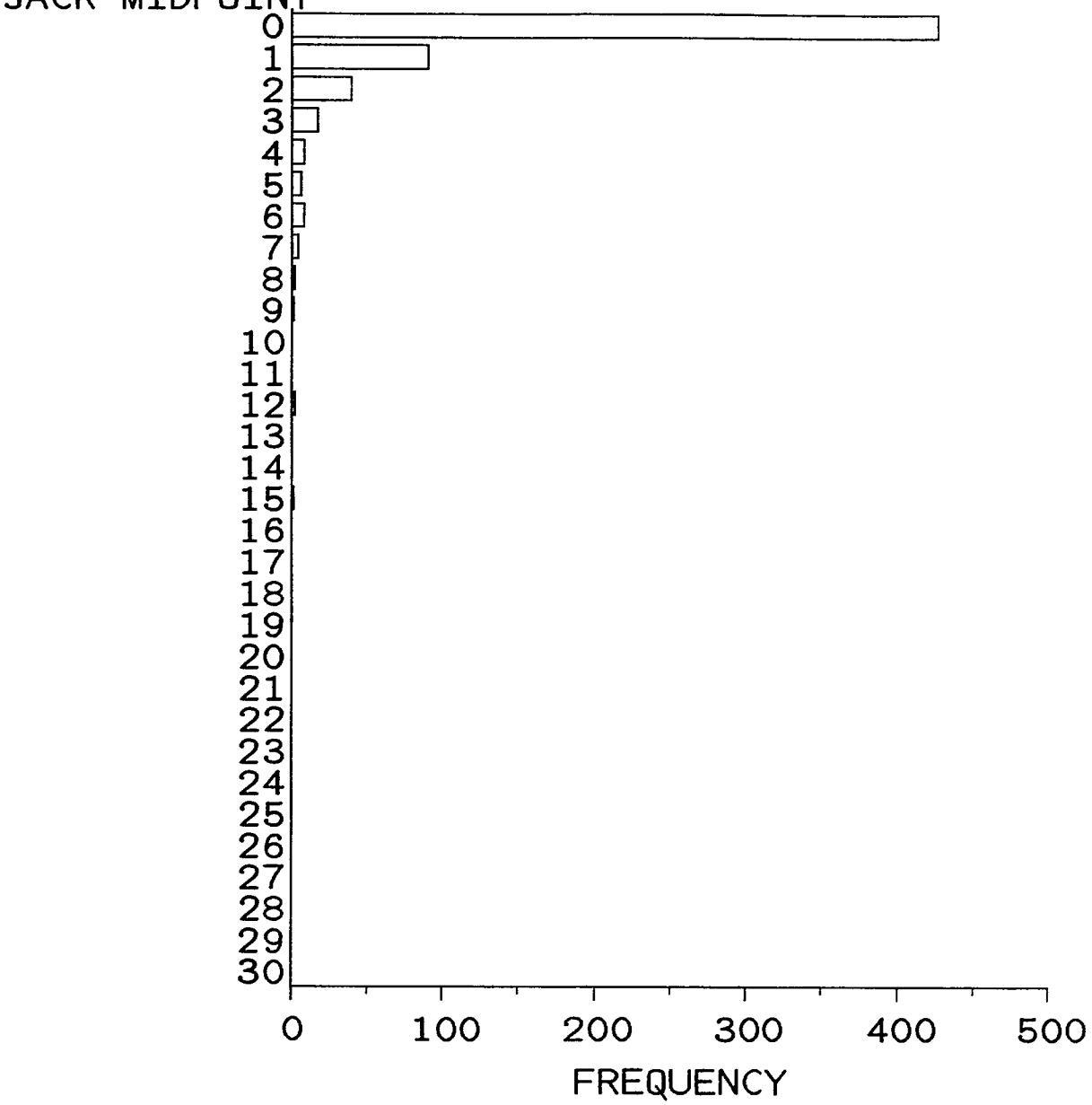
SOCKEYE MIDPOINT	FREQ	CUM. FREQ	PERCENT	CUM. PERCENT
29000	4	4	0.4	0.4
29500	5	9	0.5	0.9
30000	4	13	0.4	1.3
30500	14	27	1.4	2.7
31000	11	38	1.1	3.8
31500	20	58	2.0	5.8
32000	25	83	2.5	8.3
32500	40	123	4.0	12.3
33000	40	163	4.0	16.3
33500	58	221	5.8	22.1
34000	52	273	5.2	27.3
34500	65	338	6.5	33.8
35000	86	424	8.6	42.4
35500	69	493	6.9	49.3
36000	73	566	7.3	56.6
36500	65	631	6.5	63.1
37000	75	706	7.5	70.6
37500	56	762	5.6	76.2
38000	41	803	4.1	80.3
38500	44	847	4.4	84.7
39000	36	883	3.6	88.3
39500	33	916	3.3	91.6
40000	21	937	2.1	93.7
40500	24	961	2.4	96.1
41000	16	977	1.6	97.7
41500	8	985	0.8	98.5
42000	6	991	0.6	99.1
42500	5	996	0.5	99.6
43000	3	999	0.3	99.9
43500	1	1000	0.1	100.0
44000	0	1000	0.0	100.0

