



1974 BRISTOL BAY SOCKEYE SALMON SMOLT STUDIES

Edited by:
Paul Krasnowski

1975

ADF&G TECHNICAL DATA REPORTS

This series of reports is designed to facilitate prompt reporting of data from studies conducted by the Alaska Department of Fish and Game, especially studies which may be of direct and immediate interest to scientists of other agencies.

The primary purpose of these reports is presentation of data. Description of programs and data collection methods is included only to the extent required for interpretation of the data. Analysis is generally limited to that necessary for clarification of data collection methods and interpretation of the basic data. No attempt is made in these reports to present analysis of the data relative to its ultimate or intended use.

Data presented in these reports is intended to be final, however, some revisions may occasionally be necessary. Minor revision will be made via errata sheets. Major revisions will be made in the form of revised reports.

1974 BRISTOL BAY SOCKEYE SALMON SMOLT STUDIES

A summary of data collected from sockeye salmon
(Oncorhynchus nerka) smolt programs on the
Kvichak, Naknek and Ugashik Rivers

Edited by:

Paul Krasnowski
Division of Commercial Fisheries
Research Section
Anchorage, Alaska

TABLE OF CONTENTS

	Page
LIST OF TABLES.....	i
LIST OF FIGURES.....	iii
1974 KVICHAK RIVER SOCKEYE SALMON SMOLT STUDIES.....	1
INTRODUCTION.....	1
INDEX PROGRAM.....	1
Materials and Methods.....	1
Results.....	2
Climatological and Hydrological Information.....	2
Index Catch.....	2
Age-Weight-Length.....	5
OUTMIGRATION PROGRAM.....	5
Materials and Methods.....	5
Results.....	7
Sonar Sampling.....	7
Calibration.....	7
LITERATURE CITED.....	13
1974 NAKNEK RIVER SOCKEYE SALMON SMOLT STUDIES.....	14
INTRODUCTION.....	14
MATERIALS AND METHODS.....	14
RESULTS.....	14
LITERATURE CITED.....	23
1974 UGASHIK RIVER SOCKEYE SALMON SMOLT STUDIES.....	24
INTRODUCTION.....	24

TABLE OF CONTENTS (Cont.)

	Page
MATERIALS AND METHODS.....	24
RESULTS.....	24
SONAR.....	28
LITERATURE CITED.....	37

LIST OF TABLES

		Page
1974 KVICHAK RIVER SOCKEYE SALMON SMOLT STUDIES		
Table 1	Weather observations, Kvichak River, May 13-June 9, 1974.....	3
Table 2	Kvichak River Index aperture counter calibrations, 1974.....	4
Table 3	Kvichak River sockeye salmon smolt 24-hour index by day and age group.....	6
Table 4	Kvichak River sockeye salmon smolt sonar calibrations, 1974..	9
Table 5	Kvichak River daily sockeye salmon smolt counts by array, 1974. Counts include expansions for unsonified areas between arrays, water velocity differences, non-functioning transducers and mean calibration.....	10
Table 6	Kvichak River sockeye salmon smolt outmigration by day and age group, 1974.....	11
1974 NAKNEK RIVER SOCKEYE SALMON SMOLT		
Table 1	Mean water and air temperatures, Naknek River, 1974.....	15
Table 2	Naknek River index net catches of sockeye salmon smolt by fishing site, 1974.....	16
Table 3	Naknek River index net catches of sockeye salmon by 90-minute periods, May 22-June 25, 1974.....	17
Table 4	Age composition of the random sampling catches of sockeye salmon smolt, by date, Naknek River, 1974.....	20
Table 5	Naknek River sockeye salmon smolt mean weight in grams, 1974.....	21
Table 6	Naknek River sockeye salmon smolt mean length in millimeters, 1974.....	22
1974 UGASHIK RIVER SOCKEYE SALMON SMOLT STUDIES		
Table 1	Three-hour index catch, random sampling scheme catch and total outmigration estimate, Ugashik River, 1958-1969.....	25
Table 2	Ugashik River sockeye salmon smolt index catch by hour and day, 1974.....	26

LIST OF TABLES (Cont.)

	Page
Table 3 Ugashik River sockeye salmon smolt index catch during 24-hour periods, 1974.....	27
Table 4 Ugashik River sockeye salmon smolt sampling data, 1974....	29
Table 5 Age, weight and length of sockeye salmon smolt by sampling period from the Ugashik River, 1974.....	29
Table 6 Weather observations, Ugashik River, 1974.....	30
Table 7 Ugashik River sockeye salmon smolt sonar calibrations, 1974.....	31
Table 8 Sonar counts during index hours by day from 12-transducer array placed in front of index net, Ugashik River, 1974.....	32

LIST OF FIGURES

Page

1974 KVICHAK RIVER SOCKEYE SALMON SMOLT STUDIES

Figure 1. Percent of total outmigration by day as measured by index and sonar, 1974..... 12

1974 UGASHIK RIVER SOCKEYE SALMON SMOLT STUDIES

Figure 1. Daily index net catches of sockeye salmon smolt in percent of total index catch, Ugashik River, 1974..... 35

Figure 2. Comparison of sonar counts and index catches by day, Ugashik River, 1974..... 36

1974 KVICHAK RIVER SOCKEYE SALMON SMOLT STUDIES

By

Paul Krasnowski
Alaska Department of Fish and Game
Division of Commercial Fisheries
Anchorage, Alaska

INTRODUCTION

For the past twenty years, annual indices have been obtained of the abundance of downstream migrant sockeye salmon smolt (Oncorhynchus nerka) from the Lake Clark-Lake Iliamna system. Information obtained from this program is directed toward forecasting age composition and magnitude of adult returns based on estimates of smolt production. Although the index program has provided information on the dynamics of the Lake Clark-Lake Iliamna sockeye salmon population, it has proven to be of variable reliability as a forecast tool.

Beginning in 1965 attempts were made to improve the outmigration index. During 1969, experiments were conducted utilizing underwater sonar to obtain a total outmigration estimate (Parker, 1973b). Sonar gear was utilized during the 1970 field season (Russell, 1972). Improved gear was operational during the 1971 and 1972 field seasons (Paulus and McCurdy, 1972; Parker, 1973a). A new sonar site was utilized during the 1973 field season (Parker, 1973b). This site was again utilized for the 1974 program. The results are presented in this report.

The index program has been continued, utilizing the new sonar aperture counter. It is hoped that eventually a relationship can be established between the index and the outmigration estimate that will allow analysis of historical index data to obtain total outmigration estimates for past years.

In this report Age I, Age II and Age III smolt are defined as young sockeye salmon that have spent one, two or three winters, respectively, in fresh water prior to emigration.

1974 INDEX PROGRAM

Materials and Methods

Materials and methods utilized in the index program have remained virtually unchanged since 1955. A 4' x 4' fyke net is fished in 3.8' of water in a standard location 2 1/2 miles downstream from the outlet of Lake Iliamna.

Mid-way through the 1973 field season, the 14-year old Veeder-Root photo-electric counter that was used with the fyke nets failed. A new sonar-aperture counter was developed in the field by Mr. Al Menin. This system was refined and a new aperture counter was purchased and used during the 1974 field season. This system utilized two sets of horizontally opposed transducers scanning a 4" by 18" aperture on the downstream end of a funnel attached to the fyke net. The transducers are restricted to an 18 degree beam width which samples approximately 20% of the aperture. Advantages of this equipment and method of operation are described in Parker (1973b).

During the season, calibrations of the equipment were conducted to determine whether the counters were functioning at the theoretical five fish per count level. The mean calibration was then used to expand hourly counts to calculate the index catch. To calibrate, a bypass gate in the tunnel is opened causing smolt that enter the fyke net to pass out of the side of the tunnel and not through the sonified aperture. A cod end is then attached to the tunnel, the digital totalizers are reset to zero, the apparatus is lowered back into the water and the bypass gate is closed. When at least 100 counts have been registered, the bypass gate is opened and the cod end is removed. The smolt are placed in a basket and weighed to the nearest 0.1 pound. A one pound subsample is taken and the fish are enumerated. Calibration time, total sample weight and the number of fish per pound are recorded.

Results

Climatological and Hydrological Information

Climatological and hydrological information was recorded at the Barge Island field station from May 13 through June 9, 1974 (Table 1). During this period water temperatures ranged from 3 degrees C. to 8 degrees C. with a seasonal mean of 6 degrees C. A mean water temperature of 7 degrees C. was recorded during the peak outmigration period (May 25 through June 2). Outflow of lake ice caused minimal interference with the index program during the season.

Index Catch

Smolting operations began on May 18 and continued through until noon on June 9 for a total of 21 days of index sampling. The peak day index outmigration occurred on May 28 (29.57 percent), the peak period from May 26 through May 30 accounted for 71.44 percent of the index outmigration.

Table 2 shows the aperture counter calibrations. Mean calibration was 5.43 fish per count. The aperture counter was used from May 22 through June 7. Confidence limits ($p < .20$) calculated from all calibrations were applied proportionally to the index total yielding an index for the 1974 season of 619,013 (\pm 38,998 smolt).

Table 1. Weather observations, Kvichak River, May 13, - June 9, 1974.

