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1980 BRISTOL BAY SALMON TEST FISHING PROJECTS

Edited by:
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ALASKA DEPARTMENT OF FISH AND GAME
P.O. Box 3-2000, Juneau, Alaska 99802

Ronald O. Skoog
Commissioner

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1980 BRISTOL BAY SALMON TEST FISHING PROJECTS

A summary of data collected from salmon *(Oncorhynchus sp.)* test fishing projects in Bristol Bay, including Kvichak, Egegik, Ugashik, and Igushik escapement and Port Moller and Nushagak offshore test fishing

Edited by:

Henry J. Yuen

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

1981

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ABSTRACT

Test fishing was conducted in Bristol Bay to estimate salmon run timing and run size into Bristol Bay and into Nushagak Bay, and to estimate escapements in four selected rivers. Tagging to determine lag time between escapement test fishery and escapement counting towers was also conducted. Summary and data tables are presented.

FOREWORD

The common objective in test fishing for Bristol Bay salmon is to estimate numbers of returning salmon *(Oncorhynchus sp.)* before actual counts become available. There are references in the following sections of this report to management decisions. These decisions, whether or not to open or close a fishery, depend on the best estimate of the numbers of fish entering and leaving the fishery. The Bristol Bay salmon fisheries are managed by river systems. Fishing is limited to the mouths of the rivers. Each river has, at least for sockeye salmon *(O. nerka)*, an escapement goal. Management of the fishery is then directed to achieving escapement goals, while at the same time to maximize catch of the available surplus. Although fishery closures are frequently necessary to achieve escapement goals, short fishing periods are used early and throughout the season to spread the catch over the duration of the run. Actual counts of escapement are not available until the fish swim upriver in clear water where they can be counted. In the same manner, estimates of run size and, therefore, potential catch and escapement are not available until after the fact, when catch and escapement reports can be added together. Thus test fishing in Bristol Bay is designed to estimate, before the actual numbers are available, the abundance of: (1) total inshore run size as from the Port Moller Offshore Test Fishing project; (2) district inshore run size as from the Nushagak Offshore Test Fishing project; and (3) escapement past the commercial fishery in the various escapement test fishing projects. In the past, escapement test fisheries have been referred to as inside test fishing. Likewise, district test fishing has been referred to as outside test fishing. While most of these estimates are based on historical catch per unit of effort, there are some estimates based primarily on mean weights, mean lengths, and lag times. There are also references in this report to both catchability and passage rates. Catchability refers to estimating the return or escapement per index point from the size of the fish. Passage rate is another term for return or escapement per index point. Daily passage is the passage rate multiplied by the daily index. These methods as well as other objectives specific to a particular project will be discussed in the individual project sections. This report is the second in a series of Technical Data Reports in which all Bristol Bay test fishing reports are combined into a single report.

1980 PORT MOLLER OFFSHORE TEST FISHING

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INTRODUCTION

Port Moller offshore test fishing has been conducted in Bristol Bay routinely since 1967. While location, timing, and gear specifications have become standardized only since 1968, the goal of the program has always been to preview the salmon runs to Bristol Bay 5 to 9 days prior to their arrival inshore (Mundy and Mathisen 1977). Specific objectives of the 1980 Port Moller project were as follows:

1) Forecast the daily entry of sockeye *(Oncorhynchus nerka)*, chum *(O. keta)*, and pink salmon *(O. gorbuscha)* into Bristol Bay;

2) Forecast timing and entry patterns of these salmon runs to the inshore areas;

3) Forecast total sockeye salmon abundance using relationships between fish size and total run size as well as entry pattern analysis, and

4) Obtain age, weight, and length data to monitor the performance of the pre-season sockeye salmon forecast.

Historic estimates of sockeye salmon return per index values by the Port Moller test fishing project have been highly variable (Meacham 1979). Catchability based on fish length or weight, however, can explain more than 90% of this variability. Two return per index values based on length and weight were, therefore, used in 1980. These catchability-adjusted passage rates also provided the earliest estimates of passage in 1980. Later, as daily catch and escapement figures become available, actual return per index values were computed.

A total sockeye salmon abundance estimate was generated from three independent methods. The earliest total abundance estimate was generated from a fish length to total run size model after 3 to 5 days of data collection (Huttunen 1979). A second total abundance estimate was based upon the historic entry pattern of sockeye salmon into Bristol Bay (Mundy and Mathisen 1978). The most reliable, but least timely estimate of total run size, was generated by summing all of the actual return per index-adjusted daily passages throughout the season.

METHODS AND MATERIALS

Figure 1 shows the location of the offshore test fishing in 1980, which remained essentially the same as for the last 12 years (Randall 1977). The fishing schedule and gear type also remained unchanged throughout most of the sockeye run: fishing 200 fm of gillnet for about 1 hour each at 5 or 6 ten-mi intervals. During the last 7 days of the project, however, 100 fm of pink salmon gillnet (114 mm or 4-1/2 inch stretch mesh) were fished attached to 100 fm of sockeye salmon gillnet (137 mm or 5-3/8 inch stretch mesh) at all stations. This was done to intercept pink salmon destined for Bristol Bay while still collecting data on the sockeye salmon migration.

