

# **TECHNICAL FISHERY REPORT 89-03**

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Alaska Department of Fish and Game  
Division of Commercial Fisheries  
PO Box 3-2000  
Juneau, Alaska 99802

March 1989

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## **Frazer Lake sockeye salmon investigations, 1987**

by

**Bruce M. Barrett**

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State of Alaska

Steve Cowper, Governor

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## **ACKNOWLEDGMENTS**

I thank Chuck Hastings of Division of Commercial Fisheries of the Alaska Department of Fish and Game (ADF&G) and his assistant, Roslyn Rooeheaver of the U.S. Fish and Wildlife Service (USFWS), for conducting most of the field data collections and operating the Frazer Lake fishpass. Thanks also go to Tony Chatto (USFWS) for providing a volunteer for the field work. Appreciation is extended to Lucinda R. Neel (ADF&G) for administrative and clerical help.

## TABLE OF CONTENTS

	<u>Page</u>
LIST OF TABLES . . . . .	iv
LIST OF FIGURES . . . . .	v
LIST OF APPENDICES . . . . .	vi
ABSTRACT . . . . .	vii
INTRODUCTION . . . . .	1
METHODS . . . . .	1
RESULTS AND DISCUSSION . . . . .	3
LITERATURE CITED . . . . .	7
APPENDICES . . . . .	30

## LIST OF TABLES

<u>Table</u>	<u>Page</u>
1. Daily sockeye salmon smolt and other downstream migrant fish catches in the inclined plane and concrete traps operated at the Frazer Lake fishpass, 1987 . . . . .	9
2. Age composition of the sockeye smolt outmigration from Frazer Lake by statistical week, 1987 . . . . .	12
3. Age composition of sockeye smolt sampled at the Frazer Lake fishpass, 1965-87 . . . . .	13
4. Littoral zone catch by species, date, and location using a 50-ft beach seine at Frazer Lake, 1987 . . . . .	14
5. Average lengths, standard deviations, and ranges (mm) for age-0. sockeye fry taken by beach seining selected littoral locations in Frazer Lake, by date, 1987 . . . . .	15
6. Sockeye daily and cumulative escapement counts at Dog Salmon Creek weir and the Frazer Lake fishpass, 1987 . . . . .	16
7. Frazer Lake sockeye salmon returns by age class and brood year, 1962-87 . . . . .	19
8. Age composition of the Frazer Lake sockeye escapements, 1965-87 . . . . .	20
9. Peak sockeye salmon counts of the primary spawning areas in the Frazer Lake drainage and the percent of the total Frazer Lake escapement represented by the combined peak counts, 1965-87 . .	21

## LIST OF FIGURES

<u>Figure</u>	<u>Page</u>
1. Map of Frazer Lake . . . . .	22
2. Schematic of the Frazer Lake fishpasses . . . . .	23
3. Map of the Alitak Bay District with the fishing areas and major early run sockeye stocks defined . . . . .	24
4. Weekly sockeye salmon smolt catch in the inclined plane and concrete traps at the Frazer Lake fishpass, 1987 . . . . .	25
5. Sockeye salmon and threespine stickleback catch at four Frazer Lake littoral areas combined by sampling date, 1987 . . . . .	26
6. Length composition of age-0. sockeye salmon fry caught at four littoral areas combined by sampling date, 1987 . . . . .	27
7. Weekly sockeye salmon escapement through the Dog Salmon Creek weir and the Frazer Lake fishpass, 1987 . . . . .	28
8. Sockeye salmon peak counts of Linda, Midway, and Stumble Creeks combined, Pinnell Creek, and Frazer Lake shoals as a percentage of the escapement through the Frazer Lake fishpass, 1965-87 . . .	29

**LIST OF APPENDICES**

	<u>Page</u>
APPENDIX A: LITTORAL SEINING LOCATIONS AT FRAZER LAKE	
A.1 - Frazer Lake with inlet streams and littoral seining locations identified . . . . .	31
APPENDIX B: CALENDAR WEEKS	
B.1 - 1987 calendar weeks . . . . .	32
APPENDIX C: FRAZER LAKE SMOLT and ESCAPEMENT DATA	
C.1 - Length, weight, and condition of age-1.0 sockeye salmon smolt produced from 1963 through 1987 escapements . . . . .	33
C.2 - Length, weight, and condition of age-2.0 sockeye salmon smolt produced from 1962 through 1987 escapements . . . . .	34
C.3 - Sex composition of the Frazer Lake sockeye escapement by statistical week, 1987 . . . . .	35
C.4 - Length composition of the Frazer Lake sockeye escapement samples by age and sex, 1987 . . . . .	36
C.5 - Sockeye salmon escapement surveys of Frazer Lake and its inlet streams, 1987 . . . . .	37

## ABSTRACT

In 1987 sockeye salmon smolt (*Oncorhynchus nerka*) outmigrated from Frazer Lake from mid-May through mid-June. The peak migration occurred from 22 May through 30 May. Based on inclined plane trap catches there was about 75% fewer smolt in 1987 as compared to 1986. The smolt in 1987 were 17% age 1., 65% age 2., and 18% age 3. The age-1. smolt averaged 80.8 mm in length, 4.0 g in weight, and 0.74 in condition, while the age-2. smolt averaged 103.7 mm in length, 8.2 g in weight, and 0.73 in condition. The age-1. and age-2. smolt were near the 1980-86 average for length, weight, and condition. A weak return from the 1985 parent escapement of 485,000 fish has been projected based on the relatively low catch of age-1. smolt in 1987. Sockeye fry emergence in the Frazer Lake littoral area occurred from 17 May through 28 June and peaked about 7 June. Age-0. sockeye fry rearing in the littoral area occurred from 17 May through 10 August and peaked about 28 June. The littoral area age-0. sockeye salmon to threespine stickleback (*Gasterosteus aculeatus*) ratio was 6.4:1 from 17 May through 10 August. The 1987 Frazer Lake sockeye run was 57,581 fish, while the escapement was 40,544 fish. The escapement peaked at the Frazer Lake fishpass on 13 July. The escapement was 50% age 1.3, 17% age 2.1, and 16% age 1.2. The primary spawning areas were Pinnell Creek and Frazer Lake shoals. Peak survey counts indicated more lake shore spawners than inlet stream spawners for the first time since spawning surveys began in 1965. Brown bears (*Ursus arctos middendorfi*) killed about 3% of the escapement at Pinnell Creek alone.

KEY WORDS: Frazer Lake, sockeye salmon, fishpass, smolt, escapement, spawning surveys, stickleback, Kodiak, bear

## INTRODUCTION

Frazer Lake is 1,701 surface hectares in size and is located on the south end of Kodiak Island (Figure 1). It supports the largest introduced sockeye salmon (*Oncorhynchus nerka*) run in Alaska (Blackett 1979). Sockeye salmon were first introduced into this lake by an egg plant in 1951 (Russell 1972). This was followed by a combination of egg, fry, and adult transplants from Red River (early run), Karluk Lake (early run), and Becharof Lake (late run) sockeye escapements (Barrett 1988a). In 1962 a fishpass was completed at the (30-ft) barrier falls on Dog Salmon Creek (0.6 mi) below the lake outlet, and in 1979 a second fishpass was added (Blackett 1987). Figure 2 shows the schematics of these fishpasses.

The introduced sockeye salmon initially responded well in the system. The average returns were 72,600 fish from the 1966-70 escapements of 14,000 to 24,000 fish, 177,111 fish from the 1971-75 escapements of 55,400 to 82,600 fish, and 357,300 fish from the 1976-79 escapements of 119,300 to 142,000 fish, but less than 300,000 fish from the 1980-82 escapements of 377,700 to 430,423 fish (Barrett 1988a). The recent decline in production can be attributed to three consecutive years of escapements in the 400,000 fish range which produced more fry than the lake rearing area could support (Kyle et al. 1988).

The Frazer Lake sockeye run is harvested commercially in June and early July by set gill net and purse seine fishermen mainly at the south end of Kodiak Island in the Alitak Bay District (Figure 3). The run is managed using several data sets including (1) catch trends from an annual June 9 Alitak Bay District commercial test fishery; (2) aerial counts of escapement build-up in the closed waters at the mouth of Dog salmon Creek; (3) escapement counts through the weir on Dog Salmon Creek located 0.3 mi above lower Olga Bay; (4) escapement counts through the Frazer Lake fishpass as a back-up for the Dog Salmon Creek weir washing-out; (5) and an Alaska Department of Fish and Game (ADF&G) pre-season run forecast. Management of the Alitak Bay District is frequently complicated by the commingling of the Upper Station Lakes early sockeye run with the normally stronger Frazer Lake run (Barrett 1988b).

Base-line population statistics for the 1987 run to Frazer Lake and the smolt statistics for the 1987 outmigration from Frazer Lake have been collected and are organized in this report to facilitate developing brood tables, forecasting runs, and evaluating escapement and management objectives.

## METHODS

To assess the timing, relative abundance and age, length, weight, and condition of the smolt outmigrating from Frazer Lake an inclined plane trap as described by Mesiar (1986) was operated below the adult weir at the base of the Frazer Lake falls from 15 May through 12 July. The trap was positioned between weir unipods #6 and #8 and was equipped with (13-ft) leads (Figure 2). To augment these data the concrete trap at the south end

of the adult weir was operated concurrently with the inclined plane trap from 15 May through 12 July. The concrete trap was fitted with a single lead consisting of 30 ft. of galvanized perforated smolt panels faced with visqueen which was laid against the upstream face of the adult weir starting at the offshore end of the trap opening. Both traps were routinely checked for catch and proper operation several times each day. At each check the contents were enumerated by species and released. All catches were recorded by respective trap by sampling day. A sampling day extended from noon to noon and was identified by the calendar day of the noon to midnight period. An age, length, and weight sample of 220 sockeye smolt was collected weekly from a single day's catch from both traps on the first day that 220 smolt were available. If both traps did not catch enough smolt to meet 220 fish sample size, sampling continued into the next day but not beyond. To insure random selection the trap contents were stirred immediately preceding the removal of any smolt for the sample. The smolt were removed using a small mesh dip net and placed in (5-gal) plastic buckets filled with water. The smolt were then anesthetized with MS-222, measured to the nearest millimeter from tip-of-snout to fork-of-tail, weighted to the nearest 0.1 g, and sampled for age by taking 5-10 scales from the preferred area (INPFC 1963). Condition factor for each smolt sampled was determined from the formula:  $K = W(10^5)/L^3$ , where W is weight in grams and L is tip-of-snout to fork-of-tail length in millimeters.

Escapement accessed Frazer Lake through the old fishpass (1962) at the Frazer Lake falls which was operated from 15 June through 16 August. For the first year since its construction the new (1979) fishpass was not operated because of design deficiencies (Barrett 1988a). Operation of the old fishpass was as described by Blackett (1979). An escapement sample of 240 sockeye salmon was taken weekly at the fishpass exit tank for age, length, and sex following the methodology described in McGregor et al. (1984). The sample size of 240 fish was chosen to describe the dominant age class composition of the population with a  $\pm 5\%$  precision and a 0.90 probability of being accurate (Thompson 1987).

To determine temporal use of the Frazer Lake littoral area by juvenile fish beach seining was conducted at four littoral area sites with a 6-ft (1.8 m) deep and 50-ft (15.2 m) long net once every 2 weeks starting on 17 May and ending on 10 August (Appendix A.1). Each seine catch was enumerated by species, and the first 30 fish of each species were measured for total length (tip-of-snout to fork-of-tail). Seining was discontinued after 10 August due to salmon spawning in the sampling areas.

The distribution of the escapement to the various spawning grounds was determined by aerial and foot surveys. The lake inlet streams were surveyed almost weekly on foot from 18 July through 18 August. The exception was Pinnell Creek which was surveyed along with Frazer Lake shoals from the air on 17 August, 20 August, and 29 September. All spawning surveys were performed with the observers using polarized glasses and hand-held tally counters. During the surveys both the live and dead fish by species were counted separately.