Date	Sky		Wind Direction-Velocity (MPH)		Air Temp. °C		Water Temp. °C	24-hour Precipitation (inches)	Water Gauge feet	Turbidity
	0800	2000	0800	2000	Max.	Min.	0800	(inches)	0800	0800
5/13	0	1	-	-	-	-	-	-	-	1
14	2	2	CalM	S30	-	-	4	-	-	1
15	3	3	S30	SW25	-	-	5	0	-	1
16	4	3	SW10	SW10	-	-	3	T	-	1
17	4	1	SW10	CalM	-	-	3	T	-	1
18	1	1	N10	CalM	-	-	4	0	-	1
19	2	3	SW5	NE10	-	-	4	0	-	1
20	4	3	N15	NE10	-	-	4	T	-	1
21	1	1	N10	CalM	-	-	6	0	-	1
22	1	1	CalM	N-5	-	-	5	0	-	2
23	1	2	SW5	SW5	-	-	5	0	-	2
24	1	2	S10	S5	33	2	7	T	-	2
25	2	2	SW15	SW10	29	3	5	T	-	2
26	3	1	SW10	S5	25	2	6	0	-	1
27	1	2	N10	CalM	32	2	6	0	0.5	1
28	4	3	NE5	S5	20	4	7	0	0.5	1
29	1	1	NE5	NE15	19	2	7	0	0.6	2
30	1	1	NE15	NE20	28	-4	8	0	0.6	2
31	2	2	NE20	NE10	28	4	6	0	0.6	2
6/1	1	2	NE5	CalM	23	2	8	0	0.6	1
2	1	3	SW10	SW5	28	7	8	0	0.6	1
3	1	2	SE5	SW5	31	5	8	0	0.6	1
4	2	2	NE15	NW15	30	5	8	0.5	0.7	1
5	4	3	NE10	SW10	20	-1	8	0.11	0.7	1
6	3	2	SW10	CalM	24	8	8	0	0.6	1
7	1	1	CalM	SW30	26	12	8	0	-	1
8	4	3	SW20	SW25	26	2	8	0	0.6	1
9	1	1	SW20	-	29	4	8	0	-	1

Sky Codes:

- 1-Clear sky, cloud covering not more than 1/10.
- 2-Cloud covering not more than 1/2 sky.
- 3-Cloud covering more than 1/2 sky.

Turbidity Codes:

- 4-Complete overcast.
- 5-Fog or thick haze.

- 1-Clear.
- 2-Partly Cloud.
- 3-Cloudy.
- 4-Debris.

Table 2. Kvichak River Index Aperture Counter Calibrations, 1974.

Date	Elapsed Time (min.)	Total Counts	Weight of Catch (lb.)	Fish per Pound	Total Catch	Rate (fish/min.)	Fish per Count
5/23	5	111	17.7	29	513	103	4.62
	5	148	27.5	39	1,073	215	7.25
5/24	20	32	4.3	44	211	11	6.60
5/27	3	128	23.5	38	893	298	6.98
	6	53	8.0	38	304	51	5.74
	3	137	16.8	37	622	207	4.54
	4	16	2.3	35	81	20	5.06
	1	121	15.5	42	651	651	5.38
5/31	4	124	15.0	41	615	154	4.96
	3	141	15.0	46	690	230	4.89
	4	134	15.1	42	634	159	4.73
	8	134	16.5	45	743	93	5.54
	12	105	11.7	40	468	39	4.46
6/4	9	103	12.4	44	546	61	5.30

$\bar{x} = 5.43$

Age-Weight-Length

A total of 39 samples (2,014 smolt) were taken throughout the smolt season to determine the length frequency distribution of the outmigration. From these samples, 349 scale samples were collected for age determination. Age class separation points were determined by the weighted mean length of those smolt that fall within the overlap between Age I and Age II and Age III. Daily age class composition was determined on the basis of daily length frequencies and the estimated age class separation points.

Although samples of adult returns to the Kvichak River have sometimes contained individuals which had spent three winters in fresh water, this was the first time Age III outmigrating smolt were collected.

The above technique provided an estimated age composition of the 1974 index catch of 82,120 (13.27 percent) Age I smolt, 493,557 (79.73 percent) Age II smolt and 43,336 (7.00 percent) Age III smolt (Table 3).

The seasons weighted mean length by age class was determined by applying each days mean length by age class to the daily index catch of that age class. The resulting season weighted mean length, based on these daily weighted mean lengths was 95.5 mm for Age I smolt (20-year average = 88 mm) 111.0 mm for Age II smolt (20-year average = 109 mm) and 123.5 mm for Age III smolt.

Mean weights by age class were determined from the age-weight-length samples using a least squares regression ($y = ax + b$ where $x =$ length and $y =$ weight). This yielded a mean weight of 8.3 g. for Age I smolt (20-year average = 5.9 g.), 13.1 g. for Age II smolt (20-year average = 10.8 g.) and 17.5 g. for Age III smolt.

Figure 1 shows the percent of total outmigration by day as measured by the index sampling and the sonar total outmigration estimate. Both generally show the same day to day fluctuations although the magnitude differs between index and sonar. Statistical analysis shows a highly significant correlation ($p < .1$) between the daily index catch and daily sonar outmigration estimate. Examination of 1973 data demonstrates a similar correlation of the daily results of the index and sonar projects ($p < .01$). If data from future years can be used to refine this statistical relationship between the index and the sonar estimate, then past index values could be converted to total outmigration estimates for use with adult return data to determine past marine survival parameters.

OUTMIGRATION PROGRAM

Materials and Methods

The sonar site used during the 1973 smolt season, approximately 1/3 mile upstream from the index site, was used again in 1974. Two Bendix smolt counting systems were utilized in the 1974 total smolt outmigration estimate. The 1972 model electronics were operated from the west bank and the 1971 model from the east bank. The placement of the support cable and arrays was similar to that used in 1973 (Parker, 1973b).

Table 3. Kvichak River sockeye salmon smolt 24-hour index by day and age group, 1974.

Date Noon-Noon	Age I Smolt		Age II Smolt		Age III Smolt		24-Hour Index	
	Number	Percent ^{1/}	Number	Percent ^{1/}	Number	Percent ^{1/}	Number	Percent ^{2/}
5/18-19	0	0	164	80.2	41	19.8	205	0.03
19-20	0	0	3,975	80.2	981	19.8	4,956	0.76
20-21	63	1.8	2,319	65.9	1,137	32.3	3,519	0.54
21-22	0	0	3,536	72.3	1,355	27.7	4,891	0.75
22-23	177	0.8	18,830	84.9	3,172	14.3	22,179	3.06
23-24	0	0	13,158	87.1	1,949	12.9	15,107	2.65
24-25	188	5.8	2,935	90.4	124	3.8	3,247	0.54
25-26	322	1.5	20,850	94.1	975	4.4	22,157	3.82
26-27	8,624	10.2	70,934	83.9	4,988	5.9	84,546	14.39
27-28	0	0	7,895	52.2	7,229	47.8	15,124	2.52
28-29	1,714	6.2	24,417	88.3	1,521	5.5	27,652	4.45
29-30	29,102	15.9	144,045	78.7	9,884	5.4	183,031	29.57
30-31	20,391	16.3	101,955	81.5	2,752	2.2	125,098	20.51
31-1	5,803	33.3	10,787	61.9	837	4.8	17,427	3.04
6/1-2	4,264	8.5	40,838	81.4	5,068	10.1	50,170	7.83
2-3	353	19.8	1,221	68.5	208	11.7	1,782	0.28
3-4	3,699	25.3	10,014	68.5	906	6.2	14,619	1.98
4-5	4,936	24.6	14,968	74.6	161	0.8	20,065	2.81
5-6	2,383	79.0	609	20.2	25	0.8	3,017	0.46
6-7	39	56.8 ^{3/}	25	37.0 ^{3/}	5	6.2 ^{3/}	69	0.01
7-8	0	0	1	100.0	0	0	1	0.00
8-9	52	34.6	81	53.8	18	11.6	151	0.02
TOTAL	82,120	13.27	493,557	79.73	43,336	7.00	619,013	100.00

^{1/} Percent of daily index catch.

^{2/} Percent of total index catch.

^{3/} Estimated for missing age composition data.

Count expansion techniques remained unchanged from previous years. Sonar counts by array were recorded with appropriate adjustments made for "false" counts caused by boats, ice or wind. Daily sonar counts were adjusted for inoperative transducers and corrected for water velocity differences between inshore and offshore arrays. Total counts were multiplied by the theoretical 10 fish per count calibration to transpose them to numbers of smolt. The number of smolt per foot of array for each array was calculated and expanded for the amount of unsonified river that each array was considered to sample. Additional information regarding count expansion techniques can be found in Parker (1973a).

Calibrations were attempted using a 4' x 6' fyke net attached to a second support cable. The fyke net support cable was stretched across the river upstream of the sonar support cable. Lines were attached from the cable to the fyke net bridles in order to position the net behind the array which was to be calibrated. The calibrations were intended to confirm the functioning of the electronics at the theoretical 10 fish per count level.

Results

Sonar Sampling

Sonar sampling outmigration enumeration began May 19 and continued until June 9. There was very little interference caused by ice, wind or equipment problems. Sonar counting was continuous from installation until the project termination on June 9. The peak day outmigration, as measured by sonar, occurred on May 26 (13.14 percent), the peak period from May 25 through June 1 accounted for 74.06 percent of the total outmigration.

Calibration

The calibration fyke net was placed approximately 15 feet downstream from the array. The calibration procedure is essentially the same as that used for the index aperture counter calibration. The digital totalizers were cleared and the cod end installed. When the electronics registered sufficient counts to indicate that a school of smolt had crossed the array, the crew waited for a time sufficient for the fish to have entered the fyke net then removed the cod end, and weighed the catch to determine the number of smolt. This number divided by the number of counts registered by that array is an estimate of the rate (fish per count) at which the electronics are enumerating smolt.