The 22 meter F/V WALTER N was chartered for the 1980 test fishing project. The 200 fm of net were set from and retrieved with a hydraulic reel which required the net to be picked before it could be wound on the drum. This created a tendency for the sets with large catches to be slightly longer in time than sets with smaller catches. The direction of each set was parallel to the transect line to avoid catch variability because of net orientation.

All catches were expressed as "index" points or fish caught per 100 fam of net fished per hour. Indices from each station fished were then summed to yield a daily index. These daily indices were multiplied by two return per index values, based on both mean fish length and weight, to produce two independent estimates of daily passage (Table 1).

Both size to return per index relationships were in the form of a power curve as follows:

Mean length adjusted return per index:

$$\text{Daily passage} = aL^b$$

where $a = 1.347 \times 10^{56}$
$b = -18.898$
L = Daily mean length (mm)

Mean weight adjusted return per index

$$\text{Daily passage} = aW^b$$

where $a = 302481.85$
$b = -2.903$
W = Daily mean weight (g)

Mean lengths and weights by station were weighted by fathom-hours actually fished to achieve daily means, as fathom-hour was the two-dimensional sample unit used. Indices from stations missed during the fishing schedule because of weather or mechanical breakdowns were linearly interpolated from indices from stations fished on both sides of the missed station on the transect and from indices from the missed stations on the sampling day prior to and following

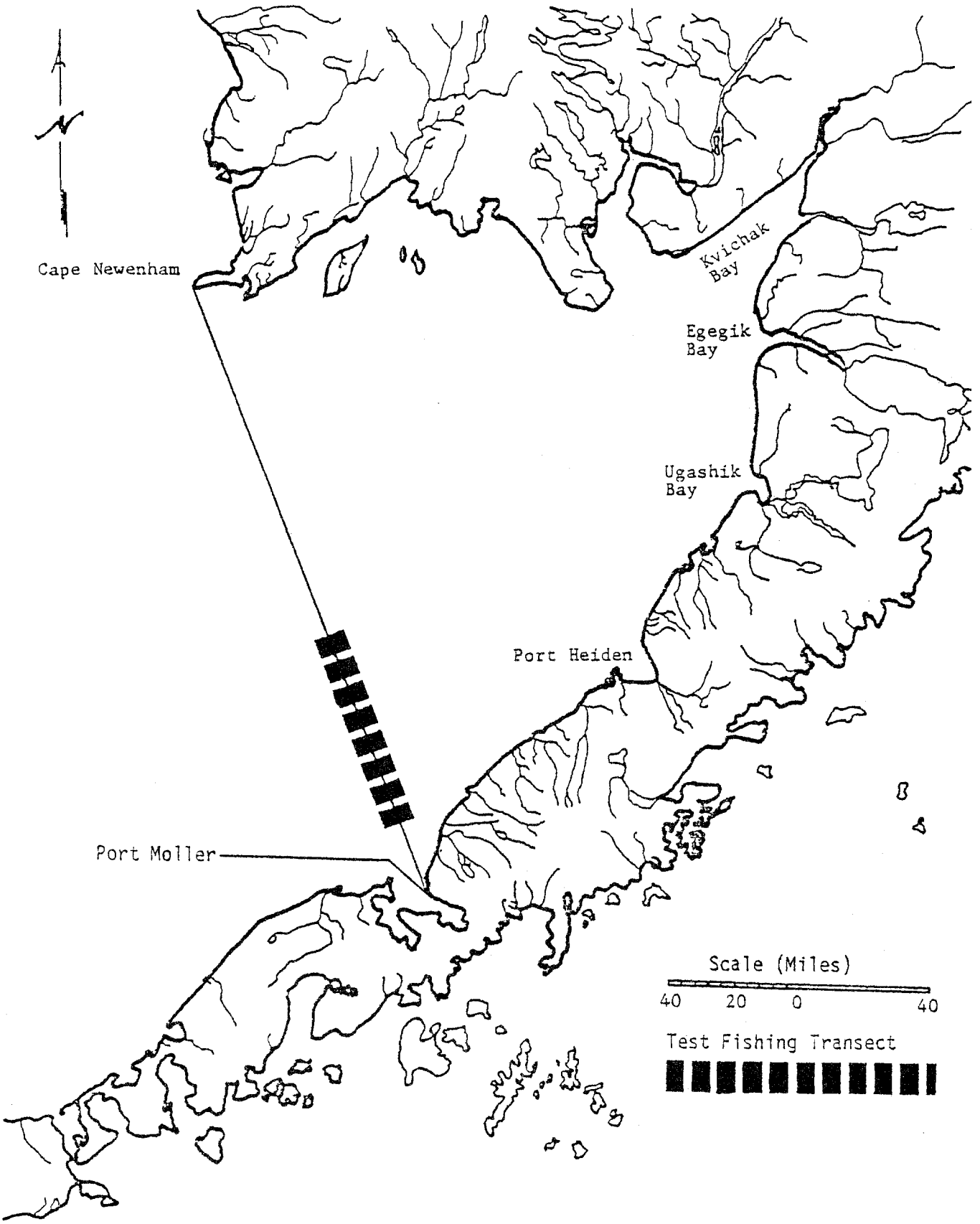

Figure 1. Transect area fished during the Port Moller offshore gillnet test fishery.