All fish ages were reported in European notation (e.g., 2.2, where the first digit is number of winters the fish spent in freshwater before smoltification, the second digit is the number of winters the fish spent in

the ocean, and the total age is the sum of both digits plus 1 to account for the incubation time. Most of the data in this document were reported by statistical week. A statistical week is a 7-day period which begins at 0000 hours on Sunday and ends at 2400 hours the following Saturday. Each week is sequentially numbered starting with the first Sunday in January. The statistical weeks and the corresponding calendar dates for 1987 are provided in Appendix B.1. All graphically presented data were smoothed by the von Hann linear/filter method (BMP 1981).

Sockeye predation by brown bear (*Ursus arctos middendorfi*) at Pinnell Creek was calculated by estimating the number of bears present daily during the sockeye spawning period. The daily bear numbers were determined from:

- (1) the periodic daily survey counts made by the U.S. Fish and Wildlife Service (USFWS) expanded by a factor of three based on the assumption that one-third only of the bears present on any individual survey day were counted by USFWS STAFF (Vic Barnes, USFWS, Kodiak, personal communication);
- (2) linear interpolation of the daily estimated bear numbers between the USFWS surveys from the expanded daily survey counts; and
- (3) the methodology described by Johnson and Barrett (1988) for estimating the daily number of bears present before and after the USFWS surveys were conducted.

The daily numbers of bears present during the sockeye spawning period were then totaled. This sum was then multiplied by a 10-fish/bear/day consumption rate, which was provided by Vic Barnes (USFWS, Kodiak, personal communication), for an estimate of the total sockeye consumed by bears at Pinnell Creek.

## RESULTS AND DISCUSSION

Based on 1987 trap catches, sockeye smolt outmigrated from Frazer Lake from mid-May through mid-June (weeks 20-25; Table 1). Most (62%) of the smolt migrated from 22 May through 30 May (week 22) which was approximately the same time that the peak occurred in 1986 (Figure 4; Barrett 1988a).

In 1987 there may have been less smolt outmigrating from Frazer Lake than in 1986 even though the concrete and inclined plane traps combined caught more smolt (61,830) in 1987 (Table 1) than in 1986 (28,003). The concrete trap catch in 1987 was 10 times greater than the 1986 catch, while the inclined plane trap catch in 1987 was four times less than the 1986 catch. Barrett (1988a) reported that the catch efficiency of the concrete trap, which is located against the south creek bank, is more influenced by flow than the inclined plane trap which is located in the mid-channel area of the stream. It is suspected that the 1987 increased catch in the concrete trap from the 1986 level was due to the visually higher flow conditions in 1987 as compared to 1986 and was not due to increased smolt abundance. It is further suspected that the inclined plane trap catch provides the best estimate of smolt abundance change from 1986 to 1987. The 1987 daily smolt

catches in the inclined plane and concrete traps were slightly correlated ( $r^2 = 0.42$ ,  $df = 57$ ).

Smolt age composition in 1987 changed weekly (Table 2). Generally the older age smolt migrated earlier than the younger age smolt. The highest composition of age-3. smolt was in week 20 (10-16 May), for the age-2. smolt in week 21 (17-23 May), and for the age-1. smolt in week 28 (5-11 July). A similar change occurred in 1986 (Barrett 1988a). Overall the smolt that migrated from Frazer Lake in 1987 were 65% age 2., 18% age 3., and 17% age 1. (Table 2).

From 1965 through 1986 the age composition of Frazer Lake smolt averaged 52% age 1., 47% age 2., and 1% age 3. (Table 3). In 1987 the age-1. smolt were from the 1985 escapement of 485,835 fish, the age-2. smolt were from the 1984 escapement of 53,524 fish, and the age-3. smolt were from the 1983 escapement of 158,340 fish. Since the 1985 parent escapement of 485,835 fish was about nine times greater than the 1984 parent escapement the 1987 smolt migration, if similar to previous years, should have been at least 50% age-1. smolt and less than 5% age-3. smolt. This was not the case. The low percentage of age-1. smolt (17%) and the high percentage of age-3. smolt (18%) in the 1987 smolt migration indicate that a poor return can be expected from the record 1985 parent escapement.

The age-1. smolt averaged 80.8 mm in length, 4.0 g in weight, and 0.74 in condition (Appendix C.1). The age-2. smolt averaged 103.7 mm in length, 8.2 g in weight, and 0.73 in condition (Appendix C.2). The age-1. smolt were at the 1982-86 average for length, weight, and condition, while the age-2. smolt were above the 1980-86 average for length and weight but below the 1982-86 average for condition. The age-3. smolt were less than average on length, weight, and condition.

In the littoral area of Frazer Lake age-0. sockeye fry were present from 17 May through 10 August based on beach seine catches at four areas (Table 4). The age-0. fry were relatively abundant in the littoral area from 14 June through 14 July (Figure 5). Peak littoral area use occurred about 28 June. By early August most age-0. sockeye fry had moved into the pelagic area and were no longer using the littoral area. Wilmont (1985) reported peak age-0. fry use of the Karluk Lake littoral area from 15 May to 15 June, and averaged 7 June, which is about three weeks earlier than the Frazer Lake peak in 1987.

Gard and Drucker (1985) and White (1986) reported that sockeye fry at emergence average 29 to 30 mm in length (range: 27-33 mm). In the Frazer Lake littoral area fry 31 mm and smaller comprised 25% or more of the catch samples from 17 May through 28 June (Table 5 and Figure 6). Based on the large difference in the numbers of fry 31 mm and smaller caught between the 31 May sample and the 14 June sample, fry emergence probably peaked in the Frazer Lake littoral area about 7 June (Table 4 and Figure 6). This was about five weeks later than peak fry emergence reported by White (1986) for the Thumb River (Karluk Lake system) early run.

In the Frazer Lake littoral area there were generally more age-0. sockeye fry than threespine stickleback (*Gasterosteus aculeatus*) from late May through early August (Table 4). For the 17 May through 10 August sampling

period the average sockeye fry to stickleback ratio was 6.4:1. Sockeye fry were fewer in number than stickleback in only the 17 May and 29 July samples. Wilmont (1985) reported that sockeye fry and stickleback in the Karluk Lake littoral area were equally abundant (1.0:1) in May, but that there were fewer sockeye fry than stickleback (.04:1) from mid-June through September.

The 1987 sockeye escapement into Frazer Lake was 40,544 fish (Table 6). This was the smallest escapement into the lake since 1971 (Table 7). Most (77%) of the escapement passed through the fishpass from 5 July- 25 July (weeks 28-30) (Figure 7). The peak occurred on 13 July (week 29) with 2,521 fish passing on that day. The midpoint of the escapement was reached on 15 July (week 29).

The Frazer Lake escapement was 17% less than the 48,844 sockeye escapement counted through Dog Salmon Creek weir which is located on Dog Salmon Creek (0.48 km) above lower Olga Bay (Table 6). Most of the difference was probably due to bear predation in the 7.5 mi reach between the two counting sites. The average sockeye travel time between Dog Salmon Creek weir and the Frazer Lake fishpass was about 8 d which was determined by the average number of days for which the 25%, 50%, and 75% cumulative escapements at Frazer Lake lagged that of the Dog Salmon Creek weir (Figure 7).

The sockeye run to the Frazer Lake system was at least 57,581 fish. Approximately 15% of the run was catch (8,737 fish) and 85% was escapement (48,844 fish). The catch estimate does not include any Frazer Lake fish that may have been harvested in the Afognak, Northwest, and Southwest Kodiak Fishing Districts (Tyler et al. 1986).

The 1987 Frazer Lake sockeye run of 57,581 fish was 50% age 1.3, 17% age 2.1, 16% age 1.2, and 9% age 2.3 based on escapement sampling (Table 8). The low 1987 run can be attributed to poor returns from the the 1981-82 brood year escapements (Table 7). The 1981 and 1982 escapements, which were both in the 400,000 fish range, produced more fry than the lake could support. This was evident in the relatively few age 1.- and age 2.- smolt in 1983 and 1984 respectively produced from the 1981 parent escapement (Table 3), the record low condition (.64) of the age 1.- smolt from the 1982 parent escapement (Appendix C.1), the recent shift in the lake's zooplankton population from prey-resistant to predator-resistant (Kyle et al. 1988), and the approximate 0.1:1 return-per-spawner ratio for the 1981 and 1982 parent escapements (Table 7).

The female-to-male ratio of the 1987 Frazer Lake sockeye escapement was 0.8:1 (Appendix C.3). The males were dominant in four of the five weekly samples collected. The average sockeye length in the escapement was 509 mm (Appendix C.4).

The Frazer Lake sockeye escapement spawned almost exclusively on the lake shoals and in Pinnell Creek (Table 9 and Appendix C.5). Based on surveys the peak spawning occurred about the third week of August (week 34). In Pinnell Creek sockeye spawning was over by late September but was still in progress along the lake shoals. The peak counts indicate that the lake shoals supported twice as many spawners as Pinnell Creek. Since surveys began in 1965, this was probably the first year that the lake shoals had

more spawners than Pinnell Creek (Figure 8). Most of the shoal spawning this season was on the northeast side of the lake near Midway Creek (Appendix C.5). Relatively few fish spawned in Midway, Linda, and Stumble Creeks.

From late July to early August USFWS made three aerial surveys of Pinnell Creek to count brown bears. They reported sighting: two bears on the evening of 23 July, two bears on the morning of 25 July, and eight bears on the evening of 7 August. Based on a bear kill rate of 10 fish/day and 140 bear-days at Pinnell Creek, approximately 1,400 fish were bear-killed at Pinnell Creek, which represents 3% of the total Frazer Lake escapement. An unquantified amount of predation by bears occurred on the fish spawning in other Frazer Lake inlet streams and along the lake shoals.

In addition to 40,544 sockeye salmon, 94 chinook (*O. tshawytscha*), 285 pink (*O. gorbuscha*), and 5 chum salmon (*O. keta*) were counted through the fishpass at Frazer Lake. Most (96%) of the chinook salmon passed from 3 July through 28 July, while most (93%) of the pink salmon passed from 31 July and 16 August.

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Table 1. Daily sockeye salmon smolt and other downstream migrant fish catches in the inclined plane and concrete traps operated at the Frazer Lake fishpass, 1987.

Stat. Week	Calendar Day	Inclined Trap		Concrete Trap		Combined Concrete Trap and Inclined Plane Trap Catch									
		Sockeye		Sockeye		Sockeye		Chinook		Coho		Dolly Varden		Stickleback	
		Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum
20	15-May	27	27	177	177	204	204	0	0	0	0	0	0	2	2
	16-May	45	72	537	714	582	786	0	0	0	0	0	0	1	3
21	17-May	127	199	2,029	2,743	2,156	2,942	0	0	0	0	0	0	0	3
	18-May	48	247	669	3,412	717	3,659	0	0	0	0	0	0	0	3
	19-May	19	266	109	3,521	128	3,787	0	0	0	0	0	0	0	3
	20-May	87	353	1,843	5,364	1,930	5,717	0	0	0	0	0	0	0	3
	21-May	239	592	5,298	10,662	5,537	11,254	0	0	0	0	0	0	2	5
	22-May	29	621	1,078	11,740	1,107	12,361	0	0	0	0	0	0	0	5
	23-May	52	673	49	11,789	101	12,462	0	0	0	0	0	0	0	5
22	24-May	1	674	5,239	17,028	5,240	17,702	0	0	0	0	0	0	2	7
	25-May	75	749	2,057	19,085	2,132	19,834	0	0	0	0	0	0	0	7
	26-May	544	1,293	6,335	25,420	6,879	26,713	0	0	0	0	0	0	1	8
	27-May	652	1,945	18,432	43,852	19,084	45,797	0	0	0	0	0	0	0	8
	28-May	721	2,666	1,496	45,348	2,217	48,014	0	0	0	0	0	0	3	11
	29-May	1,151	3,817	486	45,834	1,637	49,651	0	0	0	0	0	0	4	15
	30-May	221	4,038	0	45,834	221	49,872	0	0	0	0	0	0	2	17
	31-May	97	4,135	4	45,838	101	49,973	0	0	0	0	0	0	1	18
	01-Jun	387	4,522	1,356	47,194	1,743	51,716	0	0	0	0	0	0	0	18
	02-Jun	10	4,532	1,331	48,525	1,341	53,057	0	0	5	5	0	0	2	20
03-Jun	257	4,789	6	48,531	263	53,320	0	0	0	5	0	0	2	22	
04-Jun	3	4,792	122	48,653	125	53,445	0	0	0	5	0	0	0	22	
05-Jun	16	4,808	48	48,701	64	53,509	0	0	0	5	0	0	0	22	
06-Jun	198	5,006	29	48,730	227	53,736	0	0	0	5	0	0	0	22	