Fig.10 Bootstrap estimates for sockeye in Johnstone Strait, 1989



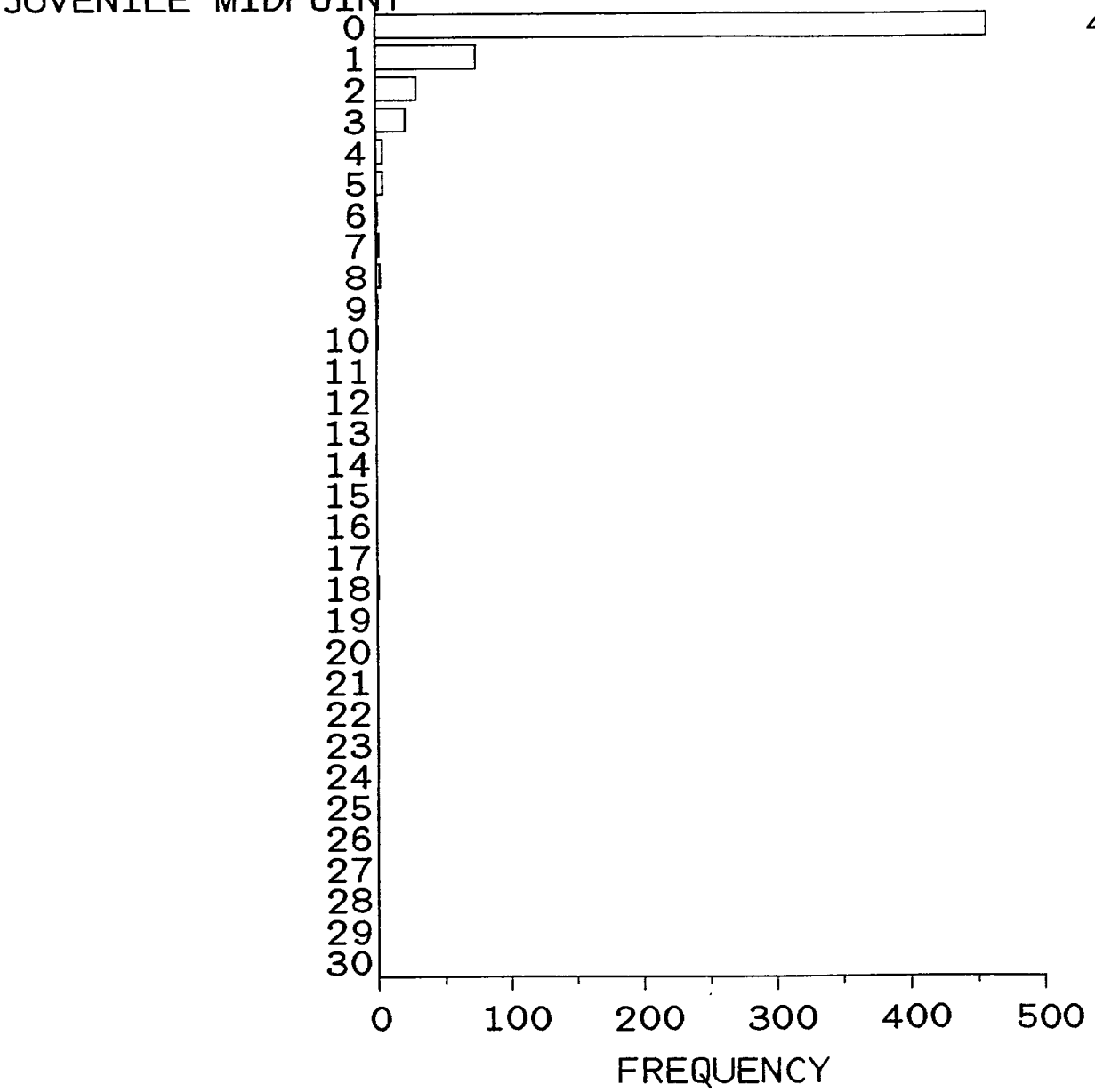
ADULT MIDPOINT	FREQ	CUM. FREQ	PERCENT	CUM. PERCENT
0	310	310	51.32	51.32
1	165	475	27.32	78.64
2	51	526	8.44	87.09
3	44	570	7.28	94.37
4	17	587	2.81	97.19
5	8	595	1.32	98.51
6	4	599	0.66	99.17
7	2	601	0.33	99.50
8	1	602	0.17	99.67
9	0	602	0.00	99.67
10	0	602	0.00	99.67
11	2	604	0.33	100.00
12	0	604	0.00	100.00
13	0	604	0.00	100.00
14	0	604	0.00	100.00
15	0	604	0.00	100.00
16	0	604	0.00	100.00
17	0	604	0.00	100.00
18	0	604	0.00	100.00
19	0	604	0.00	100.00
20	0	604	0.00	100.00
21	0	604	0.00	100.00
22	0	604	0.00	100.00
23	0	604	0.00	100.00
24	0	604	0.00	100.00
25	0	604	0.00	100.00
26	0	604	0.00	100.00
27	0	604	0.00	100.00
28	0	604	0.00	100.00
29	0	604	0.00	100.00
30	0	604	0.00	100.00