Table 1. Relationship between average fork length and weight of sockeye salmon captured offshore of Port Moller and inshore run size and return per index, Bristol Bay, 1971-1980.

DATE	INSHORE RUN (millions)	RETURN PER INDEX (thousands)	LENGTH (mm)	WEIGHT (kg)
1971	15.82	24.2	549.9	2.65
1972	5.37	-	566.8	2.94
1973	2.42	7.2	584.9	3.31
1974	10.94	-	-	-
1975	24.20	18.8	547.9	2.38
1976	11.47	16.7	552.1	2.78
1977	9.47	12.2	567.8	3.18
1978	19.65	-	545.4	2.76
1979	40.80	39.4	548.0	2.71
1980	62.28	109.0	545.0	2.68

Power Curve $y = ax^b$

Inshore run versus:

Length	$r^2 = 0.85$	$a = 1.928 \times 10^{92}$	$b = -33.209$
Weight	$r^2 = 0.55$	$a = 3.190 \times 10^{4}$	$b = -7.458$

Return per index versus:

Length	$r^2 = 0.61$	$a = 1.889 \times 10^{74}$	$b = -26.563$
Weight	$r^2 = 0.31$	$a = 1.845 \times 10^{3}$	$b = -4.287$

the day of the missing data. All sockeye, chum and pink salmon caught were sampled for length, weight, and sex. Scale samples were also taken from sockeye and chum salmon.

Climatological data were recorded during each set including water surface temperatures, wind direction and velocity, tide stage, air temperature, and cloud cover. In addition, Loran coordinates were recorded for each station fished.

RESULTS

In 1980, 782 sockeye salmon were caught with the 5-3/8 inch gear. These catches generated total indices of 526.78, including interpolated values for missed fishing. Seasonal mean length and weight of sockeye salmon captured in the 137 mm mesh gear was 545 mm and 2.68 kg, respectively.

Initially two separate estimates of sockeye return per index point were determined from mean fish length and weight. However, the estimate based on mean weight was not used because it appeared to underestimate the return per index. By 30 June it was apparent that the estimate based on mean length was also short, being half of the estimate of return per index based on the actual inshore return (Figure 2). It therefore became necessary to rely entirely upon the actual inshore return per index point method of estimating daily passage rates. The final forecast of total sockeye abundance based upon 108,962 inshore returns per index point was 57.4 million, about 8% below the actual return of 62.28 million (Table 2).

The forecast of total sockeye abundance based solely on the mean length of all sockeye captured at Port Moller was 23.51 million, some 36.7 million below actual. There were, however, some 1.35 million sockeye that did arrive in Bristol Bay which were smaller than the smallest fish intercepted at Port Moller which meant the test fishing mean length estimate was inflated. This larger test fishing mean length value then produced a deflated total run estimate.

The forecast of total sockeye abundance based upon entry pattern analysis was 54.0 million, some 8.4 million below the actual run size. In addition, this entry pattern model suggested that the run timing was some 3 to 6 days later than normal. This model, however, required two modifications to correctly identify 28 June as the mid point of the run at Port Moller and thereby provide a forecast of run timing and magnitude. First, the average length of the run had to be adjusted by deleting the first 5 days of test fishing data. Second, the slope of the historic average cumulative run had to be reduced to more accurately reflect the 1980 run.

Peak sockeye catches at the Port Moller test fishery occurred on 1 July (Appendix Tables 1 and 2) indicating a peak abundance inshore on 6 July based on a 5 day lag time between the two dates. The actual peak of abundance inshore was in fact realized between 5-7 July.