-Continued-

Table 1. (page 2 of 3)

Stat. Week	Calendar Day	Inclined Trap		Concrete Trap		Combined Concrete Trap and Inclined Plane Trap Catch									
		Sockeye		Sockeye		Sockeye		Chinook		Coho		Dolly Varden		Stickleback	
		Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum
24	07-Jun	164	5,170	211	48,941	375	54,111	0	0	0	5	0	0	0	22
	08-Jun	5	5,175	1	48,942	6	54,117	0	0	0	5	0	0	0	22
	09-Jun	58	5,233	0	48,942	58	54,175	0	0	0	5	0	0	0	22
	10-Jun	69	5,302	0	48,942	69	54,244	0	0	0	5	0	0	1	23
	11-Jun	188	5,490	216	49,158	404	54,648	0	0	0	5	0	0	1	24
	12-Jun	21	5,511	0	49,158	21	54,669	0	0	0	5	0	0	1	25
	13-Jun	39	5,550	0	49,158	39	54,708	0	0	0	5	0	0	1	26
25	14-Jun	51	5,601	35	49,193	86	54,794	0	0	0	5	3	3	1	27
	15-Jun	0	5,601	0	49,193	0	54,794	0	0	0	5	0	3	0	27
	16-Jun	24	5,625	22	49,215	46	54,840	0	0	0	5	0	3	0	27
	17-Jun	14	5,639	73	49,288	87	54,927	0	0	0	5	1	4	1	28
	18-Jun	39	5,678	46	49,334	85	55,012	0	0	0	5	3	7	1	29
	19-Jun	11	5,689	21	49,355	32	55,044	0	0	0	5	1	8	0	29
	20-Jun	7	5,696	6	49,361	13	55,057	0	0	0	5	0	8	1	30
26	21-Jun	50	5,746	29	49,390	79	55,136	0	0	0	5	1	9	4	34
	22-Jun	31	5,777	16	49,406	47	55,183	0	0	0	5	0	9	1	35
	23-Jun	30	5,807	42	49,448	72	55,255	0	0	0	5	0	9	0	35
	24-Jun	10	5,817	10	49,458	20	55,275	1	1	0	5	0	9	0	35
	25-Jun	2	5,819	11	49,469	13	55,288	0	1	0	5	0	9	0	35
	26-Jun	13	5,832	20	49,489	33	55,321	0	1	0	5	0	9	0	35
	27-Jun	15	5,847	46	49,535	61	55,382	1	2	0	5	1	10	0	35
27	28-Jun	4	5,851	10	49,545	14	55,396	0	2	0	5	0	10	0	35
	29-Jun	13	5,864	39	49,584	52	55,448	1	3	0	5	1	11	0	35
	30-Jun	28	5,892	23	49,607	51	55,499	1	4	0	5	0	11	0	35

-Continued-

Table 1. (page 3 of 3)

Stat. Week	Calendar Day	Inclined Trap		Concrete Trap		Combined Concrete Trap and Inclined Plane Trap Catch									
		Sockeye		Sockeye		Sockeye		Chinook		Coho		Dolly Varden		Stickleback	
		Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum
	01-Jul	0	5,892	4	49,611	4	55,503	0	4	0	5	0	11	1	36
	02-Jul	11	5,903	25	49,636	36	55,539	0	4	3	8	0	11	3	39
	03-Jul	8	5,911	26	49,662	34	55,573	1	5	0	8	1	12	3	42
	04-Jul	11	5,922	0	49,662	11	55,584	0	5	1	9	0	12	0	42
28	05-Jul	15	5,937	1	49,663	16	55,600	0	5	0	9	0	12	0	42
	06-Jul	1	5,938	44	49,707	45	55,645	0	5	0	9	4	16	5	47
	07-Jul	10	5,948	3	49,710	13	55,658	0	5	0	9	2	18	2	49
	08-Jul	7	5,955	6	49,716	13	55,671	0	5	0	9	1	19	2	51
	09-Jul	6	5,961	8	49,724	14	55,685	0	5	0	9	0	19	0	51
	10-Jul	16	5,977	24	49,748	40	55,725	0	5	0	9	1	20	1	52
	11-Jul	16	5,993	13	49,761	29	55,754	0	5	0	9	0	20	1	53
29	12-Jul	30	6,023	23	49,784	53	55,807	0	5	0	9	0	20	0	53

Table 2. Age composition of the sockeye smolt outmigration from Frazer Lake by statistical week, 1987.

Stat. Week	Sample					Percent Of Migration <sup>a</sup>			
	Size	Age Composition (%)				Age Composition (%)			
		1	2	3	Combined	1	2	3	Total
20	219	6.4%	49.8%	43.8%	100.0%	0.1%	0.7%	0.6%	1.3%
21	220	2.3%	70.9%	26.8%	100.0%	0.4%	11.4%	4.3%	16.1%
22	219	14.2%	67.1%	18.7%	100.0%	8.8%	41.7%	11.6%	62.1%
23	220	19.1%	70.5%	10.5%	100.0%	2.1%	7.7%	1.1%	10.9%
24	61	59.0%	39.3%	1.6%	100.0%	2.9%	1.9%	0.1%	4.9%
25	45	44.4%	53.3%	2.2%	100.0%	0.6%	0.8%	0.0%	1.4%
26	92	57.6%	42.4%	0.0%	100.0%	0.8%	0.6%	0.0%	1.4%
27	45	55.6%	44.4%	0.0%	100.0%	0.4%	0.3%	0.0%	0.8%
28-29	43	69.8%	30.2%	0.0%	100.0%	0.7%	0.3%	0.0%	1.0%
All Weeks Combined	1,164	36.5%	52.0%	11.5%	100.0%	16.8%	65.4%	17.8%	100.0%

<sup>a</sup>Weighted on the combined catch-per-unit-of-effort of the inclined plane and concrete traps.

Table 3. Age composition of sockeye smolt sampled at the Frazer Lake fishpass, 1965-87.

Year	N	Age Composition (%)			
		0.0	1.0	2.0	3.0
1965	1,057	0.0	66.0	32.7	1.2
1966	1,916	0.0	28.3	70.9	0.8
1967	1,938	0.0	61.7	35.1	3.2
1968	1,789	0.0	84.8	14.8	0.4
1969	0	-	-	-	-
1970	2,537	0.0	74.0	25.6	0.4
1971	470	0.0	27.7	71.1	1.3
1972	474	0.0	95.4	4.6	0.0
1973	120	0.0	38.3	61.7	0.0
1974	851	0.0	24.9	66.3	8.8
1975	1,319	0.0	27.7	71.9	0.3
1976	937	0.0	52.5	44.6	2.9
1977	788	0.0	48.9	51.1	0.0
1978	330	0.0	32.4	67.6	0.0
1979	831	0.0	55.4	44.6	0.0
1980	439	0.0	79.5	20.5	0.0
1981	318	0.0	78.6	21.4	0.0
1982	327	0.0	19.6	75.8	4.6
1983	519	0.0	4.4	95.4	0.2
1984	1,261	1.5	94.3	4.0	0.2
1985	2,555	4.6	93.5	2.0	0.0
1986	1,525	0.1	5.6	94.3	0.1
1987	1,164	0.0	16.8	65.4	17.8
	Mean	0.3	48.3	45.3	1.8

Table 4. Littoral zone catch by species, date, and location using a 50-ft beach seine at Frazer Lake, 1987.

Date	Age 0. Sockeye Fry Catch By Location					Threespine Stickleback Catch By Location					Dolly Varden Catch (all sites)
	Midway	Valarian	Linda	Stumble	Total	Midway	Valarian	Linda	Stumble	Total	
17-May	3	29	66	35	133	5	5	0	26	36	0
31-May	30	5	9	195	239	0	0	4	31	35	1
14-Jun	556	16	217	130	919	28	42	3	15	88	2
28-Jun	232	1153	83	353	1821	26	18	0	62	106	3
14-Jul	3	25	135	53	216	1	33	7	9	50	2
29-Jul	21	4	55	70	150	24	78	72	45	219	0
10-Aug	14	0	8	5	27	4	1	9	2	16	0
Totals	859	1232	573	841	3505	88	177	95	190	550	8

Table 5. Average lengths, standard deviations, and ranges (mm) for age 0. sockeye fry taken by beach seining selected littoral locations in Frazer Lake, by date, 1987.

Date		Fishing Location				
		Midway	Valarian	Linda	Stumble	Combined
17-May	Avg.	33.7	29.9	30.8	30.4	30.5
	SD	1.7	2.0	1.5	1.6	1.9
	N	3	29	30	30	92
	Range					26-36
31-May	Avg.	30.9	32.6	31.0	31.4	31.2
	SD	1.9	3.4	2.5	1.5	2.0
	N	30	5	9	30	74
	Range					28-38
14-Jun	Avg.	33.5	33.0	33.1	32.3	33.0
	SD	1.9	2.5	2.5	1.7	2.2
	N	30	16	30	30	106
	Range					29-42
28-Jun	Avg.	37.0	33.8	33.4	33.7	34.5
	SD	4.4	2.0	2.1	2.5	3.3
	N	30	30	30	30	120
	Range					29-46
14-Jul	Avg.	35.0	37.9	36.4	36.2	36.7
	SD	0.0	4.0	3.6	1.9	3.3
	N	3	25	29	30	87
	Range					30-50
29-Jul	Avg.	36.5	42.5	35.6	37.9	37.0
	SD	1.9	4.2	2.7	2.5	3.0
	N	21	4	30	30	85
	Range					30-49
10-Aug	Avg.	40.6		37.4	43.4	40.1
	SD	3.0		2.0	4.0	3.7
	N	14		8	5	27
	Range					35-50

Table 6. Sockeye daily and cumulative escapement counts at Dog Salmon Creek weir and the Frazer Lake fishpass, 1987.

Stat. Week	Date	Dog Salmon Cr.		Frazer Lake		Stat. Week	Date	Dog Salmon Cr.		Frazer Lake	
		Daily	Cum.	Daily	Cum.			Daily	Cum.	Daily	Cum.
21	15-May			0	0	29	12-Jul	231	30,991	2,730	15,185
	16-May			0	0		13-Jul	1,891	32,882	4,898	20,083
	17-May			0	0		14-Jul	641	33,523	1,124	21,207
	18-May			0	0		15-Jul	530	34,053	1,131	22,338
	19-May			0	0		16-Jul	247	34,300	1,436	23,774
	20-May			0	0		17-Jul	27	34,327	259	24,033
	21-May			0	0		18-Jul	52	34,379	295	24,328
	22-May			0	0		30	19-Jul	365	34,744	679
23-May			0	0	20-Jul	68		34,812	242	25,249	
24-May			0	0	21-Jul	1,159		35,971	543	25,792	
25-May			0	0	22-Jul	286		36,257	1,540	27,332	
26-May			0	0	23-Jul	747		37,004	1,390	28,722	
27-May			0	0	24-Jul	976		37,980	2,006	30,728	
28-May			0	0	25-Jul	1,041		39,021	4,008	34,736	
29-May			0	0	31	26-Jul		2,521	41,542	1,570	36,306
30-May			0	0		27-Jul	628	42,170	1,349	37,655	
31-May			0	0		28-Jul	2,096	44,266	845	38,500	
01-Jun			0	0		29-Jul	1,202	45,468	449	38,949	
02-Jun			0	0		30-Jul	853	46,321	559	39,508	
03-Jun	0	0	0	0		31-Jul	854	47,175	192	39,700	
04-Jun	0	0	0	0		01-Aug	338	47,513	162	39,862	
05-Jun	0	0	0	0		32	02-Aug	209	47,722	317	40,179
06-Jun	0	0	0	0	03-Aug		79	47,801	94	40,273	
07-Jun	0	0	0	0	04-Aug		181	47,982	10	40,283	
08-Jun	0	0	0	0	05-Aug		123	48,105	27	40,310	

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Table 6. (page 2 of 3)