Fig.11 Catch/set for adult chinook in Juan de Fuca, 1989



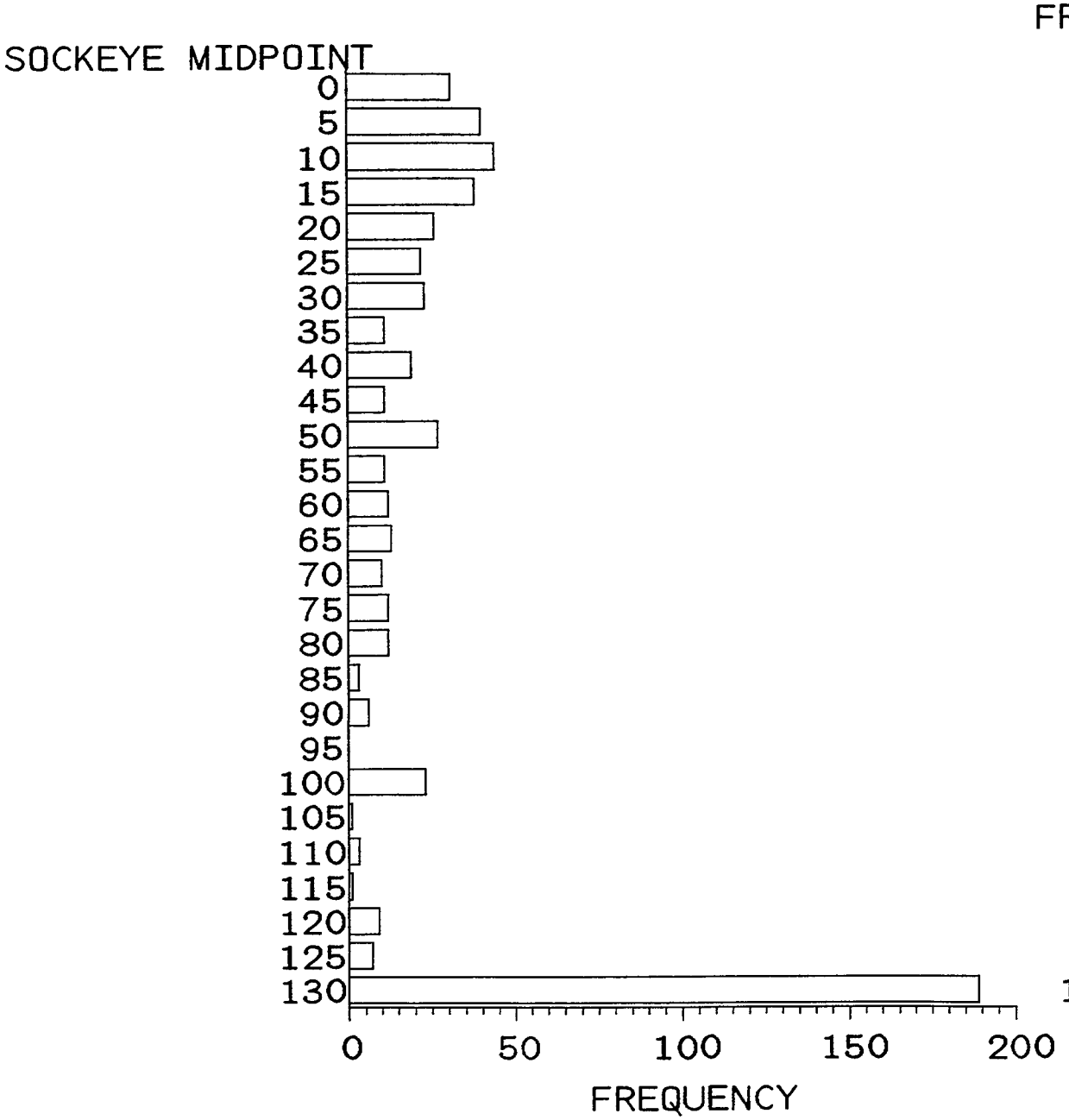
JACK MIDPOINT	FREQ	CUM. FREQ	PERCENT	CUM. PERCENT
0	426	426	70.53	70.53
1	90	516	14.90	85.43
2	39	555	6.46	91.89
3	17	572	2.81	94.70
4	8	580	1.32	96.03
5	6	586	0.99	97.02
6	8	594	1.32	98.34
7	4	598	0.66	99.01
8	2	600	0.33	99.34
9	1	601	0.17	99.50
10	0	601	0.00	99.50
11	0	601	0.00	99.50
12	2	603	0.33	99.83
13	0	603	0.00	99.83
14	0	603	0.00	99.83
15	1	604	0.17	100.00
16	0	604	0.00	100.00
17	0	604	0.00	100.00
18	0	604	0.00	100.00
19	0	604	0.00	100.00
20	0	604	0.00	100.00
21	0	604	0.00	100.00
22	0	604	0.00	100.00
23	0	604	0.00	100.00
24	0	604	0.00	100.00
25	0	604	0.00	100.00
26	0	604	0.00	100.00
27	0	604	0.00	100.00
28	0	604	0.00	100.00
29	0	604	0.00	100.00
30	0	604	0.00	100.00