Numerous problems were encountered in attempting to calibrate the electronics. The river depth (6 feet) and velocity (5 to 6 feet per second) are essentially prohibitive to fyke net operation. The six foot fyke net that had to be used was extremely unweildy requiring a crew of at least three men to set and pull it. The distance from the array to the fyke net was in part determined by the necessity of widely spacing

the lines which attached the fyke net to the fyke net support cable so that they would pass on either side of the 12 foot array. Otherwise, they would generate false counts. Because of this distance, smolt crossing the arrays could move laterally and miss the fyke net entirely. Conversely, smolt which passed over the unsonified portions of the river could move laterally and be trapped in the fyke net.

Although the calibrating was done during the darkest time of the nights to reduce net avoidance, crews repeatedly observed schools of smolt holding in the wings of the fyke net and them swimming upstream out of the net and around the wings. The fyke net was, therefore, not adequately trapping the fish that crossed the arrays. In addition, fyke nets may cause high mortality by gilling smolt in the wings and scaling others as they passed through.

Analysis of the calibration data was based on the same criteria as in previous years (Parker, 1973a). The specifications of the sonar counters, as designed into the electronics, are as follows: (1) at optimal adjustment the sonar will register one count for 10 smolt of a specific biomass, (2) it is electronically impossible that less than 5 fish could trigger a count, and (3) no more than 20 smolt could cross the unit with only a single count registered. The procedure is based on the the assumption that calibrations of less than five or more than 20 fish per count can be discounted as mechanically invalid and must be the result of errors intrinsic in the sampling procedure.

Twenty calibrations were attempted over the course of four nights. Of these, thirteen were dropped (range 4.12 - 87.59) because they fell outside the valid range. The remaining calibrations (Table 3) yielded a mean of 10.04 (± 2.3 , $p < .20$) fish per count. It was decided to accept this as confirmation that the hardware was operating within its designed specification and to use the theoretical 10 fish per count in expanding the data from each array to estimate total outmigration. Confidence limits for the total outmigration estimate were calculated using the ratio of the confidence limits to the mean calculated for the sonar calibrations ($\bar{x} = 10.04 \pm 2.3$ fish per count = $\bar{x} \pm 22.9\%$). Since the confidence interval for the outmigration estimate is based on the analysis of the calibration data, it must be considered in light of the assumptions regarding invalid calibrations as discussed above.

There were 837,261 total counts registered during the outmigration. Based on expansion of these counts the total outmigration estimate was 42.71 million (± 9.78 million) smolt. Age class composition was calculated by applying the daily index age class percentages to the corresponding days outmigration. Age class composition for the estimate of the total outmigration was 4.02 million (9.42 percent) Age I smolt, 33.77 million (79.05 percent) Age II smolt and 4.93 million (11.53 percent) Age III smolt.

Table 4. Kvichak River sockeye salmon smolt sonar calibrations, 1974.

Date	Elapsed Time (min.)	Total Counts ^{1/}	Weight of Catch (lb.)	Fish per Pound	Total Catch ^{2/}	Rate (fish/min.)	Fish per Count
5/26	1.73	142	17.4	40	927	536	6.53
	2.80	117	28.5	36	1,368	489	11.69
	4.82	167	19.8	39	1,029	213	6.16
5/27	2.83	50	23.5	28	875	309	17.50
	12.33	236	55.0	27	1,980	161	8.39
5/28	14.88	15	2.3	38	116	8	7.73
5/30	1.89	139	39.0	33	1,715	927	12.34

$\bar{x} = 10.04$

1/ Expanded for inoperative transducers.

2/ Expanded by 1.3 to adjust for difference between width of array (12') and width of fyke net (9').

Table 5. Kvichak River daily sockeye salmon smolt counts by array, 1974. Counts include expansions for unsonified areas between arrays, water velocity differences, non-functioning transducers and mean calibration.

Date Noon-Noon	East Bank		West Bank		Total
	Inshore	Offshore	Inshore	Offshore	
5/19-20	20,003	92,565	32,878	121,500	266,946
20-21	147,056	167,541	217,490	158,845	690,932
21-22	124,497	509,000	26,348	159,375	819,220
22-23	94,568	963,400	44,336	1,258,065	2,360,369
23-24	84,767	332,550	54,650	1,226,510	1,698,477
24-25	172,490	435,600	124,830	689,140	1,422,060
25-26	447,161	3,712,894	211,444	1,043,737	5,415,236
26-27	584,254	3,225,486	568,533	1,232,367	5,610,640
27-28	250,695	2,723,750	476,530	851,516	4,302,491
28-29	479,966	1,598,625	112,253	511,944	2,702,788
29-30	417,191	2,281,375	837,902	1,541,520	5,077,988
30-31	117,612	1,361,875	256,220	921,110	2,656,817
30-1	26,406	179,250	32,898	339,400	577,954
6/ 1-2	1,470,515	3,274,125	128,539	417,600	5,290,779
2-3	11,705	245,125	1,163	16,850	274,843
3-4	125,105	603,188	172,543	402,240	1,303,076
4-5	103,074	952,813	46,890	559,715	1,662,492
5-6	101,049	252,813	11,277	56,320	421,459
6-7	7,938	35,812	2,123	5,575	51,448
7-8	5,751	30,000	9,339	6,260	51,350
8-9	30,091	14,625	6,052	6,790	57,558
Total	4,821,894	22,992,412	3,374,238	11,526,379	42,714,923
Percent ^{1/}	11.29	53.83	7.90	26.98	100.00

^{1/} Percent of total outmigration by array.

Table 6 . Kvichak River sockeye salmon smolt outmigration by day and age group, 1974.

Date Noon-Noon	Age I Smolt		Age II Smolt		Age III Smolt		Total Outmigration	
	Number	Percent ^{1/}	Number	Percent ^{1/}	Number	Percent ^{1/}	Number	Percent ^{1/}
5/19-20	0	0	214,091	80.2	52,855	19.8	226,946	0.62
20-21	12,437	1.8	445,324	65.9	223,171	32.3	690,932	1.62
21-22	0	0	592,296	72.3	226,924	27.7	819,220	1.92
22-23	18,883	0.8	2,003,953	84.9	337,533	14.3	2,360,369	5.53
23-24	0	0	1,479,373	87.1	219,104	12.9	1,698,477	3.98
24-25	82,840	5.8	1,285,542	90.4	54,038	3.8	1,422,060	3.33
25-26	81,229	1.5	5,095,737	94.1	238,270	4.4	5,415,236	12.67
26-27	572,285	10.2	4,707,327	83.9	331,028	5.9	5,610,640	13.14
27-28	0	0	2,245,900	52.2	2,056,591	47.8	4,302,491	10.07
28-29	167,573	6.2	2,386,562	88.3	148,653	5.5	2,702,788	6.33
29-30	807,400	15.9	3,996,377	78.7	274,211	5.4	5,077,988	11.89
30-31	433,061	16.3	2,165,306	81.5	58,450	2.2	2,656,817	6.22
31-1	192,459	33.3	357,753	61.9	27,742	4.8	577,954	1.35
6/1-2	449,716	8.5	4,306,694	81.4	534,369	10.1	5,290,779	12.39
2-3	54,419	19.8	188,267	68.5	32,157	11.7	274,843	0.64
3-4	329,678	25.3	892,607	68.5	80,791	6.2	1,303,076	3.05
4-5	408,973	24.6	1,240,219	74.6	13,300	0.8	1,662,492	3.89
5-6	332,952	79.0	85,135	20.2 ^{3/}	3,372	0.8 ^{3/}	421,459	0.99
6-7	29,222	56.8 ^{3/}	19,036	37.0 ^{3/}	3,190	6.2 ^{3/}	51,448	0.12
7-8	29,167	56.8 ^{3/}	18,999	37.0 ^{3/}	3,184	6.2 ^{3/}	51,350	0.12
8-9	19,915	34.6	30,966	53.8	6,677	11.6	57,558	0.14
TOTAL	4,021,849	9.42	33,767,464	79.05	4,925,610	11.53	42,714,923	100.00

1/ Percent of daily outmigration.

2/ Percent of total outmigration estimate.

3/ Estimated for missing age composition data.