Stat. Week	Date	Dog Salmon Cr.		Frazer Lake		Stat. Week	Date	Dog Salmon Cr.		Frazer Lake	
		Daily	Cum.	Daily	Cum.			Daily	Cum.	Daily	Cum.
	09-Jun	1	1	0	0		06-Aug	45	48,150	51	40,361
	10-Jun	2	3	0	0		07-Aug	29	48,179	56	40,417
	11-Jun	1	4	0	0		08-Aug	27	48,206	26	40,443
	12-Jun	2	6	0	0	33	09-Aug	17	48,223	18	40,461
	13-Jun	1	7	0	0		10-Aug	14	48,237	9	40,470
25	14-Jun	0	7	0	0		11-Aug	13	48,250	11	40,481
	15-Jun	0	7	0	0		12-Aug	0	48,250	24	40,505
	16-Jun	1	8	0	0		13-Aug	23	48,273	18	40,523
	17-Jun	0	8	0	0		14-Aug	6	48,279	11	40,534
	18-Jun	1	9	0	0		15-Aug	0	48,279	7	40,541
	19-Jun	3	12	1	1	34	16-Aug	19	48,298	3	40,544
	20-Jun	0	12	0	1		17-Aug	2	48,300		
26	21-Jun	1	13	7	8		18-Aug	0	48,300		
	22-Jun	2	15	0	8		19-Aug	4	48,304		
	23-Jun	64	79	0	8		20-Aug	2	48,306		
	24-Jun	15	94	1	9		21-Aug	0	48,306		
	25-Jun	11	105	1	10		22-Aug	0	48,306		
	26-Jun	19	124	4	14	35	23-Aug	63	48,369		
	27-Jun	18	142	7	21		24-Aug	2	48,371		
27	28-Jun	16	158	8	29		25-Aug	1	48,372		
	29-Jun	2,400	2,558	12	41		26-Aug	35	48,407		
	30-Jun	4,800	7,358	3	44		27-Aug	34	48,441		
	01-Jul	16,012	23,370	14	58		28-Aug	19	48,460		
	02-Jul	1,520	24,890	121	179		29-Aug	40	48,500		
	03-Jul	1,355	26,245	1,236	1,415	36	30-Aug	50	48,550		
	04-Jul	570	26,815	2,030	3,445		31-Aug	7	48,557		

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Table 6. (page 3 of 3)

Stat. Week	Date	Dog Salmon Cr.		Frazer Lake		Stat. Week	Date	Dog Salmon Cr.		Frazer Lake	
		Daily	Cum.	Daily	Cum.			Daily	Cum.	Daily	Cum.
28	05-Jul	94	26,909	1,394	4,839		01-Sep	26	48,583		
	06-Jul	1,036	27,945	968	5,807		02-Sep	97	48,680		
	07-Jul	491	28,436	648	6,455		03-Sep	7	48,687		
	08-Jul	1,106	29,542	1,611	8,066		04-Sep	157	48,844		
	09-Jul	201	29,743	1,361	9,427						
	10-Jul	710	30,453	1,312	10,739						
	11-Jul	307	30,760	1,716	12,455						

Table 7. Frazer Lake sockeye salmon returns by age class and brood year, 1962-87.

Brood Year	Return from Brood Year (Parent) Escapement by Age Class														Return Per (Parent) Spawner	Return Less (Parent) Escap.	
	Escap.	1.1	0.3	1.2	1.3	1.4	2.1	2.2	2.3	2.4	3.1	3.2	3.3	3.4			Total
1962	3,090									0			385	0			
1963	11,857					0			4,009	0		589	0	0			
1964	9,966					0	0	16,173	279	0	204	0	66	0			
1965	9,074		0	0	475	0	1,291	12,518	2,571	0	0	66	0	0			
1966	16,456	0	0	11,820	7,580	0	1,732	16,149	2,629	0	0	0	0	0	39,910	2.4	23,454
1967	21,834	1,118	0	38,626	38,395	0	395	11,553	5,114	0	0	0	0	0	95,202	4.4	73,368
1968	16,738	461	0	15,565	15,228	0	899	14,998	10,757	0	0	0	0	0	57,910	3.5	41,172
1969	14,041	138	0	14,654	9,306	0	5,229	30,137	6,007	0	0	0	512	0	65,984	4.7	51,943
1970	24,039	2,241	0	17,672	1,687	0	16,989	51,299	9,351	0	0	3,074	1,691	0	104,005	4.3	79,966
1971	55,366	512	0	1,417	769	0	6,345	92,226	20,151	0	0	0	0	0	121,419	2.2	66,053
1972	66,419	742	0	10,888	8,032	0	11,016	91,876	71,167	0	0	345	0	0	194,066	2.9	127,647
1973	56,255	256	0	2,677	4,825	0	5,637	31,706	15,969	0	345	0	0	0	61,415	1.1	5,160
1974	82,609	10,850	0	53,591	28,713	461	9,305	75,084	30,407	0	154	461	0	0	209,026	2.5	126,417
1975	64,199	1,034	0	22,571	20,732	0	8,906	173,687	72,701	0	0	0	0	0	299,631	4.7	235,432
1976	119,321	2,150	0	223,444	73,677	0	8,753	257,625	143,383	0	0	0	393	0	709,424	5.9	590,103
1977	139,548	2,764	0	73,189	92,211	0	2,928	107,917	146,064	0	0	393	0	0	425,466	3.0	285,918
1978	141,981	7,807	0	162,130	24,148	0	507	22,970	16,844	0	0	0	638	0	235,043	1.7	93,062
1979	126,742	507	0	1,374	2,965	0	982	24,323	26,791	0	0	0	2,165	0	59,106	0.5	(67,636)
1980	405,535	0	0	6,064	7,654	0	16,305	589,393	141,065	46	0	684	52	0	761,264	1.9	355,729
1981	377,716	876	0	12,120	2,455	172	0	7,748	5,239	0	0	0	0	0	28,609	0.1	(349,107)
1982	430,423	1,276	0	23,647	28,624		431	3,735			24				57,736	0.1	(372,687)
1983	158,340	10	26	8,935			9,729								18,699		
1984	53,524	1,001															
1985	485,835																
1986	126,529																
1987	40,544																

Table 8. Age composition of the Frazer Lake sockeye escapements, 1965-87.

Year	Escapement	Age Class (% composition)											Sample Size	
		1.1	1.2	1.3	1.4	2.1	2.2	2.3	2.4	3.1	3.2	3.3		3.4
1965	9,074	0.0	0.9	1.7	0.0	6.5	78.0	9.0	0.0	0.2	3.5	0.2	0.0	463
1966	16,456	0.6	15.7	7.2	0.2	1.3	57.1	12.0	0.1	0.4	5.1	0.3	0.0	1,577
1967	21,834	0.3	6.5	6.6	0.7	1.6	42.0	29.6	1.9	0.5	6.5	3.6	0.2	1,380
1968	16,738	0.6	4.0	3.0	0.0	4.0	66.0	22.0	0.0	0.2	0.2	0.0	0.0	774
1969	14,041	0.0	0.0	0.0	0.0	5.7	71.4	17.7	0.0	0.9	2.6	1.7	0.0	424
1970	24,039	4.0	42.3	1.7	0.0	6.2	44.8	1.0	0.0	0.0	0.0	0.0	0.0	420
1971	55,366	0.7	58.6	11.5	0.0	0.6	24.5	3.9	0.0	0.0	0.1	0.1	0.0	1,386
1972	66,419	0.2	22.5	55.5	0.0	1.3	16.7	3.8	0.0	0.0	0.0	0.0	0.0	599
1973	56,255	3.9	25.5	26.5	0.0	9.1	26.1	8.9	0.0	0.0	0.0	0.0	0.0	517
1974	82,609	0.6	20.7	10.9	0.0	19.9	35.3	12.6	0.0	0.0	0.0	0.0	0.0	493
1975	64,199	1.1	2.1	2.5	0.0	9.4	76.0	8.9	0.0	0.0	0.0	0.0	0.0	629
1976	119,321	0.2	8.5	0.6	0.0	8.6	72.0	7.3	0.0	0.0	2.4	0.4	0.0	540
1977	139,548	7.7	1.9	5.7	0.0	4.0	65.2	14.3	0.0	0.0	0.0	1.2	0.0	401
1978	141,981	0.6	31.1	2.8	0.0	5.4	18.4	41.3	0.0	0.2	0.2	0.0	0.0	634
1979	126,742	1.4	14.7	18.7	0.0	5.8	48.9	10.4	0.0	0.1	0.0	0.0	0.0	654
1980	405,535	0.6	48.5	4.5	0.1	1.9	37.7	6.6	0.0	0.0	0.1	0.0	0.0	2,331
1981	377,716	1.6	15.0	15.1	0.0	0.6	52.8	14.9	0.0	0.0	0.0	0.0	0.0	1,775
1982	430,423	0.1	32.0	18.2	0.0	0.1	21.3	28.3	0.0	0.0	0.0	0.0	0.0	2,159
1983	158,340	0.0	0.7	12.3	0.0	0.5	11.7	74.4	0.0	0.0	0.2	0.2	0.0	820
1984	53,524	1.3	9.0	4.4	0.0	24.2	36.1	25.0	0.0	0.0	0.0	0.0	0.0	394
1985	485,835	0.2	1.9	1.2	0.0	0.0	92.4	4.2	0.0	0.0	0.0	0.1	0.0	1,829
1986	126,529	0.0	13.3	1.4	0.0	0.2	4.3	79.2	0.0	0.0	0.4	1.2	0.0	968
1987	40,544	1.7	15.5	49.7	0.3	17.0	6.5	9.1	0.1	0.0	0.0	0.1	0.0	870
Mean		1.2	17.0	11.4	0.1	5.8	43.7	19.3	0.1	0.1	0.9	0.4	0.0	

Table 9. Peak sockeye salmon counts of the primary spawning areas in the Frazer Lake drainage and the percent of the total Frazer Lake escapement represented by the combined peak counts, 1965-87.

Year	Peak Counts <sup>a</sup>					Totals	Total Escapement (fishpass)	Total Peak Counts/Total Escapement
	Linda Creek	Midway Creek	Stumble Creek	Pinnell Creek	Frazer Lake shoals			
1965	565	46	287	876	0	1,774	9,074	20%
1966	1,135	238	9	2,603	247	4,232	16,456	26%
1967	767	387	167	4,288	286	5,895	21,834	27%
1968	694	285	225	2,196	-	-	16,738	-
1969	646	194	222	1,057	315	2,434	14,041	17%
1970	1,086	192	93	1,508	342	3,221	24,039	13%
1971	912	148	295	3,329	712	5,396	55,366	10%
1972	1,102	131	68	1,300	4,400	7,001	66,419	11%
1973	560	142	408	9,000	6,750	16,860	56,255	30%
1974	850	38	1,570	43,662	10,542	56,662	82,609	69%
1975	616	301	195	39,100	6,642	46,854	64,199	73%
1976	752	333	430	13,679	5,720	20,914	119,321	18%
1977	898	319	1,237	94,750	5,825	103,029	139,548	74%
1978	383	382	586	46,234	9,450	57,035	141,981	40%
1979	828	408	537	22,376	6,480	30,629	126,742	24%
1980	1,302	763	1,085	145,316	36,400	184,866	405,535	46%
1981	762	1,156	1,175	182,000	22,300	207,393	377,716	55%
1982	1,333	813	885	62,232	60,550	125,813	430,423	29%
1983	444	301	61	20,650	2,908	24,364	158,340	15%
1984	139	63	1	7,537	1,690	9,430	53,524	18%
1985	504	466	380	-	156,000	157,350	485,835	-
1986	303	131	181	-	21,255	21,840	126,529	-
1987	86	53	53	2,450	7,100	9,742	40,544	24%

<sup>a</sup>Peak counts include live and dead fish.