Fig.12 Catch/set for jack chinook in Juan de Fuca, 1989



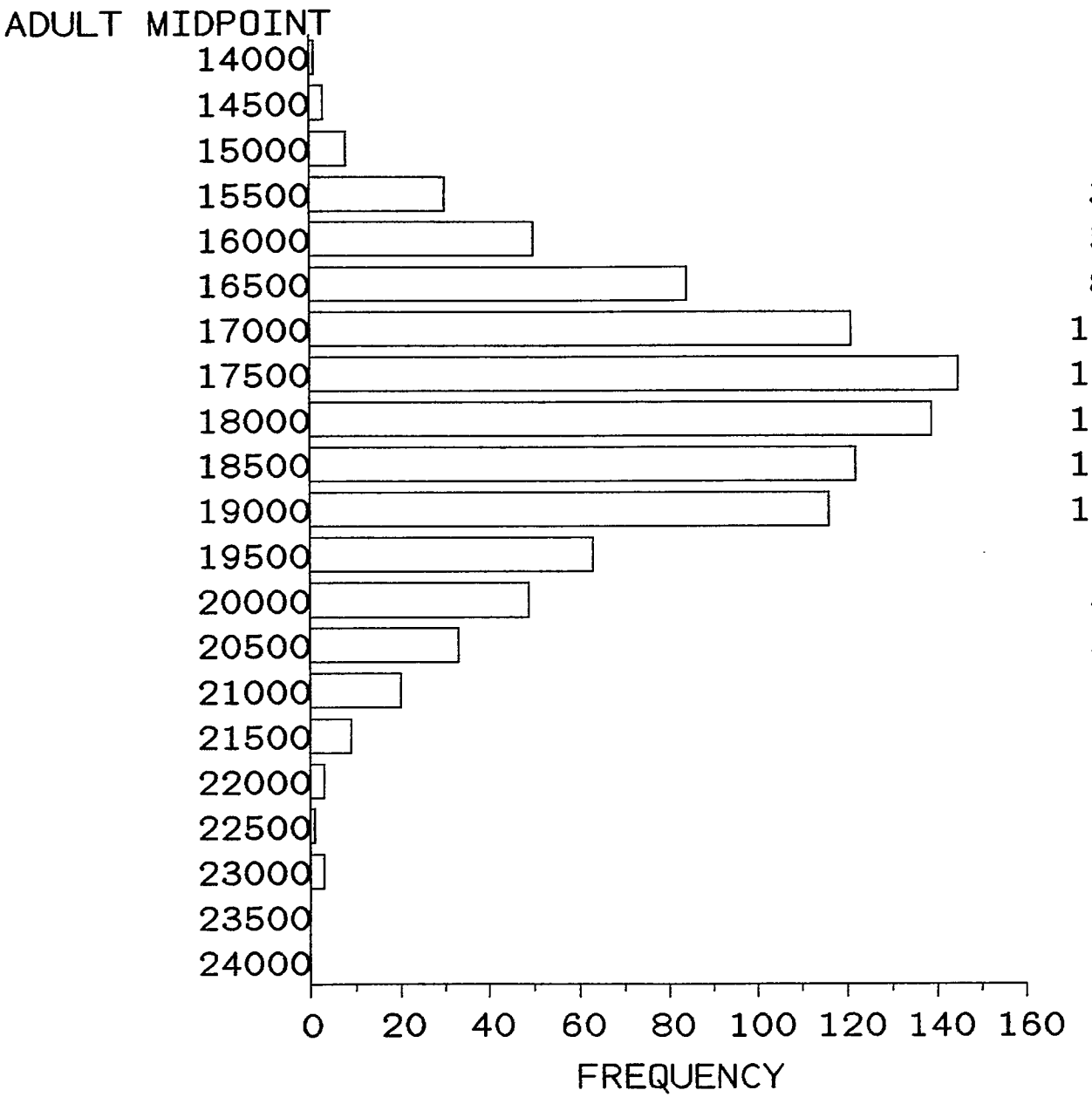
JUVENILE MIDPOINT	FREQ	CUM. FREQ	PERCENT	CUM. PERCENT
0	458	458	75.83	75.83
1	75	533	12.42	88.25
2	30	563	4.97	93.21
3	22	585	3.64	96.85
4	5	590	0.83	97.68
5	5	595	0.83	98.51
6	1	596	0.17	98.68
7	2	598	0.33	99.01
8	3	601	0.50	99.50
9	1	602	0.17	99.67
10	1	603	0.17	99.83
11	0	603	0.00	99.83
12	0	603	0.00	99.83
13	0	603	0.00	99.83
14	0	603	0.00	99.83
15	0	603	0.00	99.83
16	0	603	0.00	99.83
17	0	603	0.00	99.83
18	1	604	0.17	100.00
19	0	604	0.00	100.00
20	0	604	0.00	100.00
21	0	604	0.00	100.00
22	0	604	0.00	100.00
23	0	604	0.00	100.00
24	0	604	0.00	100.00
25	0	604	0.00	100.00
26	0	604	0.00	100.00
27	0	604	0.00	100.00
28	0	604	0.00	100.00
29	0	604	0.00	100.00
30	0	604	0.00	100.00