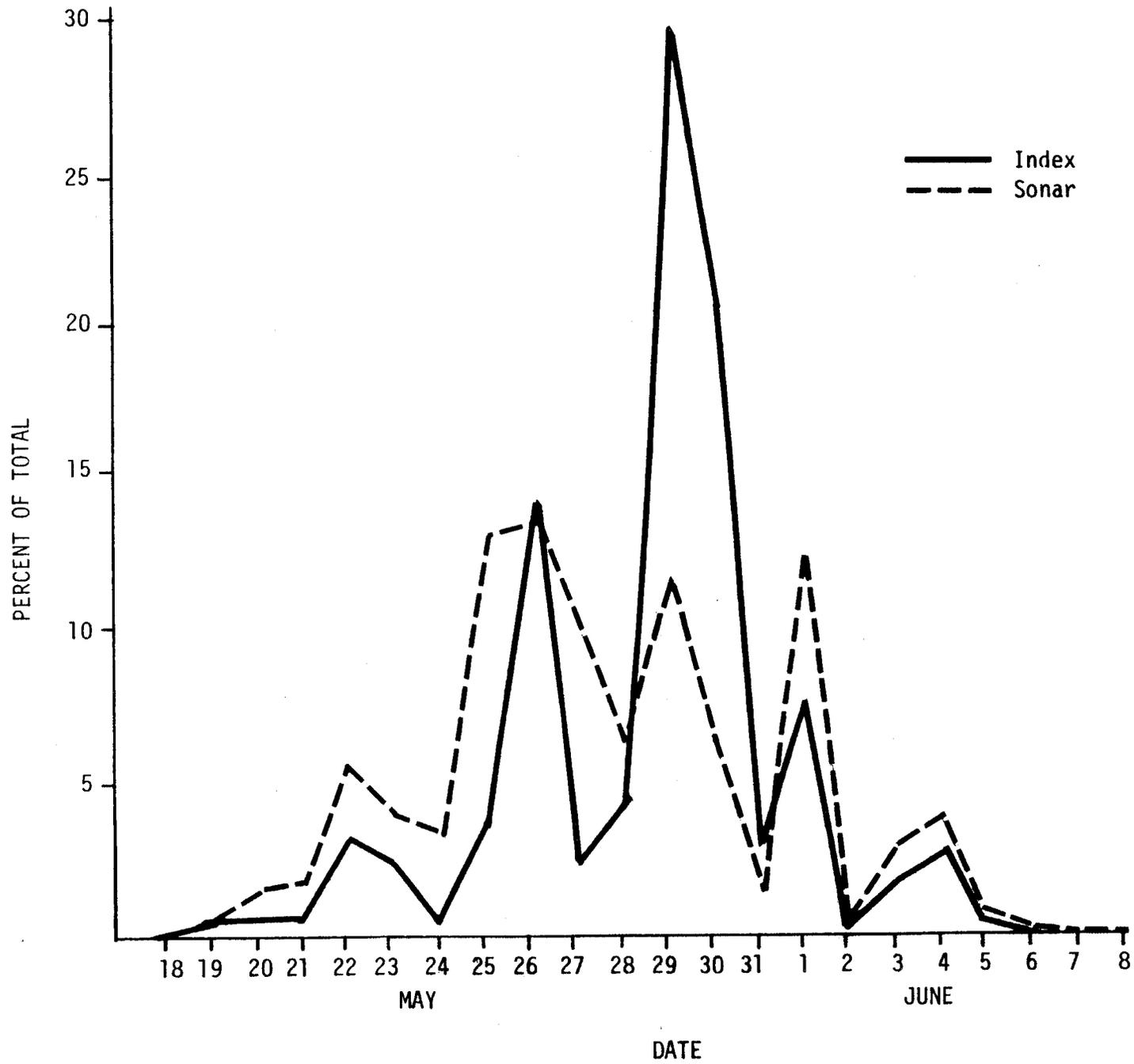


Figure 1. Percent of total outmigration by day as measured by index and sonar, 1974.

LITERATURE CITED

- Parker, Kenneth P., 1973a. 1972 Kvichak River Sockeye Salmon Smolt Studies. In 1972 Bristol Bay Sockeye Salmon Smolt Studies. (Ed. Kenneth P. Parker). Alaska Department of Fish and Game Technical Data Report No. 13, pp. 1-37.
- Parker, Kenneth P., 1973b. 1973 Kvichak River Sockeye Salmon Smolt Studies. In 1973 Bristol Bay Sockeye Salmon Smolt Studies. (Ed. Kenneth P. Parker). Alaska Department of Fish and Game Technical Data Report No. 14, pp. 1-22.
- Paulus, Robert D. and Michael L. McCurdy, 1972. 1970 Kvichak River Sockeye Salmon Smolt Studies. In 1970 Bristol Bay Sockeye Salmon Smolt Studies (ed. Phillip Russell). Alaska Department of Fish and Game Technical Data Report No. 4, pp. 1-13.
- Russell, Phillip A., 1972. 1971 Kvichak River Sockeye Salmon Smolt Studies. In 1971 Bristol Bay Sockeye Salmon Smolt Studies. (Ed. Phillip A. Russell and Michael L. McCurdy). Alaska Department of Fish and Game Technical Data Report No. 2 , pp. 1-28.

1974 NAKNEK RIVER SOCKEYE SALMON SMOLT STUDIES

By

Donald L. Bill
Alaska Department of Fish and Game
Division of Commercial Fisheries
P. O. Box 37
King Salmon, Alaska 99613

INTRODUCTION

This was the nineteenth year that the Naknek River sockeye salmon (*Oncorhynchus nerka*) smolt study has been conducted. The objective of this program is to obtain an estimate of the size and age composition of the sockeye salmon smolt outmigration in the Naknek River.

MATERIALS AND METHODS

The materials and methods for data collection and analysis of age composition, lengths and weight, and general environmental data were the same as in previous years (McCurdy, 1972, 1973).

RESULTS

Table 1 contains all mean water and air temperature data gathered during the outmigration.

The random schedule was initiated on May 21 and terminated on June 27. The total random catch was 12,105 (Table 2). Forty-eight percent of the catch occurred between June 2 and June 4. A minor peak also occurred on June 14 through June 16. A total of 18,677 smolt were caught during the index portion of the program (Table 3). During the random sampling hours, 2100-0600, the index net caught 91.85 percent of the total 24-hour catch.

The outmigration estimate for 1974 was 819,369 smolt. The estimate was obtained as follows:

1. Calculate the seasonal average random catch per 90 minute set:

$$\begin{array}{r} \text{Total season catch} = 12,105 \\ \text{No. of sites fished} = 6 \end{array}$$

no. of sampling days fished during the season = 25

Therefore the seasonal average catch per 90 minute set is derived by $12,105 / (6) (25) = 81$

TABLE 1. Mean water and air temperatures by day, Naknek River, 1974.^{1/}

Date	Mean water temperatures °F	Mean air temperatures °F
May 21-22	46.5	38.3
22-23	49.2	38.8
24-25	50.3	37.5
25-26	50.5	36.7
27-28	51.0	44.9
28-29	50.7	38.3
30-31	54.4	45.4
31-June 1	53.7	43.9
2-3	55.3	43.4
3-4	57.0	45.3
5-6	55.6	38.0
6-7	57.3	43.4
8-9	53.6	40.9
9-10	56.6	42.1
11-12	57.7	39.9
12-13	56.7	42.7
14-15	51.2	44.8
15-16	51.9	43.4
17-18	54.0	42.3
18-19	55.0	42.4
20-21	52.3	41.6
21-22	55.4	45.0
23-24	55.0	47.6
24-25	55.6	47.0
26-27	57.0	46.4

^{1/} Both water and air temperature were recorded for each 90-minute fishing period.

TABLE 2. Naknek River random sampling catches of sockeye salmon smolt by fishing site, 1974

Date	Sites						Total	Percentage of Total Catch
	1	2	3	4	5	6		
May 21-22	0	0	2	0	0	0	2	0.02
22-23	0	9	11	28	1	0	49	0.41
24-25	0	0	56	28	1	0	85	0.70
25-26	2	14	6	0	0	31	53	0.44
27-28	4	4	2	7	27	11	55	0.45
28-29	9	0	1	183	196	26	415	3.43
30-31	46	4	63	6	0	52	171	1.41
31-June 1	58	60	645	14	5	52	834	6.89
2-3	0	0	1,164	989	441	0	2,594	21.43
3-4	8	0	0	3,232	17	0	3,257	26.91
5-6	66	0	0	182	186	12	446	3.68
6-7	0	0	265	140	1	0	406	3.35
8-9	11	0	0	65	360	5	441	3.64
9-10	0	2	5	24	0	8	39	0.32
11-12	0	0	32	77	0	2	111	0.92
12-13	0	0	0	4	0	7	11	0.09
14-15	49	207	176	27	124	95	678	5.60
15-16	97	0	197	160	65	36	555	4.59
17-18	4	0	0	0	0	0	4	0.03
18-19	0	0	268	36	5	1	310	2.56
20-21	11	127	0	135	0	14	287	2.37
21-22	0	0	28	232	15	56	331	2.73
23-24	1	0	0	106	191	112	410	3.39
24-25	65	1	255	123	32	42	518	4.28
26-27	0	1	9	33	0	0	43	0.36
Total	431	429	3,185	5,831	1,667	562	12,105	100.00
Percent	3.56	3.55	26.31	48.17	13.77	4.64	100.00	

TABLE 3. Naknek River index net catches of sockeye salmon smolt by 90-minute periods, May 22 - June 25, 1974

Time	May 22-23	May 25-26	May 28-29	May 31 June 1	June 3-4	June 6-7	June 9-10	June 12-13	June 15-16	June 18-19	June 21-22	June 24-25	Total	Percent of Total catch
2100-2230	1	6	137	14	468	88	73	0	229	30	0	123	1,169	6.26
2230-2400	5	13	173	100	1,156	112	67	12	74	36	20	119	1,887	10.11
0000-0130	21	189	183	154	2,339	140	396	201	160	132	232	192	4,339	23.24
0130-0300	28	38	228	173	1,330	33	24	118	186	59	229	405	2,851	15.27
0300-0430	4	4	9	1,681	13	0	22	25	468	193	342	353	3,114	16.68
0430-0600	0	0	0	2,777	29	0	0	4	366	37	65	509	3,787	20.29
0600-0730	0	0	4	23	67	0	4	0	69	2	26	97	292	1.56
0730-0900	0	0	11	10	25	0	15	14	21	7	1	2	106	0.57
0900-1030	0	0	1	16	1	1	0	0	69	8	153	0	249	1.33
1030-1200	0	0	0	52	0	46	0	42	74	2	0	1	217	1.16
1200-1330	0	0	0	0	0	12	1	1	115	1	0	0	130	0.70
1330-1500	2	0	0	0	0	0	89	0	83	1	26	0	201	1.08
1500-1630	0	1	0	2	1	0	45	0	41	3	2	0	95	0.51
1630-1800	0	1	12	0	1	16	3	0	52	0	0	0	85	0.46
1800-1930	0	0	24	1	0	9	23	0	2	0	16	0	75	0.40
1930-2100	0	0	0	15	28	8	17	0	2	0	0	0	70	0.38
Totals	61	252	782	5,018	5,458	465	779	417	2,011	511	1,112	1,801	18,667	100.00

2. Estimate the average migration past the sampled section of the river during a 90 minute period within a sampling period.