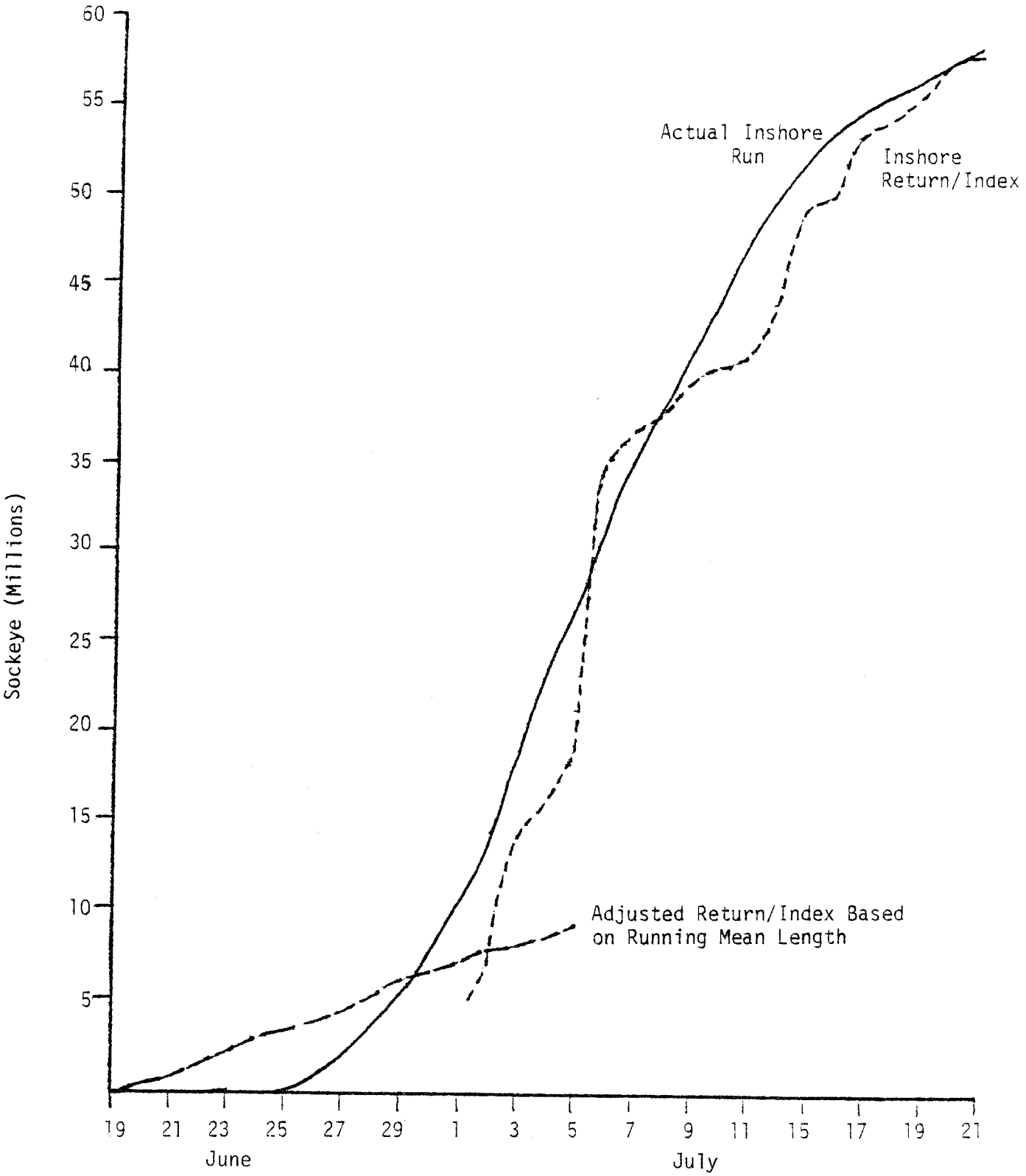

Figure 2. Comparison of estimates of inshore sockeye salmon returns based on two treatments of Port Moller test fish data with an estimate of acutal return by day, 1980.

Table 2. Daily summary of sockeye salmon catch and index, running mean weight and length, and estimated cumulative passage at the Port Moller test fishery, 1980.

Date	Sets	Catch	Index[1]	Running Mean Weight (lbs)	Running Mean Length (mm)	Estimated[2] Accum. Passage
6/07	6	6	2.85	7.11	577	310,953
6/08	3	1	0.98	6.93	577	418,130
6/09	0	0	2.45	6.93	577	685,089
6/10	3	1	0.64	6.79	573	754,640
6/11	0	0	5.62	6.79	573	1,367,012
6/12	5	17	7.92	6.36	561	2,230,174
6/13	4	19	8.82	6.23	558	3,190,755
6/14	5	7	3.44	6.42	563	3,565,985
6/15	6	41	19.49	6.40	561	5,689,865
6/16	5	40	18.50	6.34	558	7,705,828
6/17	6	36	18.70	6.26	554	9,743,431
6/18	5	50	25.59	6.14	552	12,531,536
6/19	3	45	24.45	6.15	551	15,195,211
6/20	0	0	21.17	6.15	551	17,501,956
6/21	4	28	24.08	6.10	549	20,126,131
6/22	0	0	15.95	6.10	549	21,864,090
6/23	0	0	22.30	6.10	549	24,293,963
6/24	4	20	10.74	6.08	549	25,463,831
6/25	6	46	20.87	6.00	547	27,737,839
6/26	5	44	22.14	5.94	545	30,150,132
6/27	6	58	26.40	5.96	545	33,027,275
6/28	5	14	7.39	5.94	545	33,833,016
6/29	6	49	23.30	5.93	544	36,371,600
6/30	5	39	18.65	5.91	544	38,403,603
7/01	5	103	45.19	5.87	543	43,327,517
7/02	0	0	24.44	5.87	543	45,990,571
7/03	6	17	8.65	5.87	543	46,933,279
7/04	5	37	17.13	5.88	544	48,799,999
7/05	0	0	11.25	5.88	544	50,025,832
7/06	5	7	3.52	5.88	544	50,409,185
7/07	5	19	9.20	5.90	544	51,412,123
7/08	5	6	4.84	5.89	544	51,939,805
7/09	5	15	15.70	5.92	545	53,650,506
7/10	0	0	7.64	5.92	545	54,482,983
7/11	0	0	10.02	5.92	545	55,574,791
7/12	5	10	9.71	5.91	545	56,632,729
7/13	6	5	4.75	5.92	545	57,150,286
7/14	5	1	1.15	5.92	545	57,276,012
7/15	5	1	1.15	5.92	545	57,401,739

[1] Includes interpolated values for missed fishing time.
[2] Passage is based on 108,962 inchore returns per index calculated from accumulative inshore return of 54,482,983 sockeye through 7/15 and 500 accumulative Port Moller index points through 7/10 with a lag of 5 days.