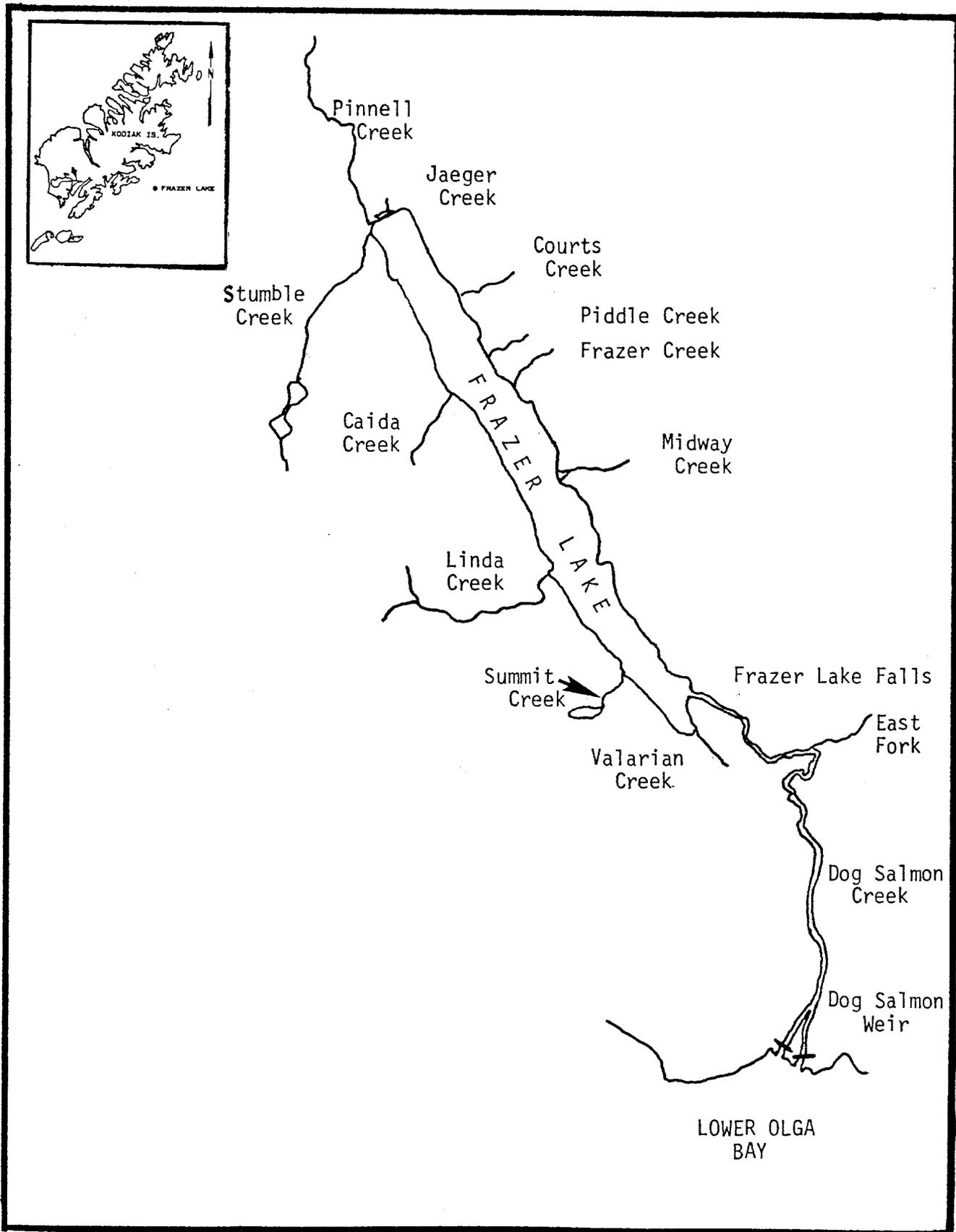


Figure 1. Map of Frazer Lake.

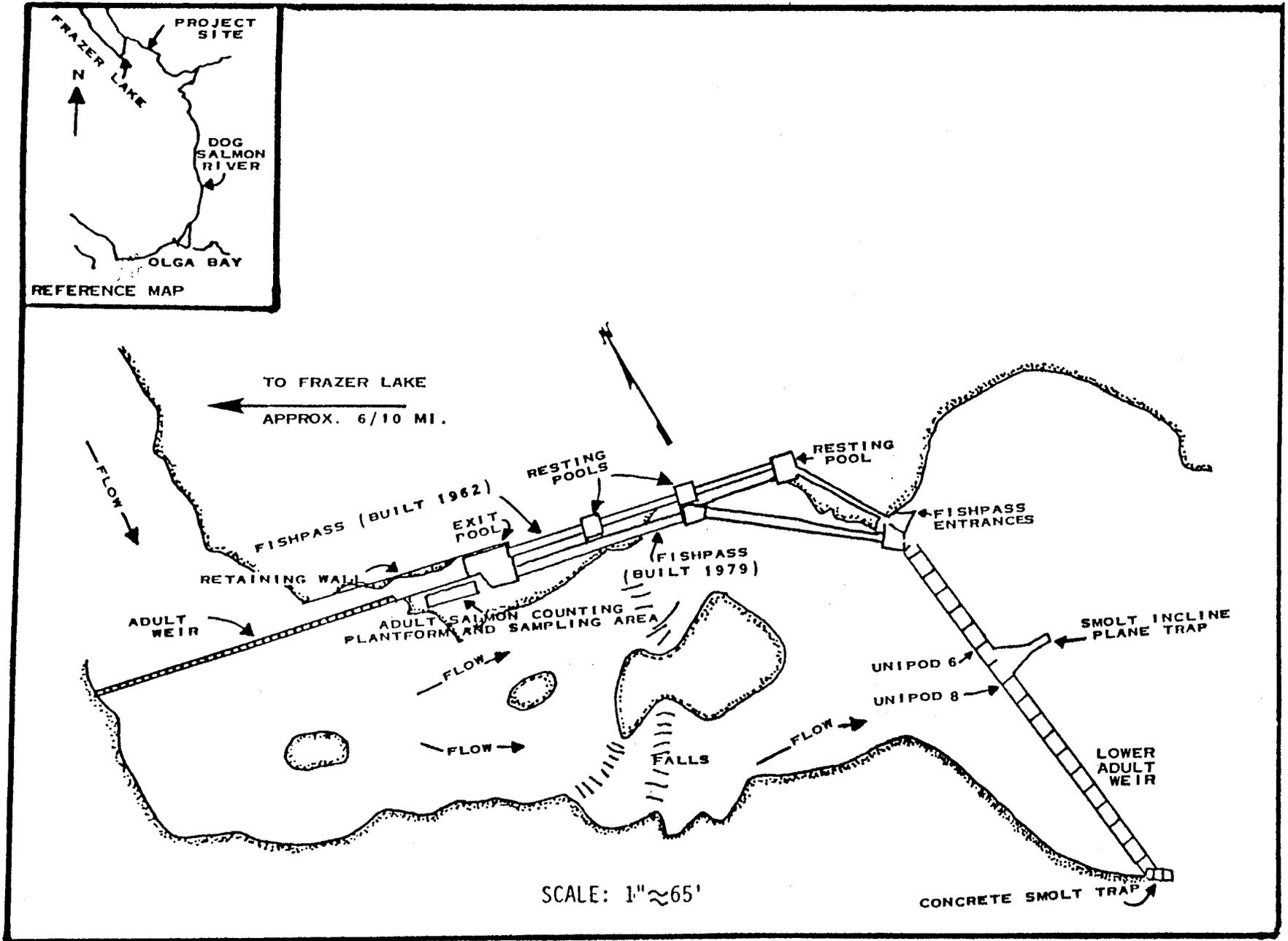


Figure 2. Schematic of the Frazer Lake fishpasses.

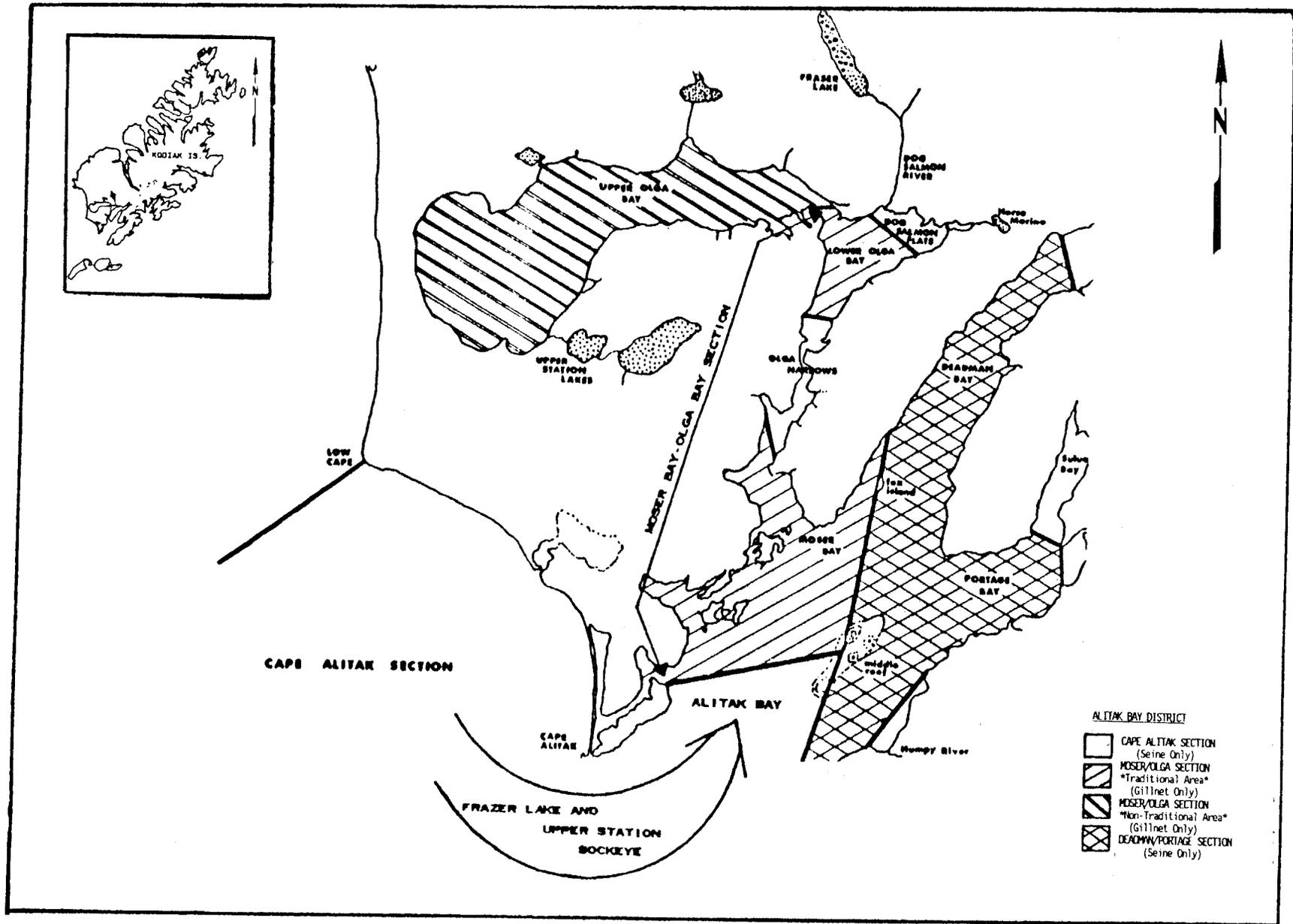


Figure 3. Map of the Alitak Bay District with the fishing areas and major early run sockeye stocks defined.