Average catch per 90-minute period = 81

No. sites fished = 6

No. of subsites for which the migration is estimated
from the catch at each fishing site = 6

Therefore the estimated average migration past the sampled section of the river during a 90-minute period within a sampling period is derived by

$$(81) (6) (6) = 2,916$$

3. Estimate the average migration past the sampled section of the river per sampling period.

No. of 90-minute periods within a sampling period = 6

Therefore, the estimated average migration past the sampled section of the river per sampling period is derived by:

$$(2,916) (6) = 17,496$$

4. Estimate the average migration past the entire width of the river at the sampling location per sampling period.

Estimated proportion of migration occurring within the section of the river presently sampled = 88.34 percent.

Therefore the estimated average migration past the entire width of the river at the sampling location per sampling period is derived by:

$$17,496 / .8834 = 19,805$$

5. Estimate the average daily migration past the sampling location.

Estimate proportion of daily migration occurring during the sampling period derived by adding the percentaged of the total season's index net catch for the hours 2100-0600 = 91.85 percent.

Therefore the estimated average daily outmigration past the sampling location is derived by:

$$19,805 / .9185 = 21,562$$

6. Estimate the total seasonal migration past the sampling location.

No. of days fished = 38

Therefore the estimated total seasonal migration past the sampling location is derived by:

$$(21,562) (38) = 819,369$$

The age composition of the outmigration estimate was 18.92 percent Age I smolt (155,025), 80.95 percent Age II smolt (563,279) and 0.08 percent Age III smolt (655). This is the lowest estimate of Age I and Age II smolt since the initiation of the program. Table 4 gives the age composition by date.

The 1974 total outmigration estimate (819,369) is one third of the previous low estimate of the 2,712,150 fish caught in 1973. The mean outmigration since 1956 is 9,735,345. The low smolt production this year is probably due to the extremely cold winters in 1970-71 and 1971-72.

A total of 827 smolt were sampled to determine lengths and weights by age class (Table 5 and 6). Age I smolt averaged 104.3 mm in length (19-year average = 102 mm) and 10.3 g. in weight (19-year average = 9.4 g.). Age II smolt averaged 118.1 mm in length (19-year average = 113 mm) and 14.5 g. in weight (19-year average = 12.6 g.).

TABLE 4. Age composition of the random sampling catches of sockeye salmon smolt, by date, Naknek River, 1974.

Date	Random Catch	Percent			Number		
		Age I	Age II	Age III	Age I	Age II	Age III
May 21-22	2	-	-	-	-	-	-
22-23	49	1.27	98.73	0	1	48	0
24-25	85	5.00	95.00	0	4	81	0
25-26	53	0	100.00	0	0	53	0
27-28	55	0	100.00	0	0	55	0
28-29	415	0	100.00	0	0	415	0
30-31	171	5.41	94.59	0	9	162	0
31-1	834	5.13	94.87	0	43	791	0
June 2-3	2,594	2.50	97.50	0	65	2,529	0
3-4	3,257	7.69	92.31	0	250	3,007	0
5-6	446	9.38	90.62	0	42	404	0
6-7	406	10.00	87.50	2.50	41	355	10
8-9	441	20.00	80.00	0	88	353	0
9-10	39	25.00	75.00	0	10	29	0
11-12	111	15.00	85.00	0	17	94	0
12-13	11	21.88	78.12	0	2	9	0
14-15	678	50.00	50.00	0	339	339	0
15-16	555	47.50	52.50	0	264	291	0
17-18	4	-	-	-	-	-	-
18-19	310	20.00	80.00	0	62	248	0
20-21	287	46.67	53.33	0	134	153	0
21-22	331	63.33	36.67	0	210	121	0
23-24	410	60.00	40.00	0	246	164	0
24-25	518	85.00	15.00	0	440	78	0
26-27	43	53.57	46.43	0	23	20	0
Total	12,105				2,290	9,799	10
Percent					18.92	80.95	0.08

TABLE 5. Naknek River sockeye salmon smolt mean weight in grams, 1974

Date	Age I		Age II		Age III	
	Percent of total season's catch	Mean weight	Percent of total season's catch	Mean weight	Percent of total season's catch	Mean weight
May 22-23	0.04	14.8	0.49	18.4	0	----
24-25	0.17	10.0	0.83	18.5	0	----
25-26	0	----	0.54	17.6	0	----
27-28	0	----	0.56	17.2	0	----
28-29	0	----	4.24	16.1	0	----
30-31	0.39	13.4	1.65	14.4	0	----
31-1	1.88	15.0	8.07	15.7	0	----
June 2-3	2.84	11.5	25.81	13.3	0	----
3-4	10.92	13.0	30.69	12.8	0	----
5-6	1.83	9.0	4.12	11.0	0	----
6-7	1.79	10.4	3.62	12.1	100	11.3
8-9	3.84	10.0	3.60	14.6	0	----
9-10	0.44	9.6	0.30	11.5	0	----
11-12	0.74	8.4	0.96	13.8	0	----
12-13	0.09	10.4	0.09	12.1	0	----
14-15	14.80	9.2	3.46	11.7	0	----
15-16	11.53	9.9	2.97	14.2	0	----
17-18	----	----	----	----	-	----
18-19	2.71	10.3	2.53	13.9	0	----
20-21	5.85	9.9	1.56	11.3	0	----
21-22	9.17	10.3	1.23	12.2	0	----
23-24	10.74	10.5	1.67	15.7	0	----
24-25	19.21	10.5	0.08	13.5	0	----
26-27	1.00	11.0	0.20	17.9	0	----
Age I mean weight = 10.3		Age II mean weight = 14.5		Age III mean weight = 11.3		

TABLE 6. Naknek River sockeye salmon smolt mean length in millimeters, 1974

Date	Age I		Age II		Age III	
	Percent of total season's catch	Mean Length	Percent of total season's catch	Mean Length	Percent of total season's catch	Mean Length
May 22-23	0.04	111.0	0.49	129.3	0.00	----
24-25	.17	102.0	0.83	128.3	0.00	----
25-26	0.00	-----	0.54	129.0	0.00	----
27-28	0.00	-----	0.56	125.0	0.00	----
28-29	0.00	-----	4.24	122.5	0.00	----
30-31	0.39	113.0	1.65	119.1	0.00	----
31-1	1.88	119.0	8.07	120.2	0.00	----
June 2-3	2.84	112.0	25.81	116.3	0.00	----
3-4	10.92	113.3	30.69	114.4	0.00	----
5-6	1.83	103.0	4.12	108.6	0.00	----
6-7	1.79	105.5	3.62	111.8	100.00	109.0
8-9	3.84	104.8	3.60	119.6	0.00	----
9-10	0.44	103.6	0.30	109.0	0.00	----
11-12	0.74	97.3	0.96	116.6	0.00	----
12-13	0.09	100.0	0.09	110.0	0.00	----
14-15	14.80	101.9	3.46	109.6	0.00	----
15-16	11.53	103.3	2.97	117.3	0.00	----
17-18	-----	-----	-----	-----	-----	----
18-19	2.71	105.0	2.53	115.9	0.00	----
20-21	5.85	104.1	1.56	109.3	0.00	----
21-22	9.17	103.4	1.23	109.4	0.00	----
23-24	10.74	106.0	1.67	121.7	0.00	----
24-25	19.21	104.9	0.08	114.0	0.00	----
26-27	1.00	105.5	0.20	123.8	0.00	----
Age I mean length = 104.3		Age II mean length = 118.1		Age III mean length = 109.0		

LITERATURE CITED

- McCurdy, Michael L., 1972. 1971 Naknek River Sockeye Salmon Smolt Studies. In 1971 Bristol Bay Sockeye Salmon Smolt Studies (Ed. Phillip Russell and Michael McCurdy). Alaska Department of Fish and Game Technical Data Report No. 2, pp. 29-34.
- McCurdy, Michael L., 1973. 1972 Naknek River Sockeye Salmon Smolt Studies. In 1972 Bristol Bay Sockeye Salmon Smolt Studies (Ed. Kenneth P. Parker). Alaska Department of Fish and Game Technical Data Report No. 13, pp. 38-48.
- McCurdy, Michael L., 1974. 1973 Naknek River Sockeye Salmon Smolt Studies. In 1973 Bristol Bay Sockeye Salmon Smolt Studies (Ed. Kenneth P. Parker). Alaska Department of Fish and Game Technical Data Report No. 14, pp. 23-30.