Fig.13 Catch/set for juvenile chinook in Juan de Fuca, 1989



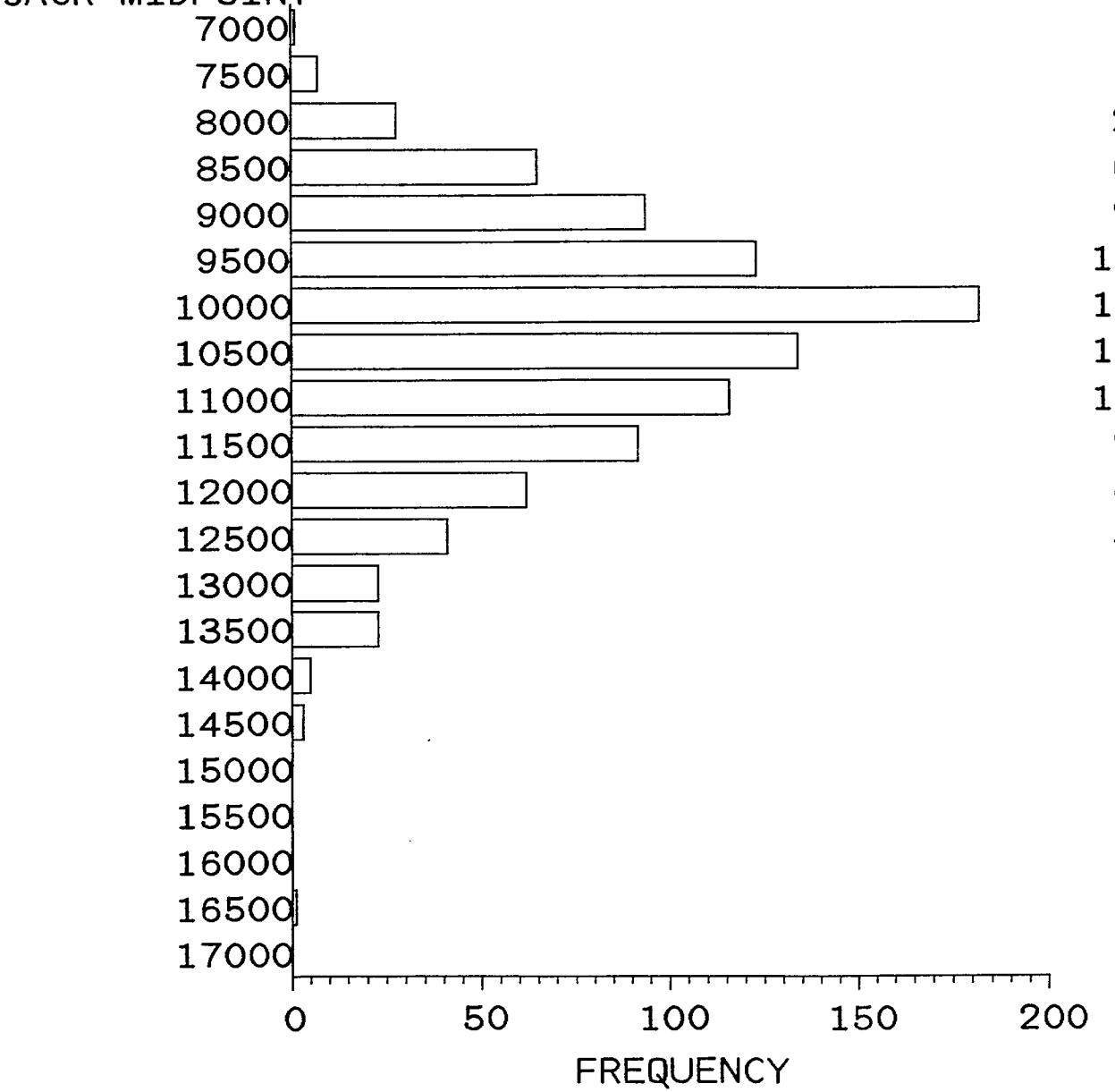
SOCKEYE MIDPOINT	FREQ	CUM. FREQ	PERCENT	CUM. PERCENT
0	31	31	5.13	5.13
5	40	71	6.62	11.75
10	44	115	7.28	19.04
15	38	153	6.29	25.33
20	26	179	4.30	29.64
25	22	201	3.64	33.28
30	23	224	3.81	37.09
35	11	235	1.82	38.91
40	19	254	3.15	42.05
45	11	265	1.82	43.87
50	27	292	4.47	48.34
55	11	303	1.82	50.17
60	12	315	1.99	52.15
65	13	328	2.15	54.30
70	10	338	1.66	55.96
75	12	350	1.99	57.95
80	12	362	1.99	59.93
85	3	365	0.50	60.43
90	6	371	0.99	61.42
95	0	371	0.00	61.42
100	23	394	3.81	65.23
105	1	395	0.17	65.40
110	3	398	0.50	65.89
115	1	399	0.17	66.06
120	9	408	1.49	67.55
125	7	415	1.16	68.71
130	189	604	31.29	100.00