The percent age class composition of the run as predicted from Port Moller was significantly different from that realized inshore. It is apparent from Table 3 that the offshore test fishery intercepted proportionately fewer small two-ocean fish, further supporting size-catchability relationships.

Altogether, 417 chum salmon were caught with the 5-3/8 inch mesh generating 276.42 index points. The chum salmon total run forecast based on the historic average of 8,730 returns per index point was 2.413 million, roughly 5% less than the actual run of 2.534 million.

Six pink salmon were captured with pink gear generating 6.34 index points, and one pink salmon was captured in the sockeye gear. From commercial catch records it became apparent that the offshore test fishing activities at Port Moller were suspended before the main body of the pink salmon run arrived there. The peak of abundance in the Nushagak District occurred on 29-30 July, 8 to 9 days later than the average peak of 21 July. These catch data lagged 6 to 8 days (assuming 1 to 3 days longer lag time for sockeye salmon) indicating that cumulative daily abundances at Port Moller were just approaching 6 to 16% of the total run when the project was terminated, yielding 20,941 to 119,629 pink salmon inshore per index point, respectively. While only six pink salmon were captured, they were evenly distributed along the entire length of the transect line (Table 4) suggesting an entry pattern spatially similar to that exhibited by sockeye entering the Bay.

ACKNOWLEDGMENTS

The Alaska Independent Fishermen's Marketing Association provided financial support for the test fishing activities. In addition, the enthusiasm of Fisheries Technician Sheryl Salasky and the crew of the WALTER N contributed immeasurably to the success of the offshore test fishing project in 1980.

Table 3. Predicted age classes from Port Moller sampling and actual return, 1980.

Age Class	Actual	Port Moller
4_2	19.3	11.8
5_3	54.8	44.7
2-Ocean	74.1	56.6
5_2	21.7	36.7
6_3	3.5	4.7
3-Ocean	25.2	41.7

Table 4. Pink salmon catch and index data collected in 4-1/2 inch mesh gillnets during offshore test fishing at Port Moller, 1980.

Date	Set	Station	Catch	Index
7/08	1	2	1	1.111
7/08	4	8	1	0.811
7/08	5	10	1	1.200
7/09	6	11	1	1.034
7/12	12	2	1	0.984
7/12	13	4	1	1.200
Total			6	6.340

LITERATURE CITED

Huttunen, Dan. 1979. Total run size of Bristol Bay sockeye salmon *(Oncorhynchus nerka)* as a function of body size. Alaska Department of Fish and Game Bristol Bay Data Report No. 74. 11 pp.

Meacham, Charles P. 1979. 1979 Port Moller offshore test fishing. In: 1979 Bristol Bay sockeye salmon test fishing projects. (Ed. Henry J. Yuen). Alaska Department of Fish and Game Technical Data Report (in press). Pp. 1-16.

Mundy, Phillip R. and Ole A. Mathisen. 1977. Handbook of Bristol Bay sockeye salmon management. FRI-UW-7720. Fisheries Research Institute, Seattle, Washington. 100 pp.

Mundy, Phillip R. and Ole A. Mathisen. 1978. Handbook of Bristol Bay sockeye salmon management. FRI-UW-7817. Fisheries Research Institute, Seattle, Washington. 56 pp.

Randall, Richard C. 1977. Offshore test fishing in Bristol Bay, 1977. Alaska Department of Fish and Game Bristol Bay Data Report No. 63. 18 pp.

APPENDIX TABLE 1. Sockeye salmon catch indices by date and station, Port Moller, 1980.