1974 UGASHIK RIVER SOCKEYE SALMON SMOLT STUDIES

By

Thomas R. Schroeder
Alaska Department of Fish and Game
Division of Commercial Fisheries
Dillingham, Alaska

INTRODUCTION

The Ugashik River sockeye salmon smolt enumeration and sampling program was initiated in 1956 and has been operated annually since then, except for 1966 and 1971. Data obtained from this program have been used to estimate total abundance by age class, and average lengths and weights of sockeye salmon smolt migrating to sea. These data are used to estimate optimum escapement ranges and to forecast numbers of age composition of returning adults.

MATERIALS AND METHODS

The index sampling scheme and 24-hour sampling schemes were run this year from May 17 to June 17. The smolt site, equipment, sampling scheme and computation formulae used are described in Schroeder (1973). The random fishing scheme was not run because of the unavailability of proper size nets and the highly significant correlation ($p < .01$) existing in the historical data between the outmigration estimates from the random fishing scheme and the index caught (Table 1). The regression equation ($y = 2268346.124 + 34.474 x$, where y = outmigration estimate based on the random scheme, and x = calculated 24-hour index) was used to directly calculate an outmigration estimate based on the index catch. The smolt sampling sites were changed slightly by moving both deadmen upriver approximately 280 feet. Net sites 1-3 were left in the same position, but site 4 was moved 10 feet to the right (east).

A smolt sonar counter, developed by the Bendix Corporation, was used for the second consecutive year to test the feasibility of utilizing this gear to replace fyke nets. Only one array was used during the 1974 season. It was positioned directly in front of the index net to facilitate calibration of the sonar equipment and to allow comparison of sonar counts with fyke net catches.

RESULTS

The index scheme was fished for 32 days and resulted in a catch of 116,388 smolt (Table 2). The linear regression between index catches and outmigration estimates for past years yielded an outmigration estimate of $6.28 + 2.58$ million smolt ($p < .05$). The confidence intervals were calculated on the basis of the variation about the regression line and do not take into account the variation in the 1974 index itself.

Table 1. Three-hour index catch, random sampling scheme catch and total outmigration estimate, Ugashik River, 1958-1969.

Year	Index ^{1/}	Random	Outmigration Estimate
1958	286,591	42,662	11,659,905
1959	59,778	13,600	2,887,002
1960	148,628	76,859	5,503,646
1961	96,362	53,363	3,802,079
1962	170,920	169,394	16,692,089
1963	919,451	662,298	33,750,496
1964	205,145	138,612	9,990,048
1965	172,893	62,917	3,640,115
1966	-	-	-
1967	64,185	68,721	5,137,063
1968	439,587	614,719	42,205,912
1969	63,999	32,598	5,048,673

^{1/} Index hours are 2200-0100.

Table 2. Ugashik River sockeye salmon smolt index catch by hour and day, 1974.

Date	Index Hours			Total Index Catch		Index Points ^{1/}		Daily % of Total
	2200-2300	2300-2400	2400-0100	Daily	Accum.	Daily	Accum.	
5/17	5	10	6	21	21	0.00	0.00	0.02
18	105	3	2	110	131	0.04	0.04	0.09
19	245	12	5	262	393	0.09	0.13	0.23
20	4	29	22	55	448	0.02	0.15	0.05
21	551	497	61	1,109	1,557	0.37	0.52	0.95
22	1,384	923	1,031	3,338	4,895	1.11	1.63	2.87
23	1,279	644	96	2,019	6,914	0.67	2.30	1.74
24	160	37	101	298	7,212	0.10	2.40	0.26
25	190	205	147	542	7,754	0.18	2.58	0.47
26	274	554	511	1,339	9,093	0.44	3.02	1.15
27	10,479	7,279	1,724	19,482	28,575	6.47	9.49	16.74
28	4,927	9,623	3,126	17,676	46,251	5.87	15.36	15.19
29	7,084	4,914	1,716	13,714	59,965	4.55	19.91	11.78
30	5,184	8,865	4,425	18,474	78,439	6.13	26.04	15.87
31	1,255	3,703	2,549	7,507	85,946	2.49	28.53	6.45
6/ 1	184	147	184	515	86,461	0.17	28.70	0.44
2	73	498	495	1,066	87,527	0.35	29.05	0.92
3	650	1,771	409	2,830	90,357	0.94	29.99	2.43
4	1,171	783	186	2,140	92,497	0.71	30.70	1.84
5	273	1,862	3,162	3,162	95,659	1.05	31.75	2.72
6	2,093	2,497	2,090	6,680	102,339	2.22	33.97	5.74
7	810	1,889	899	3,598	105,937	1.19	35.16	3.09
8	202	18	38	258	106,195	0.09	35.25	0.22
9	227	323	74	624	106,819	0.21	35.46	0.54
10	173	280	274	727	107,546	0.24	35.70	0.62
11	686	568	262	1,516	109,062	0.50	36.20	1.30
12	75	362	404	841	109,903	0.28	36.48	0.72
13	180	138	211	529	110,432	0.18	36.66	0.45
14	70	114	51	235	110,667	0.08	36.74	0.02
15	285	208	423	916	111,583	0.30	37.04	0.79
16	1,404	1,680	832	3,916	115,499	1.30	38.34	3.36
17	30	589	270	889	116,388	0.30	38.64	0.76
Totals	41,712	51,025	23,651	116,388	116,388	38.64	38.64	100.00

^{1/} One index point equals a catch of 3012.32.

Table 3. Ugashik River sockeye salmon smolt index catch during 24-hour fishing periods, 1974.

Time period	May 19-20	May 23-24	May 27-28	May June 31- 1	June 4 - 5	June 8 - 9	June 12-13	Total	Percent
2200-2300	245	1,279	10,479	1,255	1,171	202	75	14,706	32.70
2300-2400	12	644	7,279	3,703	783	18	362	12,801	28.46
2400-0100	5	96	1,724	2,549	186	38	404	5,002	11.12
0100-0200	4	25	5,141	1,567	67	17	146	6,967	15.49
0200-0330	3	27	2,843	193	9	7	23	3,105	6.90
0330-0500	0	2	0	1	3	0	4	10	0.02
0500-0630	0	0	1	2	0	5	0	8	0.02
0630-0800	3	1	4	0	0	1	0	9	0.02
0800-0930	0	1	1	0	367	0	0	369	0.82
0930-1100	2	0	1	0	0	0	0	3	0.01
1100-1230	0	0	0	0	0	0	0	0	0.00
1230-1400	0	1	4	0	0	0	87	92	0.21
1400-1530	1	0	0	0	0	0	72	73	0.16
1530-1700	1	0	19	0	0	0	0	20	0.05
1700-1830	0	0	4	1	0	0	1	6	0.01
1830-2000	0	0	2	1	0	0	0	3	0.01
2000-2100	0	1	1	0	0	0	0	6	0.01
2100-2200	1	5	1,659	1	2	120	4	1,792	3.99
Total	277	2,082	29,162	9,273	2,588	408	1,182	44,972	100.00

Age, weight and length sampling data are given in Tables 4 and 5. Age I smolt comprised 21.1 percent of the outmigration (1.33 million smolt). Age I average 94.2 mm in length (15-year average = 91.3 mm) and 7.4 grams in weight (15-year average = 6.6 g.). Age II smolt comprised 78.9 percent of the outmigration (4.95 million smolt). Age II smolt averaged 119.3 mm in length (15-year average = 114.4 mm) and 13.6 grams in weight (15-year average = 12.4 g.). Both Age I and Age II smolt were the largest since the 1970 outmigration. Daily index catch is shown in Figure 1 as a percent of the total index catch. The peak outmigration occurred on May 27 (16.74%) with 66.03% of the index catch being recorded between May 27 and May 31.

Wind speed and direction and mean daily water temperature are given in Table 6.

SONAR

The 1970 model Bendix sonar smolt counter was tested again this year at the Ugashik River smolt project. Total sonar counts recorded by the 12-transducer array located in front of the index net were 14,234 (Table 7). These counts were adjusted to coincide with the three-hour index net fishing period. Counts caused by air entrapped in the water by high winds or heavy precipitation, or by ice, were deducted from the recorded sonar counts prior to expansion procedures.

Numerous calibrations were made during the 1974 season (Table 8). As described in Parker (1973), the Bendix biomass counters are designed to operate at optimal adjustment at a rate of 10 smolt per count. It is electronically impossible that less than 5 fish could trigger a count. Conversely, no more than 20 smolt can cross the array with only a single count registered. Calibrations outside this range do occur and are assumed to be attributable to lateral movements of smolt in the distance between the array and the fyke net and to net avoidance by smolt. Calibrations outside the 5 to 20 fish per count range were disregarded as invalid and were not used in calculating a mean calibration. The mean calibration for the 1974 season was $9.06 \pm .72$ ($p < .05$) and was considered to be confirmation that the counters were operating within the design specifications. The sonar counts were expanded for missed fishing period, reduced by 20% to adjust for the differences its width compared to that of the index net (10 and 8 feet respectively) and multiplied by the theoretical 10 fish per count. This yielded an expanded sonar count of 140,150 smolt as compared with 116,388 for the index net. When substituted in the linear regression for the index net catches, it yielded an outmigration estimate of 7.10 million smolt. The correlation between the sonar counts and the index catch by index hour by day was highly significant ($p < .01$). A comparison of sonar counts and index catch by day is shown in Figure 2.

TABLE 4. Ugashik River sockeye salmon smolt sampling data, 1974.