Fig.14 Catch/set for sockeye in Juan de Fuca, 1989



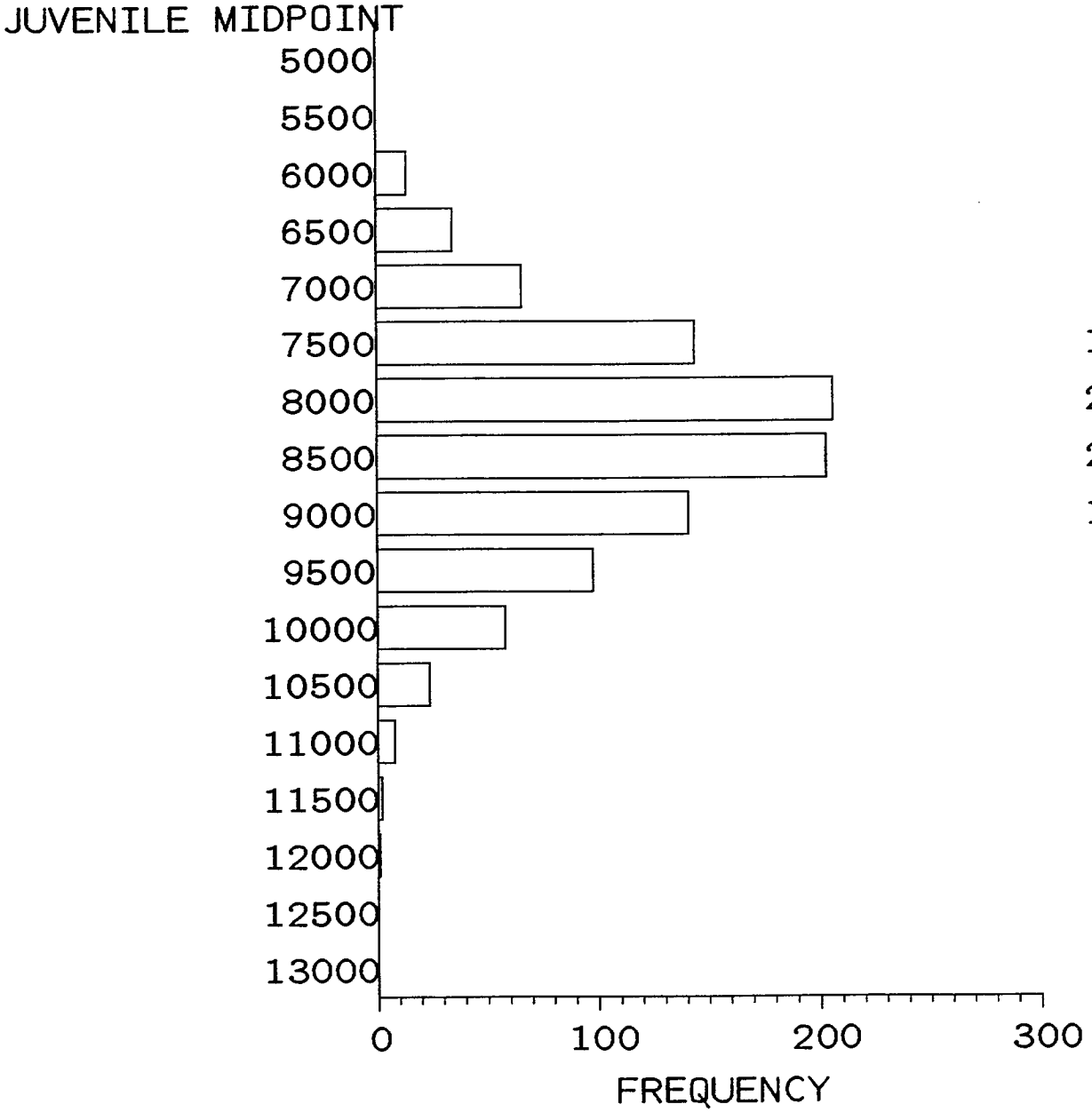
ADULT MIDPOINT	FREQ	CUM. FREQ	PERCENT	CUM. PERCENT
14000	1	1	0.1	0.1
14500	3	4	0.3	0.4
15000	8	12	0.8	1.2
15500	30	42	3.0	4.2
16000	50	92	5.0	9.2
16500	84	176	8.4	17.6
17000	121	297	12.1	29.7
17500	145	442	14.5	44.2
18000	139	581	13.9	58.1
18500	122	703	12.2	70.3
19000	116	819	11.6	81.9
19500	63	882	6.3	88.2
20000	49	931	4.9	93.1
20500	33	964	3.3	96.4
21000	20	984	2.0	98.4
21500	9	993	0.9	99.3
22000	3	996	0.3	99.6
22500	1	997	0.1	99.7
23000	3	1000	0.3	100.0
23500	0	1000	0.0	100.0
24000	0	1000	0.0	100.0