	STATION													
Date	1	2	3	4	5	6	7	8	9	10	11	12	13	Total
6/07	0	-	0.48	-	0.49	-	0	-	1.89	-	0	-	-	2.86
6/08	-	0	-	0	-	0.98	-	-	-	-	-	-	-	0.98
6/09	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6/10	-	0	-	0.64	-	0	-	-	-	-	-	-	-	0.64
6/11	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6/12	-	0.99	-	4.09	-	2.38	-	0.46	-	0	-	-	-	7.92
6/13	-	-	-	-	0.99	-	6.00	-	1.83	-	0	-	-	8.82
6/14	-	0.49	-	0.51	-	2.44	-	0	-	0	-	-	-	3.44
6/15	0	-	0	-	2.73	-	9.02	-	7.74	-	0	-	-	19.49
6/16	-	1.03	-	0	-	6.32	-	10.62	-	0.54	-	-	-	18.51
6/17	0	-	3.72	-	3.42	-	8.00	-	3.10	-	0.45	-	-	18.69
6/18	-	0	-	4.10	-	2.14	-	12.10	-	7.24	-	-	-	25.58
6/19	-	-	-	-	-	-	6.71	-	12.28	-	1.58	-	-	20.57
6/20	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6/21	0	-	0	-	0.59	-	11.74	-	-	-	-	-	-	12.33
6/22	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6/23	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6/24	-	-	-	7.43	-	3.30	-	0	-	0	-	-	-	10.73
6/25	2.72	-	2.35	-	0.57	-	3.58	-	1.41	-	0.48	-	-	11.11
6/26	-	0	-	5.50	-	6.21	-	5.26	-	5.17	-	-	-	22.14
6/27	1.41	-	2.59	-	4.07	-	14.36	-	3.44	-	0.54	-	-	26.41
6/28	-	1.67	-	0.56	-	3.30	-	0.57	-	1.45	-	-	-	7.55
6/29	0.57	-	3.27	-	10.16	-	7.06	-	2.24	-	0	-	-	23.30
6/30	-	0	-	6.61	-	6.19	-	5.45	-	1.02	-	-	-	19.27
7/01	5.81	-	2.18	-	13.52	-	19.49	-	2.07	-	2.17	-	-	45.24
7/02	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/03	0.55	-	2.10	-	0.49	-	2.07	-	2.03	-	1.41	-	-	8.65
7/04	-	1.39	-	2.03	-	7.83	-	2.50	-	3.39	-	-	-	17.14
7/05	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/06	-	1.94	-	0.49	-	1.09	-	0	-	0	-	-	-	3.52
7/07	0	-	0.58	-	2.90	-	3.87	-	1.41	-	0.51	-	-	9.27
7/08	-	0	-	0	-	0.90	-	2.82	-	1.85	-	-	-	5.57
7/09	0	-	0	-	7.16	-	4.29	-	3.83	-	0	-	-	15.28
7/10	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/11	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7/12	-	0	-	1.97	-	1.94	-	5.81	-	0	-	-	-	9.72
7/13	0	-	1.09	-	0	-	0.86	-	1.82	-	0.98	-	-	4.75
7/14	-	-	-	0	-	1.15	-	0	-	0	-	0	-	1.15
7/15	-	-	-	-	0	-	0	-	0	-	1.15	-	0	1.15
Totals	11.06	7.51	18.36	33.93	47.09	46.17	97.05	45.59	45.09	20.66	9.27	0	0	381.78
Percent	2.9	2.0	4.8	8.9	12.4	12.2	25.6	12.0	11.4	5.4	2.4	0	0	100.0

APPENDIX TABLE 2. Sockeye and chum salmon catch and index data collected during the Port Moller offshore testfish project, 1980.

6 17	43	1	200	56.5	0	0.00	0.00	0.0	3	1	0.53
6 18	44	2	200	57.5	0	0.00	0.00	0.0	3	0	0.00
6 18	45	4	200	58.5	8	4.10	2.65	547.0	2	0	0.00
6 18	46	6	200	56.0	4	2.14	2.86	552.5	4	0	0.00
6 18	47	8	200	59.5	24	12.10	2.63	543.8	4	3	1.51
6 18	48	10	200	58.0	14	7.24	2.56	539.0	3	11	5.69
6 19	49	11	200	57.0	3	1.58	2.33	519.0	3	11	5.79
6 19	50	9	200	63.5	26	12.28	2.82	546.0	3	7	3.31
6 19	51	7	200	71.5	16	6.71	2.86	550.0	4	5	2.10
6 19	0	0	0	0.0	0	3.87	0.00	0.0	0	0	0.27
6 20	0	0	0	0.0	0	21.17	0.00	0.0	0	0	9.37
6 21	52	1	200	55.5	0	0.00	0.00	0.0	3	0	0.00
6 21	53	3	200	56.0	0	0.00	0.00	0.0	3	0	0.00
6 21	54	5	200	50.5	1	0.59	2.82	544.0	4	0	0.00
6 21	55	7	200	69.0	27	11.74	2.52	530.3	4	3	1.30
6 21	0	0	0	0.0	0	11.75	0.00	0.0	0	0	5.97
6 22	0	0	0	0.0	0	15.95	0.00	0.0	0	0	6.85
6 23	0	0	0	0.0	0	22.30	0.00	0.0	0	0	6.43
6 24	56	4	200	56.5	14	7.43	2.52	534.0	2	0	0.00
6 24	57	6	200	54.5	6	3.30	2.92	573.0	4	7	3.85
6 24	58	8	200	53.5	0	0.00	0.00	0.0	4	0	0.00
6 24	59	10	200	55.5	0	0.00	0.00	0.0	1	4	2.16
6 25	60	11	200	62.5	1	0.48	3.35	591.0	4	4	1.92
6 25	61	9	200	64.0	3	1.41	2.88	551.6	3	2	0.94
6 25	62	7	200	62.0	8	3.58	2.70	545.0	3	26	11.64
6 25	63	5	200	52.5	1	0.57	2.24	521.0	3	0	0.00
6 25	64	3	200	68.5	32	14.01	2.35	524.2	4	4	1.75
6 25	65	1	200	57.0	1	0.53	2.72	560.0	4	0	0.00
6 26	66	2	200	61.5	0	0.00	0.00	0.0	4	0	0.00
6 26	67	4	200	65.5	12	5.50	2.61	538.0	3	6	2.75
6 26	68	6	200	58.0	12	6.21	2.31	529.0	3	6	3.10
6 26	69	8	200	57.0	10	5.26	2.50	531.0	2	3	1.58
6 26	70	10	200	58.0	10	5.17	2.52	529.0	4	5	1.59
6 27	71	11	200	56.0	1	0.54	3.20	573.0	4	1	0.54
6 27	72	9	200	61.0	7	3.44	3.14	567.0	1	0	0.00
6 27	73	7	200	71.0	34	14.36	2.86	553.0	3	13	5.49
6 27	74	5	200	59.0	8	4.07	2.55	537.0	3	2	1.02
6 27	75	3	200	58.0	5	2.59	2.49	535.0	4	2	1.03
6 27	76	1	200	64.0	3	1.41	2.19	519.0	4	0	0.00
6 28	77	2	200	56.0	3	1.67	2.01	496.0	4	3	1.67
6 28	78	4	200	54.0	1	0.56	3.10	577.0	1	0	0.00
6 28	79	6	200	56.0	6	3.30	2.38	543.0	3	3	1.65
6 28	80	8	200	53.0	1	0.57	2.66	530.0	3	2	1.13
6 28	82	10	200	62.0	3	1.45	2.54	532.0	4	12	5.81
6 29	83	11	200	53.0	0	0.00	0.00	0.0	0	0	0.00
6 29	84	9	200	67.0	5	2.24	3.02	555.2	0	4	1.79
6 29	85	7	200	68.0	16	7.06	2.89	547.8	1	8	3.53
6 29	86	5	200	62.0	21	10.16	2.50	532.1	3	11	5.32
6 29	87	3	200	55.0	6	3.27	2.19	517.0	3	1	0.55
6 29	88	1	200	53.0	1	0.57	3.25	593.0	4	0	0.00
6 30	89	2	200	57.0	0	0.00	0.00	0.0	4	0	0.00