Period	Date	Index Smolt Catch	% of Season Totals	# 1 lb. Sample Measured	# of Fish Measured	# of Scales Read
1	May 17-24	7,212	6.2	8	253	160
2	May 25-31	78,734	67.6	12	385	233
3	June 1- 7	19,991	17.2	7	268	140
4	June 8-17	10,451	9.0	8	355	160
Totals		116,388	100.0	35	1,261	693

TABLE 5. Age, length and weight of sockeye salmon smolt by sampling period from the Ugashik River, 1974.

Period	Date	Mean Length in mm of Age Group		Mean Weight in grams of Age Group		Percent Age Composition	
		I	II	I	II	I	II
1	May 17-24	84.9	119.9	5.7	13.8	16.6	83.4
2	May 25-31	95.0	119.7	7.8	13.8	11.9	88.1
3	June 1- 7	94.1	118.0	6.7	13.3	35.4	64.6
4	June 8-17	94.8	118.2	7.1	12.7	66.2	33.8
Weighted Averages		94.2	119.3	7.4	13.6	21.1	78.9

TABLE 6. Weather observations, Ugashik River, 1974.

Date	Wind ^{1/} Direction - Velocity (mph)		Mean Water Temperatures (°C) ^{2/}
	AM	P.M	
May 16	-	10-12 W.	-
17	0	6- 8 E.	-
18	2- 4 S.	3- 6 E.	3.0
19	10-12 S.W.	0- 2 S.W.	3.7
20	0- 2 E.	10-15 E.	3.5
21	5- 8 S.E.	0	3.8
22	2- 3 S.	0- 2 E.	5.1
23	5- 7 S.E.	5 S.W.	5.0
24	8-12 S.W.	3- 7 W.	4.9
25	7-10 W.	7-10 W.	4.8
26	0	3- 5 S.E.	4.4
27	20 S.E.	10-15 S.E.	5.3
28	20 S.E.	15-20 S.E.	6.0
29	10-15 S.E.	20-25 S.E.	5.2
30	15-20 S.E.	5-10 S.E.	5.9
31	15-20 S.E.	2- 5 S.E.	5.6
June 1	0- 5 S.	0- 5 S.	5.3
2	0- 5 S.W.	0- 5 W.	5.6
3	0- 2 S.E.	10-15 S.E.	5.9
4	10-15 S.E.	0- 5 S.E.	6.1
5	5-10 S.W.	10-15 S.W.	6.2
6	0	0- 5 S.E.	5.8
7	5- 7 N.W.	5-10 N.W.	6.0
8	5-10 S.W.	10-20 S.W.	5.7
9	5-10 S.W.	0- 5 S.W.	4.8
10	5 N.W.	8-12 N.W.	5.9
11	5- 7 N.	0	5.8
12	0	0	5.5
13	3- 5 S.E.	20-25 S.E.	5.4
14	40-50 S.E.	10-15 S.E.	6.6
15	2- 4 S.E.	0- 2 S.E.	6.5
16	10-15 S.E.	5 S.E.	6.3
17	0	0	7.2

^{1/} Wind velocities were taken with a Dwyer wind gauge which is inaccurate over 10 mph.

^{2/} Water temperatures were recorded six times daily.

Table 7. Sonar counts during index hours by day from 12-transducer array placed in front of index net, Ugashik River, 1974^{1/}.

Date	2200-2300	2300-2400	2400-0100	Total Sonar Counts		
				Daily	Accum.	Daily %
5/17	-	-	-	-	-	-
18	26	16	11	53	53	0.37
19	43	2	2	47	100	0.33
20	13	23	18	54	154	0.38
21	218	221	19	458	612	3.22
22	236	331	171	738	1,350	5.18
23	196	271	45	512	1,862	3.60
24	112	25	34	171	2,033	1.20
25	7	83	36	126	2,159	0.89
26	11	59	67	137	2,296	0.96
27	1,770	1,604	254	3,628	5,924	25.49
28	-	-	-	-	-	-
29	-	-	-	-	-	-
30	366	2,251	1,337	3,954	9,878	27.78
31	76	491	327	822	10,700	5.77
6/ 1	19	28	57	104	10,804	0.73
2	16	30	93	139	10,943	0.98
3	-	-	-	-	-	-
4	40	78	45	163	11,106	1.14
5	221	543	347	1,111	12,217	7.81
6	125	147	493	765	12,982	5.37
7	142	522	96	760	13,742	5.34
8	-	-	-	-	-	-
9	118	51	108	277	14,019	1.95
10	-	-	-	-	-	-
11	12	21	37	70	14,089	0.49
12	83	10	52	145	14,234	1.02
Totals	3,850	6,735	3,649	14,234	14,234	100.00

^{1/} Counts adjusted to coincide with the three hour index net fishing period.

Table 3. Ugashik River sockeye salmon smolt sonar calibrations, 1974.

Date	Elapsed Time (min.)	Weight (pounds)	Fish per Pound	Total Catch	Sonar Counts	Adjusted Counts ¹ /	Fish Per Minute	Fish Per Count
5/18	60	3.5	30	105	26	20.8	1.75	5.05
5/19	60	7.0	35	245	43	34.4	4.08	7.12
5/21	45	8.2	36	295	71	56.8	6.56	5.19
5/22	47	26.8	43	1,152	215	172.0	24.51	6.70
	13	5.8	40	232	21	16.8	17.85	13.81
	5	-	-	32	3	2.4	6.40	13.33
5/23	40	19.8	36	713	125	100.0	17.83	7.13
	20	8.6	37	318	46	36.8	15.90	8.64
	23	14.5	39	566	53	42.4	24.61	13.35
	18	7.0	36	252	37	29.6	14.00	8.51
	9	9.4	30	282	69	55.2	31.33	5.11
	10	5.6	32	179	37	29.6	17.90	6.05
5/26	60	4.2	35	147	67	53.6	2.45	13.13
	60	16.8	33	554	17	13.6	9.23	11.74
5/27	60	14.2	36	511	67	53.6	8.52	9.53
	4	19.0	33	627	50	40.0	156.75	15.68
	3	4.0	29	116	17	13.6	38.67	8.53
	6	21.2	33	700	91	72.8	116.67	9.62
	4	22.4	31	694	160	128.0	173.50	5.42
	1	19.8	29	574	44	35.2	574.00	16.31
	3	13.3	32	426	77	61.6	142.00	6.92
	3	23.4	32	749	87	69.6	249.67	10.76
	3	20.8	31	645	85	68.0	215.00	9.49
	3	18.8	31	583	70	56.0	194.33	10.41
	2	15.2	32	486	88	70.4	243.00	6.90
	2	26.6	30	798	133	106.4	399.00	7.50
	2	13.0	29	377	57	45.6	188.50	8.27
	3	17.2	32	550	70	56.0	183.33	9.82
	3	8.3	33	274	51	46.8	91.33	6.72
	4	20.4	31	632	115	92.0	158.00	6.87

Table 8. Ugashik River sockeye salmon smolt sonar calibrations, 1974. (Continued)

Date	Elapsed Time (min.)	Weight (pounds)	Fish per Pound	Total Catch	Sonar Counts	Adjusted Counts ^{1/}	Fish per Minute	Fish per Count
5/27	3	19.4	30	982	130	104.0	194.00	5.60
	9	12.0	32	384	74	59.2	42.67	6.49
5/28	14	11.4	32	365	61	48.8	26.07	7.48
	11	10.8	32	346	36	28.8	31.45	12.01
	10	15.4	32	493	101	80.8	49.30	6.10
	22	25.0	29	725	105	84.0	32.95	8.63
	3	14.6	32	467	115	92.0	155.67	5.08
	5	15.2	31	471	55	44.0	94.20	10.70
	7	23.2	33	766	173	138.4	109.43	5.53
	9	21.0	33	693	172	137.6	77.00	5.04
	6	7.2	31	223	46	36.8	37.17	6.06
	11	16.5	31	512	71	56.8	46.55	9.01
27	11.4	33	376	82	65.6	13.93	5.73	
5/30	8	29.2	32	934	108	86.4	116.75	10.81
	5	22.9	38	870	73	58.4	174.00	14.90
	3	12.5	34	425	43	34.3	141.67	12.39
	12	13.3	31	412	56	44.8	34.33	9.20
	9	35.8	35	1,253	162	129.6	139.22	9.67
	2	23.6	33	779	141	112.8	389.50	6.91
	8	17.6	33	616	93	74.4	77.00	8.28
	2	20.1	35	704	61	48.8	352.00	14.43
1	14.9	34	507	58	46.4	507.00	10.93	
5/31	37	18.1	37	670	55	44.0	18.11	15.23
	16	29.5	38	1,121	153	122.4	70.06	9.16
	7	11.1	35	389	30	24.0	55.57	16.21
	6	19.2	32	614	88	70.4	102.33	8.72
	10	17.0	36	612	125	100.0	61.20	6.12
6/ 1	13	12.2	36	439	58	46.4	33.77	9.46
	8	12.2	32	390	76	60.8	48.75	6.41
	19	18.3	35	641	73	58.4	33.74	10.98
	15	18.6	33	614	95	76.0	40.93	8.08

Table 8. Ugashik River sockeye salmon smolt sonar calibrations, 1974. (Continued)

Date	Elapsed Time (min.)	Weight (pounds)	Fish per Pound	Total Catch	Sonar Counts	Adjusted Counts ^{1/}	Fish per Minute	Fish per Count
6/ 1	19	14.2	32	454	52	41.6	23.89	10.91
	60	4.0	46	184	19	15.2	3.07	12.11
	60	4.2	35	147	28	22.4	2.45	6.56
6/ 2	60	-	-	73	16	12.8	1.22	5.70
6/ 3	60	15.0	33	495	93	74.4	8.25	6.65
6/ 4	60	18.2	43	783	78	62.4	13.05	12.55
6/ 5	60	5.8	32	186	45	36.0	3.10	5.17
6/ 6	15	11.4	40	456	58	46.4	30.40	9.83
6/ 7	30	43.0	35	1,505	313	250.4	50.17	6.01
6/12	60	5.7	46	262	37	29.6	4.37	8.85
6/13	60	9.4	43	404	52	41.6	6.73	9.71

^{1/} Sonar array samples a 10 ft. area compared to an 8 ft. area fished by the fyke nets. Sonar counts are multiplied by 0.8 to adjust for this difference.