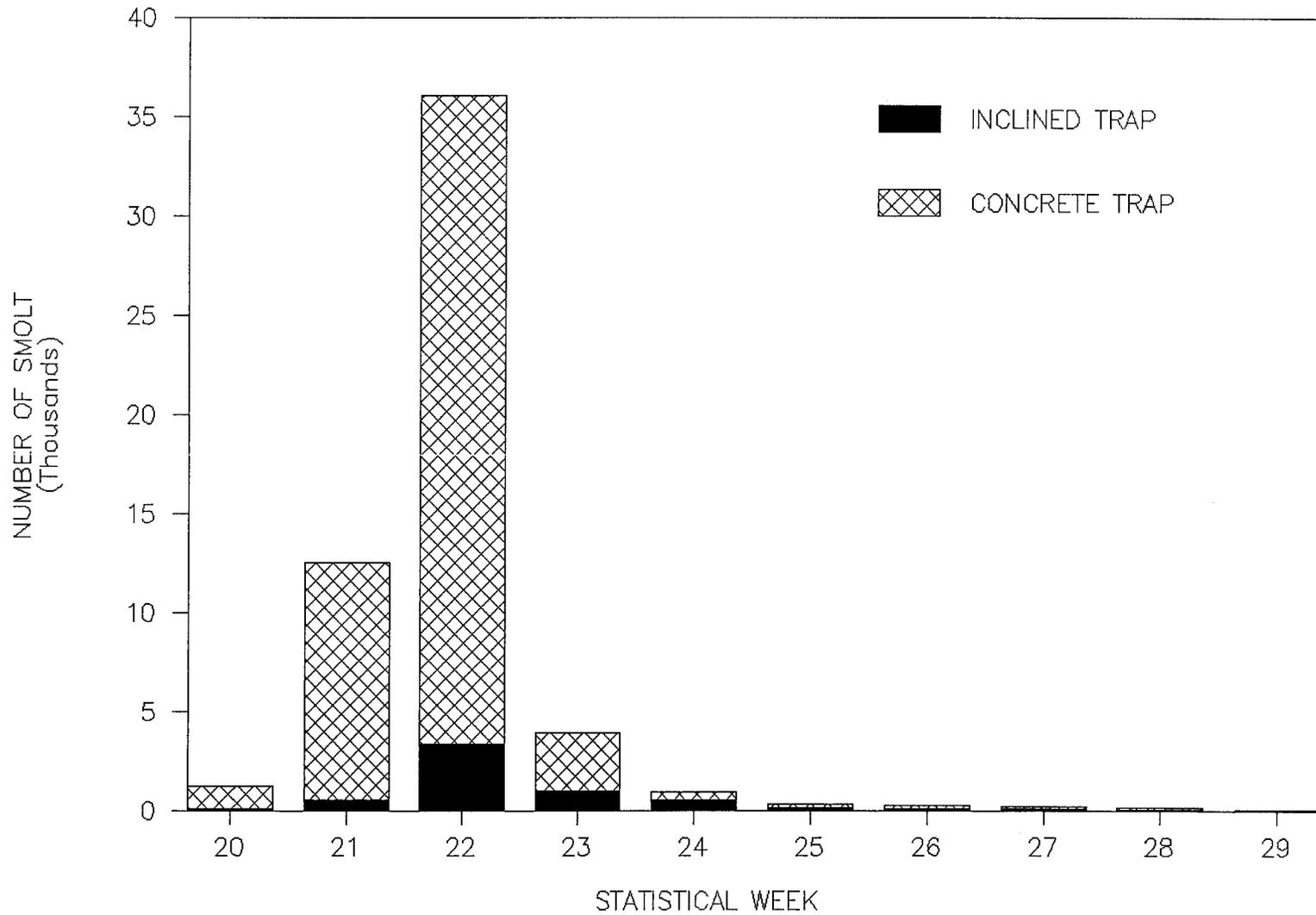


Figure 4. Weekly sockeye salmon smolt catch in the inclined plane and concrete traps at the Frazer Lake fishpass, 1987.

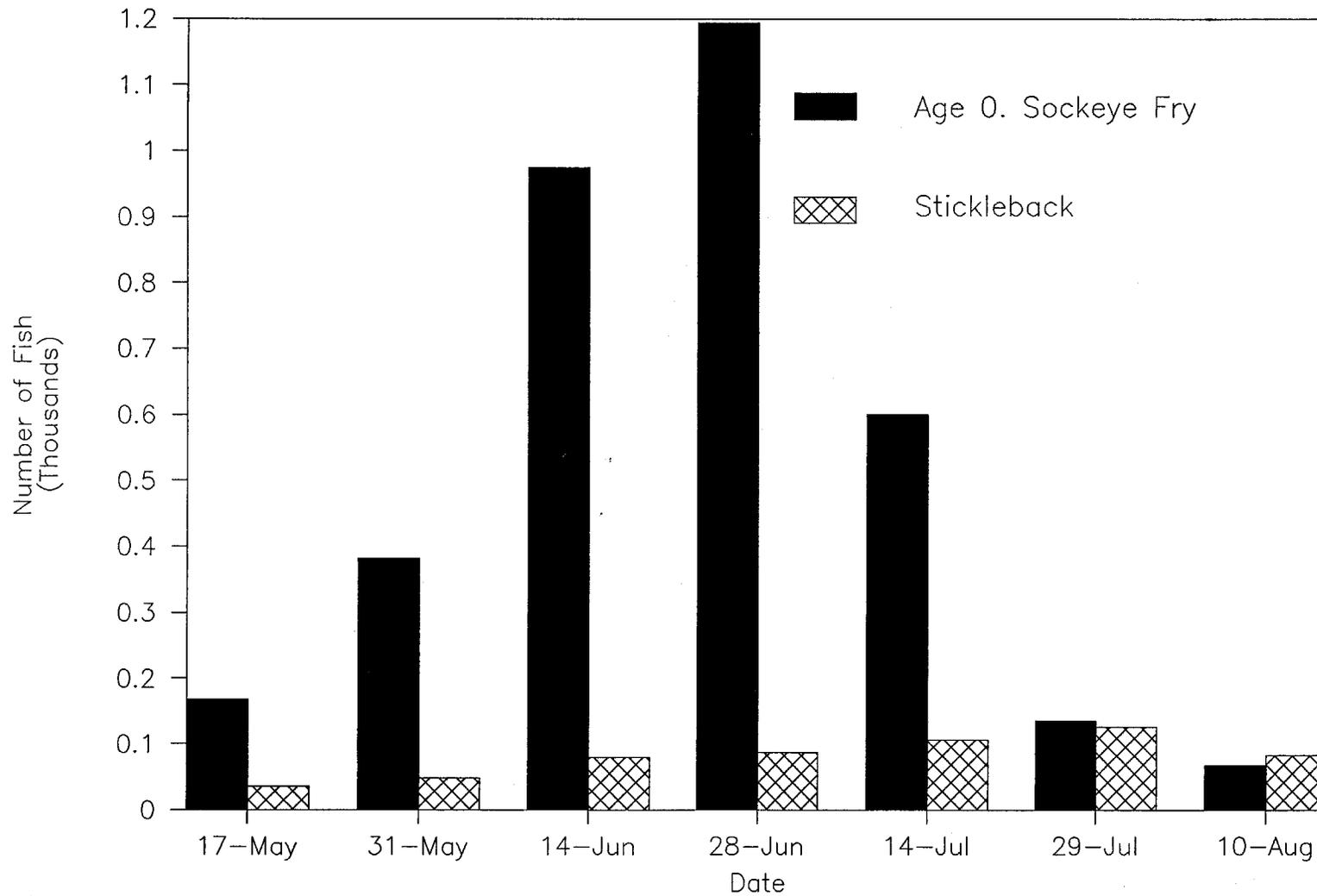


Figure 5. Sockeye salmon and threespine stickleback catch at four Frazer Lake littoral areas combined by sampling date, 1987.

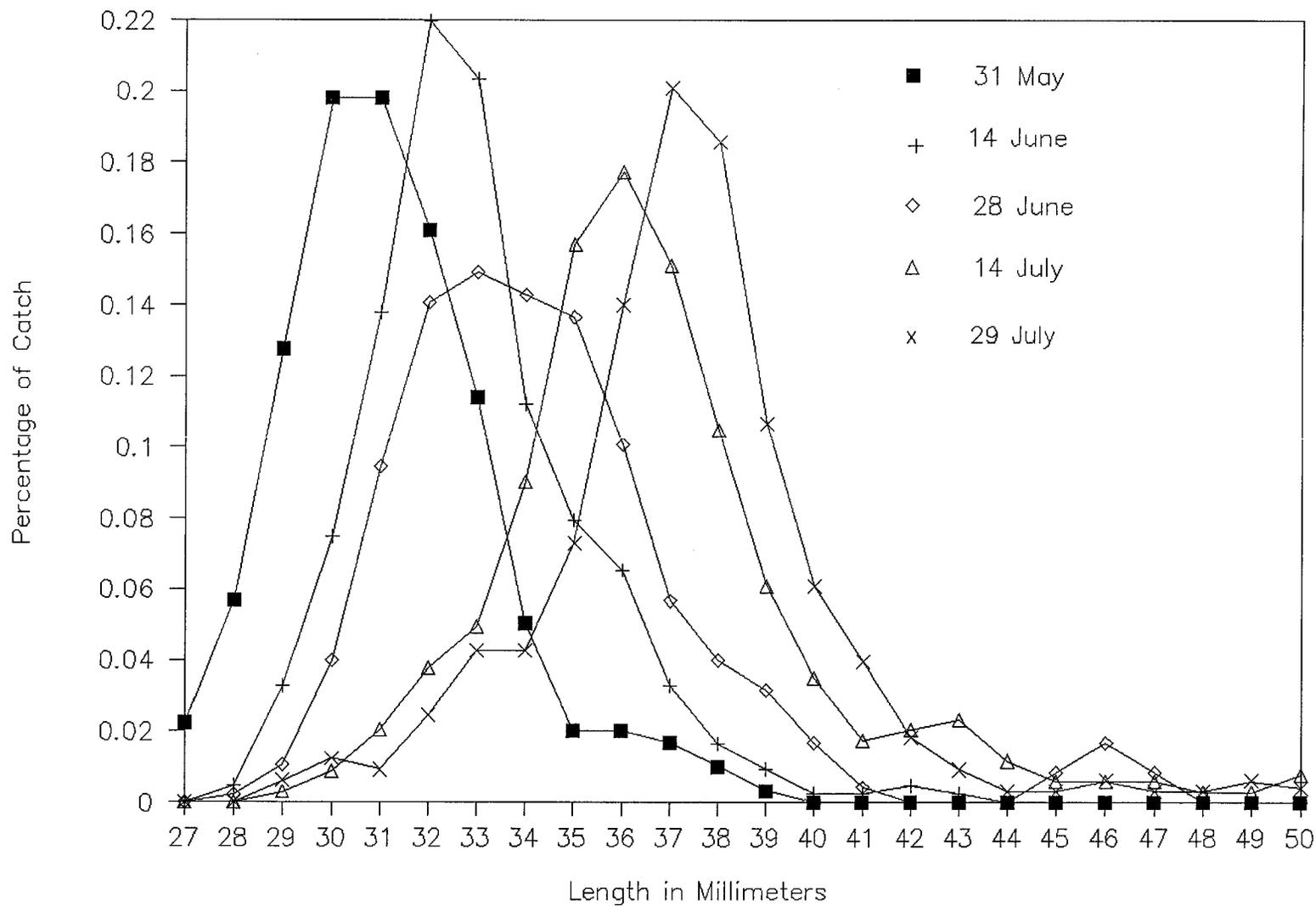


Figure 6. Length composition of age 0. sockeye salmon fry caught at four Frazer Lake littoral areas combined by sampling date, 1987.