-Continued-

APPENDIX TABLE 2. Sockeye and chum salmon catch and index data collected during the Port Moller offshore testfish project, 1980 (Continued).

6	30	90	4	200	59.0	13	6.61	2.47	529.0	4	0	0.00
6	30	91	6	200	63.0	12	6.19	2.59	536.0	4	4	1.91
6	30	92	8	200	66.0	12	5.45	2.78	547.0	3	6	2.73
6	30	93	10	200	69.0	2	1.02	2.80	554.0	3	1	0.51
7	1	94	11	200	69.0	5	2.17	2.59	541.6	2	2	0.87
7	1	95	9	200	58.0	4	2.07	2.68	550.5	4	1	0.52
7	1	96	7	200	71.0	46	19.49	2.46	536.2	4	5	2.11
7	1	97	5	200	71.0	32	13.52	2.55	539.8	0	7	2.96
7	1	98	3	200	55.0	4	2.18	3.11	565.5	0	2	1.09
7	1	99	1	200	62.0	12	5.81	2.63	542.8	0	2	0.97
7	2	0	0	0	0.0	0	24.44	0.00	0.0	0	0	12.28
7	3	100	1	200	55.0	1	0.55	2.20	525.0	2	1	0.55
7	3	101	3	200	57.0	4	2.10	2.53	535.8	4	3	1.58
7	3	102	5	200	61.0	1	0.49	2.20	519.0	4	2	0.98
7	3	103	7	200	58.0	4	2.07	2.64	551.3	3	5	2.59
7	3	104	9	200	59.0	4	2.03	2.86	557.5	3	2	1.02
7	3	105	11	200	64.0	3	1.41	3.05	571.0	3	1	0.47
7	4	106	10	200	62.0	7	3.39	3.00	562.0	2	5	2.42
7	4	107	8	200	60.0	5	2.50	2.66	539.6	3	13	6.50
7	4	108	6	200	69.0	18	7.83	2.82	556.4	4	9	3.91
7	4	109	4	200	59.0	4	2.03	2.22	526.0	4	1	0.51
7	4	110	2	200	65.0	3	1.39	2.26	523.7	4	8	3.69
7	5	0	0	0	0.0	0	11.25	0.00	0.0	0	0	11.36
7	6	111	2	200	62.0	4	1.94	2.79	557.3	4	2	0.97
7	6	112	4	200	61.0	1	0.49	3.55	589.0	1	2	0.98
7	6	113	6	200	55.0	2	1.09	2.77	556.0	3	5	2.73
7	6	114	8	200	57.0	0	0.00	0.00	0.0	3	0	0.00
7	6	115	10	200	59.0	0	0.00	0.00	0.0	3	2	1.02
7	7	116	11	200	59.0	1	0.51	3.05	563.0	3	2	1.02
7	7	117	9	200	64.0	3	1.41	2.60	543.6	3	6	2.81
7	7	118	7	200	63.0	8	3.87	3.26	572.4	4	1	0.48
7	7	119	5	200	62.0	6	2.90	2.99	559.8	4	7	3.39
7	7	120	3	200	52.0	1	0.58	1.92	499.0	4	0	0.00
7	8	121	2	100	54.0	0	0.00	0.00	0.0	2	0	0.00
7	8	122	4	100	54.0	0	0.00	0.00	0.0	4	3	3.33
7	8	123	6	100	78.0	1	0.90	2.44	540.0	4	5	4.48
7	8	124	8	100	85.0	4	2.82	2.74	553.5	4	8	5.65
7	8	125	10	100	48.0	1	1.85	1.70	498.0	1	2	2.50
7	9	126	11	100	44.0	0	0.00	0.00	0.0	4	0	0.00
7	9	127	9	100	47.0	3	3.83	2.97	557.0	3	0	0.00
7	9	128	7	100	51.0	4	4.29	2.96	563.7	4	0	0.00
7	9	129	5	100	67.0	8	7.16	2.94	553.8	4	1	0.90
7	9	130	3	100	58.0	0	0.00	0.00	0.0	4	0	0.00
7	9	131	1	100	65.0	0	0.00	0.00	0.0	1	0	0.00
7	10	0	0	0	0.0	0	7.64	0.00	0.0	0	0	1.87
7	11	0	0	0	0.0	0	10.02	0.00	0.0	0	0	2.87
7	12	132	2	100	75.0	0	0.00	0.00	0.0	4	0	0.00
7	12	133	4	100	61.0	2	1.97	2.29	535.0	4	2	1.97
7	12	134	6	100	62.0	2	1.94	2.16	529.5	1	0	0.00
7	12	135	8	100	62.0	6	5.81	2.84	558.3	3	0	0.00
7	12	136	10	100	65.0	0	0.00	0.00	0.0	2	2	1.85