Fig.15 Bootstrap estimates for adult chinook in Juan de Fuca, 1989



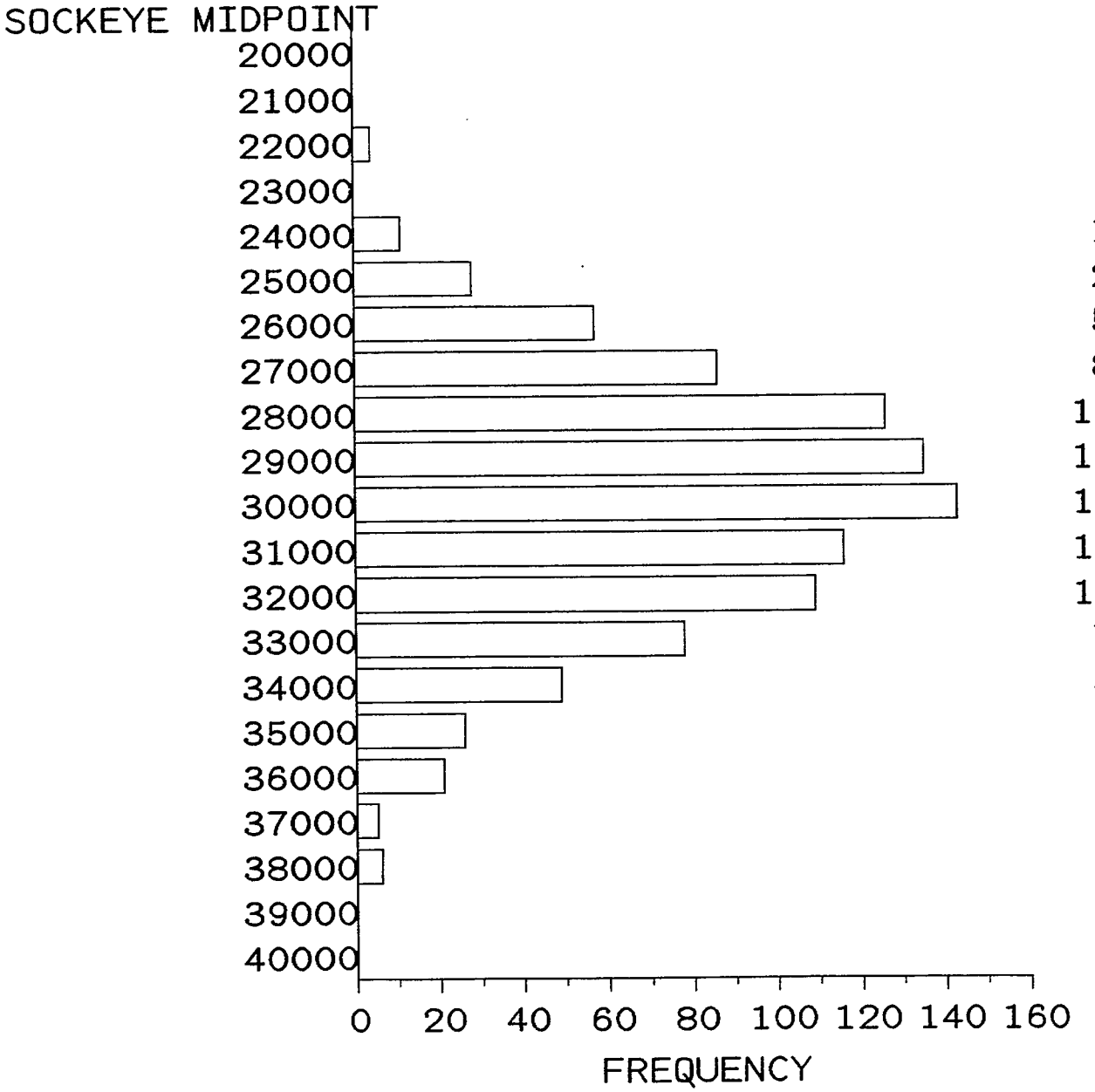
JACK MIDPOINT	FREQ	CUM. FREQ	PERCENT	CUM. PERCENT
7000	1	1	0.1	0.1
7500	7	8	0.7	0.8
8000	28	36	2.8	3.6
8500	65	101	6.5	10.1
9000	94	195	9.4	19.5
9500	123	318	12.3	31.8
10000	182	500	18.2	50.0
10500	134	634	13.4	63.4
11000	116	750	11.6	75.0
11500	92	842	9.2	84.2
12000	62	904	6.2	90.4
12500	41	945	4.1	94.5
13000	23	968	2.3	96.8
13500	23	991	2.3	99.1
14000	5	996	0.5	99.6
14500	3	999	0.3	99.9
15000	0	999	0.0	99.9
15500	0	999	0.0	99.9
16000	0	999	0.0	99.9
16500	1	1000	0.1	100.0
17000	0	1000	0.0	100.0

Fig.16 Bootstrap estimates for jack chinook in Juan de Fuca, 1989



JUVENILE MIDPOINT	FREQ	CUM. FREQ	PERCENT	CUM. PERCENT
5000	0	0	0.0	0
5500	0	0	0.0	0
6000	14	14	1.4	1
6500	35	49	3.5	5
7000	66	115	6.6	12
7500	144	259	14.4	26
8000	206	465	20.6	47
8500	203	668	20.3	67
9000	141	809	14.1	81
9500	98	907	9.8	91
10000	58	965	5.8	97
10500	24	989	2.4	99
11000	8	997	0.8	100
11500	2	999	0.2	100
12000	1	1000	0.1	100
12500	0	1000	0.0	100
13000	0	1000	0.0	100

Fig.17 Bootstrap estimates for juvenile chinook in Juan de Fuca, 1989



FREQ	CUM. FREQ	PERCENT	CUM. PERCENT
0	0	0.0	0
0	0	0.0	0
4	4	0.4	0
0	4	0.0	0
11	15	1.1	2
28	43	2.8	4
57	100	5.7	10
86	186	8.6	19
126	312	12.6	31
135	447	13.5	45
143	590	14.3	59
116	706	11.6	71
109	815	10.9	82
78	893	7.8	89
49	942	4.9	94
26	968	2.6	97
21	989	2.1	99
5	994	0.5	99
6	1000	0.6	100
0	1000	0.0	100
0	1000	0.0	100

Fig.18 Bootstrap estimates for sockeye in Juan de Fuca, 1989