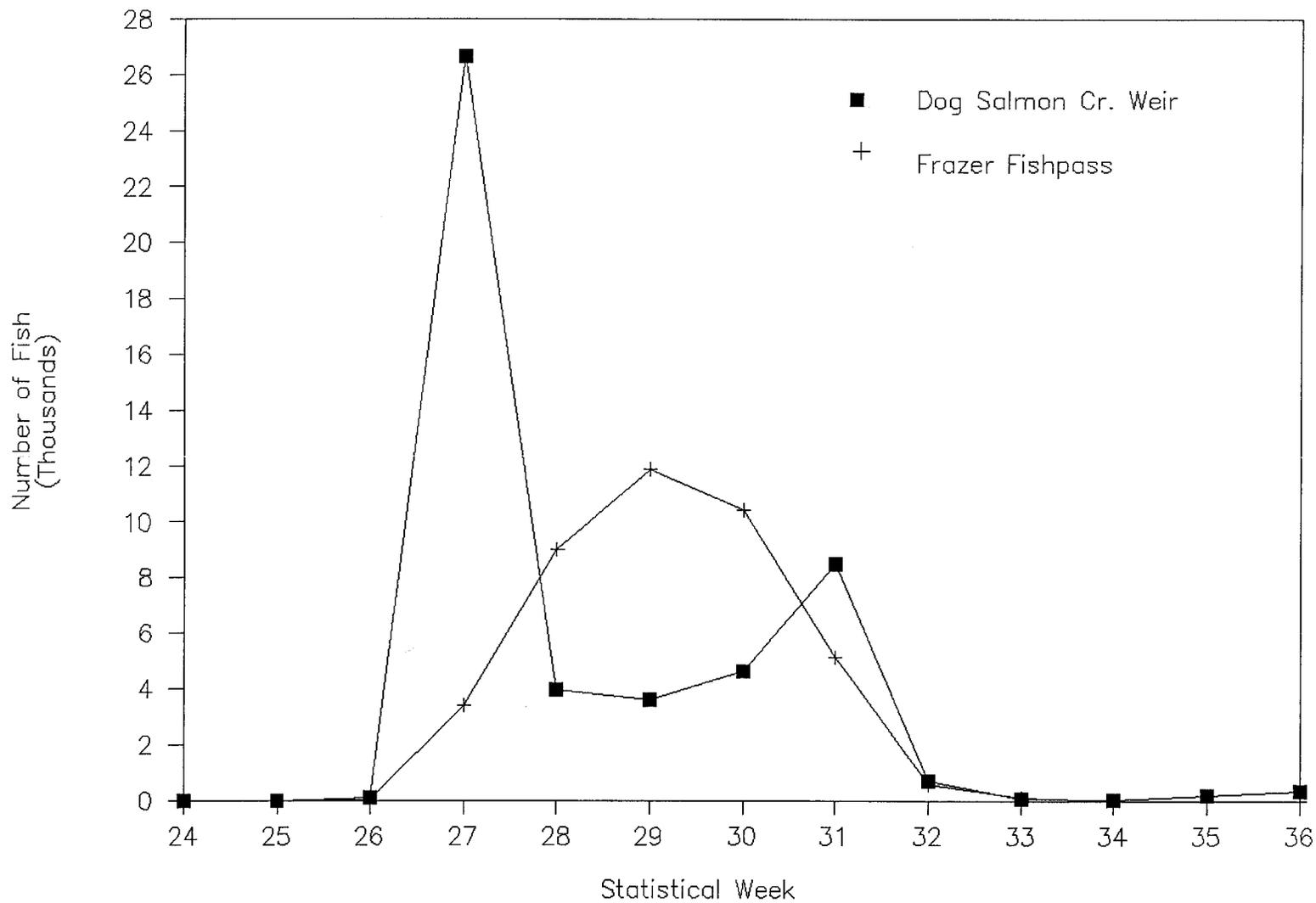


Figure 7. Weekly sockeye salmon escapement through the Dog Salmon Creek weir and the Frazer Lake fishpass, 1987.

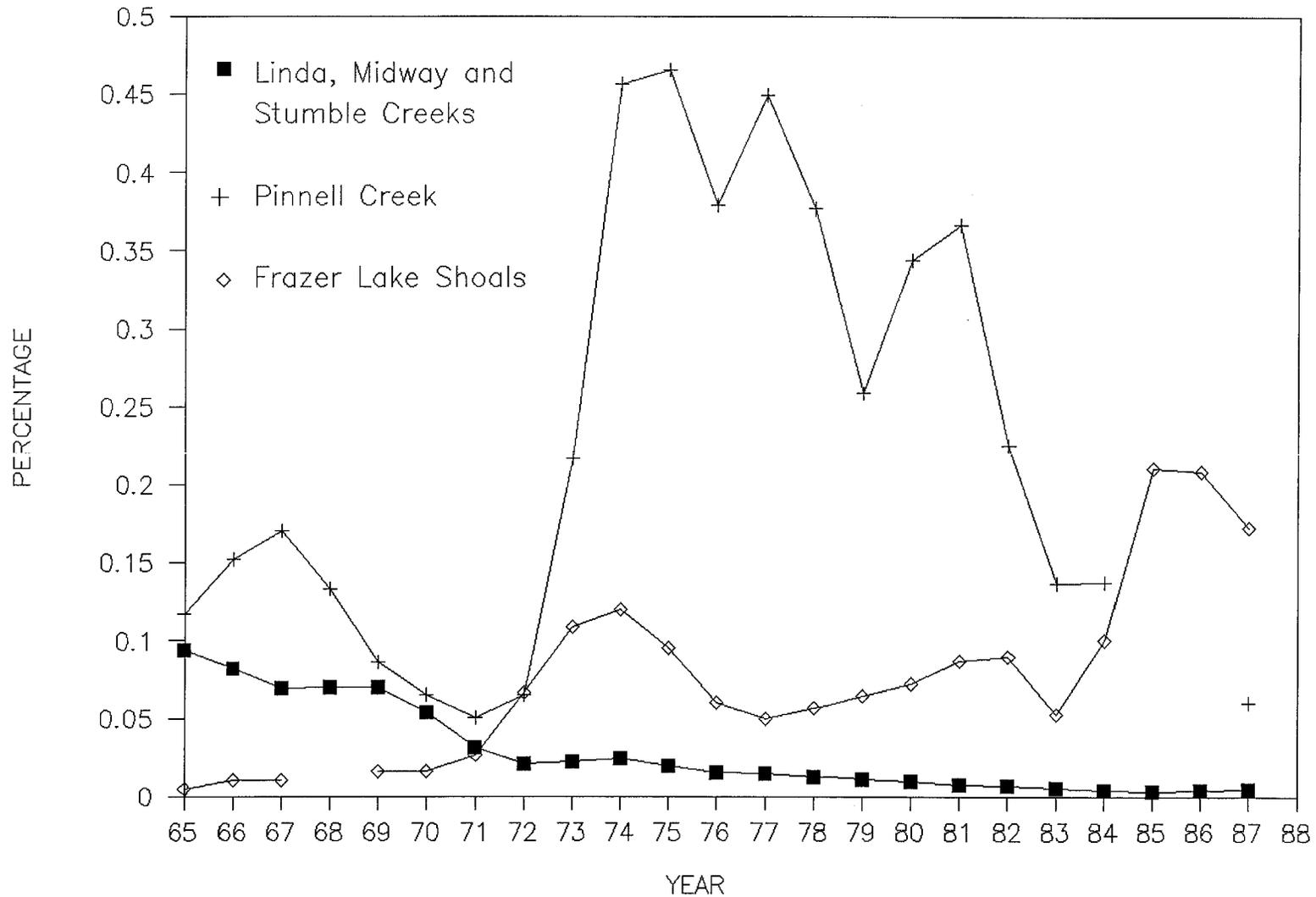
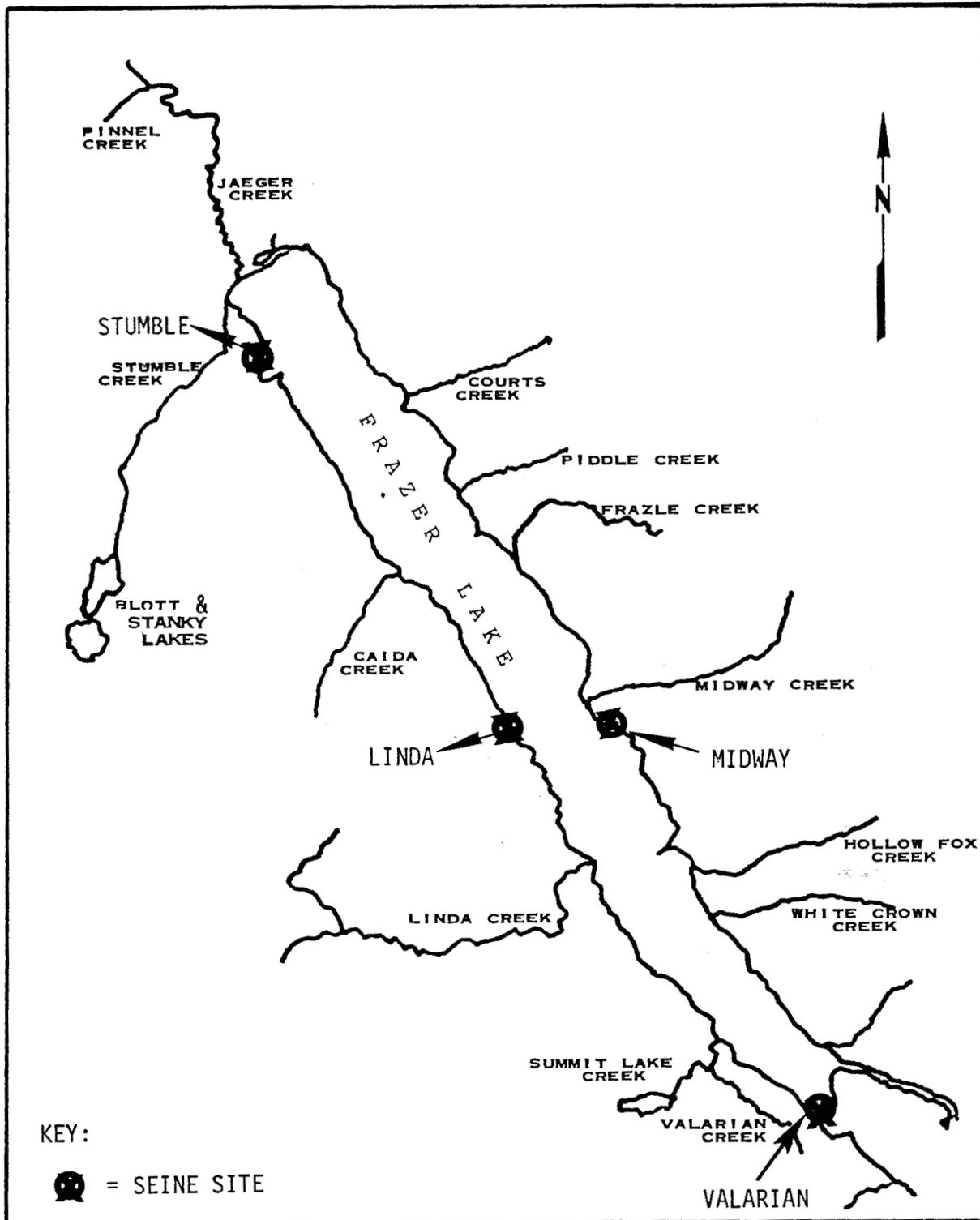


Figure 8. Sockeye salmon peak counts of Linda, Midway, and Stumble Creeks combined, Pinnell Creek, and Frazer Lake shoals as a percentage of the escapement through the Frazer Lake fishpass, 1965–87.

## APPENDICES



Appendix A.1. Frazer Lake with inlet streams and littoral seining locations identified.

Appendix B.1. 1987 calendar weeks.

STATISTICAL WEEK	CALENDAR DATES	STATISTICAL WEEK	CALENDAR DATES
1	01/01 to 01/03	28	07/05 to 07/11
2	01/04 to 01/10	29	07/12 to 07/18
3	01/11 to 01/17	30	07/19 to 07/25
4	01/18 to 01/24	31	07/26 to 08/01
5	01/25 to 01/31	32	08/02 to 08/08
6	02/01 to 02/07	33	08/09 to 08/15
7	02/08 to 02/14	34	08/16 to 08/22
8	02/15 to 02/21	35	08/23 to 08/29
9	02/22 to 02/28	36	08/30 to 09/05
10	03/01 to 03/07	37	09/06 to 09/12
11	03/08 to 03/14	38	09/13 to 09/19
12	03/15 to 03/21	39	09/20 to 09/26
13	03/22 to 03/28	40	09/27 to 10/03
14	03/29 to 04/04	41	10/04 to 10/10
15	04/05 to 04/11	42	10/11 to 10/17
16	04/12 to 04/18	43	10/18 to 10/24
17	04/19 to 04/25	44	10/25 to 10/31
18	04/26 to 05/02	45	11/01 to 11/07
19	05/03 to 05/09	46	11/08 to 11/14
20	05/10 to 05/16	47	11/15 to 11/21
21	05/17 to 05/23	48	11/22 to 11/28
22	05/24 to 05/30	49	11/29 to 12/05
23	05/31 to 06/06	50	12/06 to 12/12
24	06/07 to 06/13	51	12/13 to 12/19
25	06/14 to 06/20	52	12/20 to 12/26
26	06/21 to 06/27	53	12/27 to 12/31
27	06/28 to 07/04		

Appendix C.1. Length, weight, and condition of age-1.0 sockeye salmon smolt produced from 1963 through 1987 escapements.