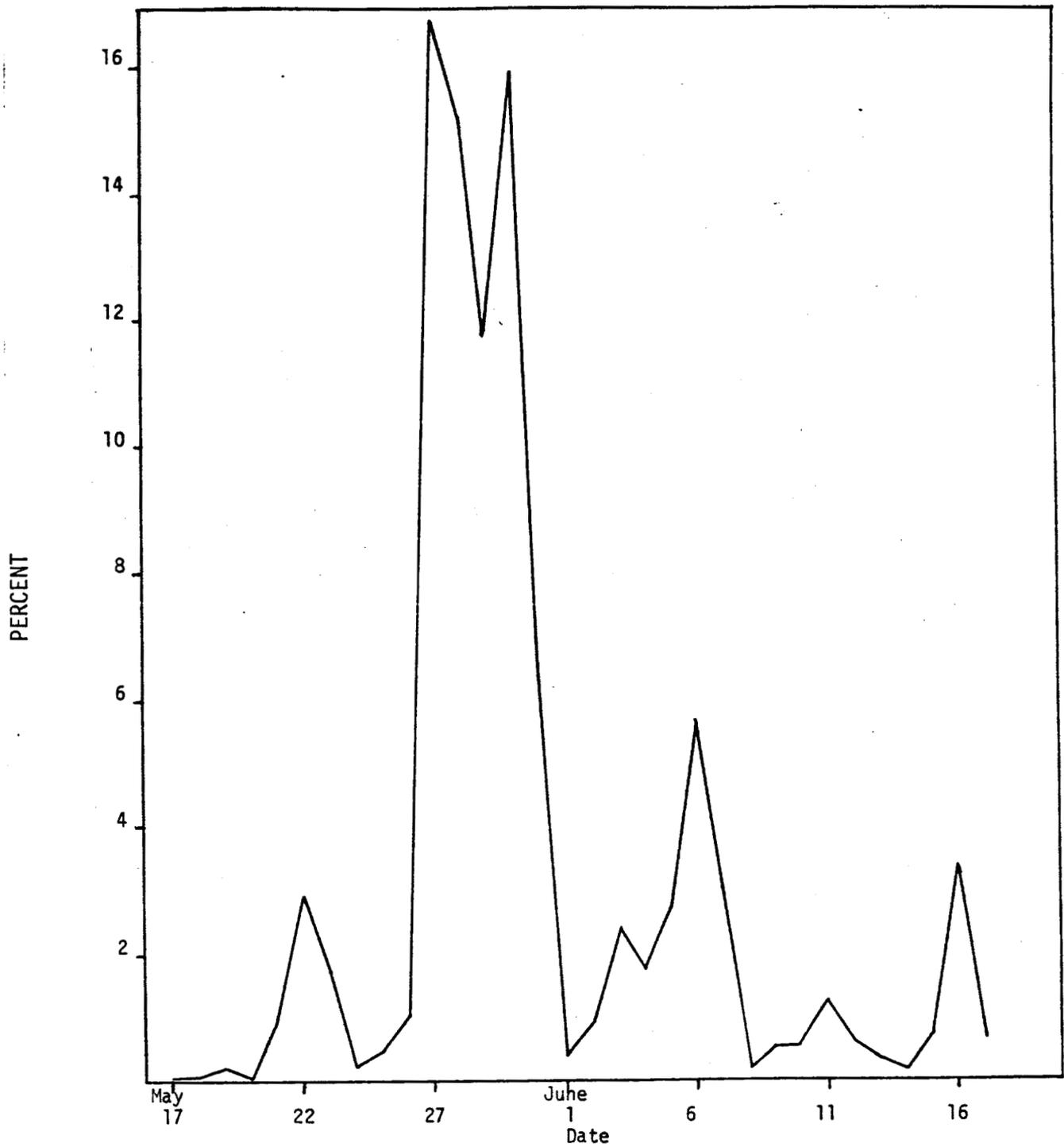


Figure 1. Daily index net catches of sockeye salmon smolt in percent of total index catch, Ugashik River, 1974.

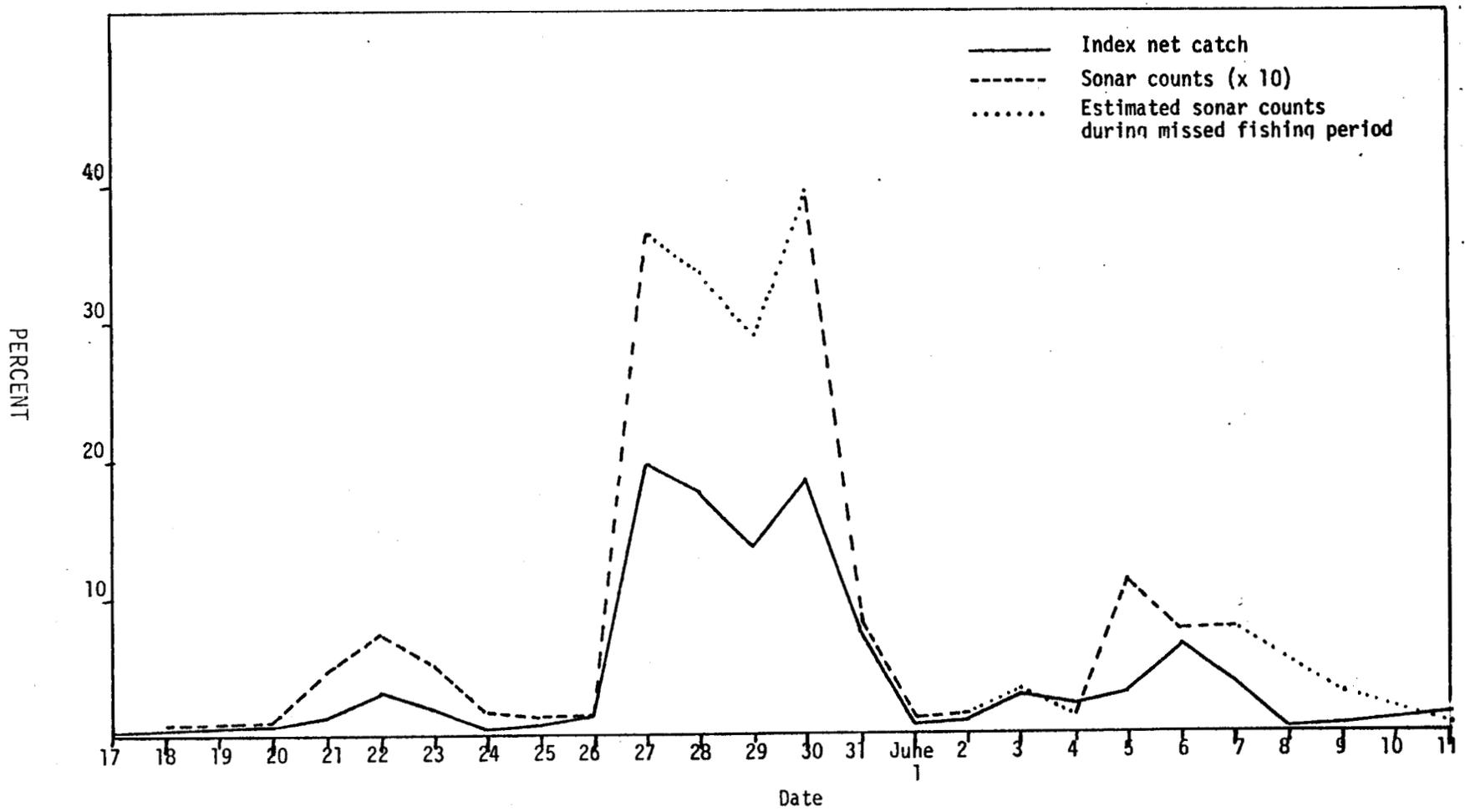


Figure 2. Comparison of sonar counts and index catches by day, Ugashik River, 1974.

LITERATURE CITED

- Parker, Kenneth P., 1973. 1972 Kvichak River Sockeye Salmon Smolt Studies. In 1972 Bristol Bay Sockeye Salmon Smolt Studies (Ed. Kenneth P. Parker). Alaska Department of Fish and Game Technical Data Report No. 13, pp. 1-37.
- Schroeder, Thomas R., 1973. 1973 Ugashik River Sockeye Salmon Smolt Studies. In 1973 Bristol Bay Sockeye Salmon Smolt Studies (Ed. Kenneth P. Parker). Alaska Department of Fish and Game Technical Data Report No. 14, pp. 33-45.

Because the Alaska Department of Fish and Game receives federal funding, all of its public programs and activities are operated free from discrimination on the basis of race, color, national origin, age, or handicap. Any person who believes he or she has been discriminated against should write to:

O.E.O.
U.S. Department of the Interior
Washington, D.C. 20240