Year	Escap.	Length			Weight			Condition <sup>a</sup>	
		Sample Size	Mean (mm)	Standard Error	Sample Size	Mean (g)	Standard Error	Sample Size	Mean
1963	11,857	698	146.0	0.4	238	27.2	0.1	238	0.91
1964	9,966	542	153.0	0.3	205	31.0	0.3	205	0.93
1965	9,074	1,196	147.0	0.2	269	28.8	0.3	269	0.90
1966	16,456	1,517	154.0	0.2	379	36.3	0.4	379	0.92
1967	21,834	-	-	-	-	-	-	-	-
1968	16,738	1,878	149.0	0.2	669	30.9	0.2	669	0.93
1969	14,041	130	129.9	0.6	62	20.5	0.5	62	0.93
1970	24,039	452	120.2	0.2	451	15.8	0.1	451	0.91
1971	55,366	46	125.5	2.0	46	18.2	0.7	46	0.91
1972	66,419	212	123.5	0.6	184	18.0	0.3	184	0.95
1973	56,255	366	132.0	0.3	362	22.4	0.1	362	0.97
1974	82,609	492	130.0	0.2	463	19.3	0.1	463	0.88
1975	64,199	385	130.0	0.3	385	20.7	0.1	385	0.95
1976	119,321	107	125.6	0.6	107	17.2	0.2	107	0.87
1977	139,548	460	112.9	0.3	460	11.9	0.1	460	0.83
1978	141,981	349	106.6	0.2	349	9.1	0.1	349	0.75
1979	126,742	250	90.3	0.3	250	5.8	0.1	250	0.78
1980	405,535	64	80.4	0.7	64	4.1	0.1	64	0.77
1981	377,716	23	84.1	1.2	23	5.0	0.2	23	0.82
1982	430,423	1,189	76.3	0.2	1,189	2.9	0.0	1,189	0.64
1983	158,340	2,388	70.0	0.1	2,388	2.6	0.0	2,388	0.73
1984	53,524	85	89.8	0.6	85	5.5	0.1	85	0.76
1985	485,835	256	80.8		256	4.0		256	0.74
1986	126,529								
1987	40,544								

<sup>a</sup>Condition:  $\frac{W \times 10^5}{L^3}$  where W = weight (g) and L = tip-of-snout to fork-of-tail length (mm)

Appendix C.2. Length, weight, and condition of age-2.0 sockeye salmon smolt produced from 1962 through 1987 escapements.

Year	Escap.	Length			Weight			Condition <sup>a</sup>	
		Sample Size	Mean (mm)	Standard Error	Sample Size	Mean (g)	Standard Error	Sample Size	Mean
1962	3,090	346	174.0	0.9	65	48.0	0.6	65	0.89
1963	11,857	1,358	180.0	0.3	488	53.1	0.5	488	0.91
1964	9,966	680	177.0	0.5	279	53.2	0.7	279	0.97
1965	9,074	264	185.0	0.7	176	62.0	0.6	176	0.94
1966	16,456	-	-	-	-	-	-	-	-
1967	21,834	649	180.0	0.5	566	54.0	0.4	566	0.93
1968	16,738	334	173.1	0.6	97	44.5	1.1	97	0.86
1969	14,041	22	151.3	2.5	22	31.7	1.7	22	0.92
1970	24,039	74	142.3	0.8	74	25.6	0.5	74	0.88
1971	55,366	564	150.5	0.4	531	29.9	0.2	531	0.89
1972	66,419	949	149.0	0.3	931	29.5	0.1	931	0.89
1973	56,255	418	157.0	0.4	390	34.0	0.3	390	0.87
1974	82,609	403	154.0	0.4	403	32.0	0.2	403	0.88
1975	64,199	223	144.5	0.7	223	26.0	0.4	223	0.86
1976	119,321	371	143.2	0.3	371	23.4	0.2	371	0.80
1977	139,548	90	109.0	0.5	90	9.8	0.1	90	0.75
1978	141,981	68	108.2	1.2	68	10.2	0.4	68	0.79
1979	126,742	248	95.2	0.8	248	7.0	0.2	248	0.78
1980	405,535	495	94.8	0.2	495	6.9	0.0	495	0.81
1981	377,716	51	99.2	1.7	51	7.1	0.5	51	0.68
1982	430,423	50	83.9	1.0	50	4.7	0.2	50	0.80
1983	158,340	1,438	98.0	0.1	1,437	7.4	0.0	1,437	0.79
1984	53,524	687	103.7		686	8.2		686	0.73
1985	485,835								
1986	126,529								
1987	40,544								

<sup>a</sup>Condition:  $\frac{W \times 10^5}{L^3}$  where W = weight (g) and L = tip-of-snout to fork-of-tail length (mm)

Appendix C.3. Sex composition of the Frazer Lake sockeye escapement by statistical week, 1987.

Statistical Week	Sample			Female-to-Male Ratio	Escapement		
	Females	Males	Total		Females	Males	Total
25-28	98	122	220	0.8:1	5,548	6,907	12,455
29	127	112	239	1.1:1	6,309	5,564	11,873
30	97	142	239	0.7:1	4,224	6,184	10,408
31	98	142	240	0.7:1	2,093	3,033	5,126
32-34	48	58	106	0.8:1	309	373	682
Total	468	576	1,044	0.8:1	18,483	22,061	40,544

Appendix C.4. Length composition of the Frazer Lake sockeye escapement samples by age and sex, 1987.

	AGE											Total
	1.1	0.3	1.2	2.1	1.3	2.2	3.1	1.4	2.3	2.4	3.3	
Females												
Mean Length	0	570	492	397	565	505	0	0	570	546	0	547
SE	-	-	3	9	1	4	-	-	3	-	-	2
Range	0-0	570-570	395-556	362-428	470-609	458-553	0-0	0-0	514-609	546-546	0-0	362-609
Sample Size	0	1	60	6	256	31	0	0	43	1	0	398
Males												
Mean Length	338	0	505	363	573	506	387	558	575	604	592	476
SE	8	-	4	2	2	6	-	-	5	-	33	5
Range	304-459	0-0	446-569	296-452	401-650	445-579	387-387	558-558	499-640	604-604	559-624	296-650
Sample Size	20	0	53	167	159	31	1	1	37	1	2	472
All Fish												
Mean Length	338	570	498	364	568	506	387	558	572	575	592	509
SE	8	-	3	2	1	3	-	-	3	29	33	3
Range	304-459	570-570	395-569	296-452	401-650	445-579	387-387	558-558	499-640	546-604	559-624	296-650
Sample Size	20	1	113	173	415	62	1	1	80	2	2	870

Appendix C.5. Sockeye salmon escapement surveys of Frazer Lake and its inlet streams, 1987.

Stream		----- Mouth -----				Stream-----			Stream	REMARKS		
Date	Observer	---Survey---		Live	---Survey---		-----Count-----		Temp.			
Name	Number	Cond.	Method	Count	Cond.	Method	Live	Dead	Total		(C)	
Frazer L.	0020	17-Aug	Barrett		Fair	Aerial	7100		7100		(2,200 on W. side; 4,900 on east side highest conc. on Midway Cr. shoals)	
Frazer L.	0020	20-Aug	Barrett		Excel.	Aerial	5200		5200		1,500 on W. side; 3,700 on E. side	
Frazer L.	0020	29-Sep	Hastings		Excel.	Aerial	3400		3400		3,000 on N.E. shore & 400 on S.W. shore	
Pinnell	2035	17-Aug	Barrett	Good	Aerial	200	Fair	Aerial	2350	0	2350	1 bear; 1,500 fish below forks
Pinnell	2035	20-Aug	Barrett	Excel.	Aerial	50	Excel.	Aerial	2450	0	2450	0 bear; 1,600 spawning below forks
Pinnell	2035	29-Sep	Hastings	Good	Aerial	0	Good	Aerial	0	0	0	0 bear
Midway	2020	18-Jul	Hastings	Good	Foot	50	Good	Foot	0	0	0	8.0
Midway	2020	29-Jul	Hastings	Good	Foot	150	Good	Foot	80	0	80	8.0
Midway	2020	06-Aug	Hastings	Fair	Foot	50	Fair	Foot	42	11	53	8.5
Midway	2020	18-Aug	Hastings	Good	Foot	40	Good	Foot	20	0	20	7.0
Piddle		18-Jul	Hastings	Good	Foot	0	Good	Foot	0	0	0	7.0
Piddle		29-Jul	Hastings	Good	Foot	40	Good	Foot	10	4	14	7.0
Piddle		06-Aug	Hastings	Fair	Foot	0	Fair	Foot	0	0	0	8.0
Piddle		18-Aug	Hastings	Good	Foot	0	Good	Foot	0	0	0	7.0
Frazle		18-Jul	Hastings	Good	Foot	0	Good	Foot	0	0	0	9.0
Frazle		29-Jul	Hastings	Good	Foot	0	Good	Foot	0	0	0	9.0
Frazle		06-Aug	Hastings	Fair	Foot	0	Fair	Foot	0	17	17	9.0
Frazle		18-Aug	Hastings	Good	Foot	25	Good	Foot	0	0	0	8.0
Courts	2026	18-Jul	Hastings	Good	Foot	0	Good	Foot	0	0	0	7.0
Courts	2026	29-Jul	Hastings	Good	Foot	50	Good	Foot	3	0	3	7.5
Courts	2026	06-Aug	Hastings	Fair	Foot	25	Fair	Foot	2	11	13	8.0
Courts	2026	18-Aug	Hastings	Good	Foot	10	Good	Foot	0	0	0	11.0

-Continued-

Stream		Mouth				Stream			Stream		REMARKS		
Date	Observer	---Survey---		Live	---Survey---		-----Count-----			Temp.			
Name	Number	Cond.	Method	Count	Cond.	Method	Live	Dead	Total	(C)			
Jaeger		18-Jul	Hastings	Poor	Foot	0	Good	Foot	0	0	0	14.0	
Jaeger		29-Jul	Hastings	Fair	Foot	0	Fair	Foot	0	0	0	17.0	
Jaeger		06-Aug	Hastings	Fair	Foot	0	Poor	Foot	0	0	0	10.5	
Jaeger		18-Aug	Hastings	Good	Foot	5	Good	Foot	0	0	0	11.0	
Stumble	2029	18-Jul	Hastings	Poor	Foot	25	Good	Foot	0	0	0	12.0	
Stumble	2029	29-Jul	Hastings	Fair	Foot	75	Fair	Foot	42	0	42	16.0	
Stumble	2029	06-Aug	Hastings	Fair	Foot	30	Poor	Foot	38	15	53	11.0	
Stumble	2029	18-Aug	Hastings	Good	Foot	25	Good	Foot	41	11	52	7.0	
Caida	2023	18-Jul	Hastings	Poor	Foot	0	Good	Foot	0	0	0	8.0	
Caida	2023	29-Jul	Hastings	Fair	Foot	0	Fair	Foot	0	0	0	9.0	
Caida	2023	06-Aug	Hastings	Fair	Foot	0	Poor	Foot	0	0	0	8.5	
Caida	2023	18-Aug	Hastings	Good	Foot	0	Good	Foot	0	0	0	10.0	
Linda	2017	18-Jul	Hastings	Poor	Foot	75	Good	Foot	0	0	0	11.0	
Linda	2017	29-Jul	Hastings	Fair	Foot	100	Fair	Foot	18	0	18	12.0	
Linda	2017	06-Aug	Hastings	Fair	Foot	20	Poor	Foot	12	4	16	10.5	
Linda	2017	18-Aug	Hastings	Good	Foot	40	Good	Foot	84	2	86	11.0	
Valarian		18-Jul	Hastings	Poor	Foot	0	Poor	Foot	0	0	0	9.0	
Valarian		29-Jul	Hastings	Fair	Foot	0	Poor	Foot	41	1	42	9.5	
Valarian		06-Aug	Hastings	Fair	Foot	0	Poor	Foot	21	3	24	9.0	
Valarian		18-Aug	Hastings	Good	Foot	0	Good	Foot	82	2	84	6.0	

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