-Continued-

APPENDIX TABLE 2. Sockeye and chum salmon catch and index data collected during the Port Moller offshore testfish project, 1980 (Continued).

7 13	137	11	100	61.0	1	0.98	3.40	586.0	4	0	0.00
7 13	138	9	100	66.0	2	1.82	2.25	520.0	4	0	0.00
7 13	139	7	100	70.0	1	0.86	3.45	570.0	4	0	0.00
7 13	140	5	100	53.0	0	0.00	0.00	0.0	1	0	0.00
7 13	141	3	100	55.0	1	1.09	3.45	570.0	3	2	2.18
7 13	142	1	100	52.0	0	0.00	0.00	0.0	3	0	0.00
7 14	143	4	100	52.0	0	0.00	0.00	0.0	4	0	0.00
7 14	144	6	100	52.0	1	1.15	2.27	512.0	4	0	0.00
7 14	145	8	100	51.0	0	0.00	0.00	0.0	3	0	0.00
7 14	146	10	100	53.0	0	0.00	0.00	0.0	3	0	0.00
7 14	147	12	100	52.0	0	0.00	0.00	0.0	2	0	0.00
7 15	148	13	100	51.0	0	0.00	0.00	0.0	4	0	0.00
7 15	149	11	100	52.0	1	1.15	3.40	612.0	4	0	0.00
7 15	150	9	100	50.0	0	0.00	0.00	0.0	4	0	0.00
7 15	151	7	100	51.0	0	0.00	0.00	0.0	4	1	1.18
7 15	152	5	100	50.0	0	0.00	0.00	0.0	3	1	1.20

1980 NUSHAGAK BAY OFFSHORE TEST FISHING

By

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INTRODUCTION

District test fishing to estimate run strength and distribution of sockeye salmon during closed fishing periods has been conducted in Nushagak Bay since 1964. The drift locations and fishing times were determined by a commercial fishermen contracted to accomplish the test fishing. In 1980, the Nushagak Bay offshore test fishing program was established. This new test fishery was to obtain daily catch per unit effort (CPUE) indices of the number of sockeye, chum, and pink salmon moving across a transect line along the outer Nushagak District boundary (Figure 1).

Long range objectives of this offshore test fishery are to make in-season estimates of the daily run size, total run size, and entry pattern of sockeye, chum, and pink salmon stocks returning to Nushagak Bay. This report summarizes the transect test fish data collected during 1980.

Normal plans called for fishing of sockeye, chum, and pink salmon along the outer district boundary. A mechanical breakdown of the test fish vessel limited sockeye and chum fishing to the inside district boundary. Therefore, the escapement modeling from daily run size data was limited to sockeye salmon in Wood and Nushagak Rivers. Sampling for pink salmon near the outer district boundary was accomplished as planned.

METHODS AND MATERIALS

Sockeye and Chum Salmon

Fishing for sockeye and chum salmon was conducted along a transect between lower Kanakanak Beach and Grassy Island from 29 June to 15 August 1980 (Figure 1). Three stations, coded 111, 140, and 141, were fished according to the grid laid out in Figure 1. The transect was fished from west to east with the station 141 set made approximately one-half hour before the time of high tide, listed in local tide books. Both the Kanakanak Beach and Grassy Island sets were made as close to shore as possible. All drifts were made with net held as perpendicular to shore as possible.

Sockeye salmon fishing was done from both an open skiff and the F/V ILIASKA, a 9.7 m gillnetter. The gill nets used had 137 mm (5-3/8 inch) stretched mesh webbing and were 28 meshes deep. The net material was multifilament nylon.

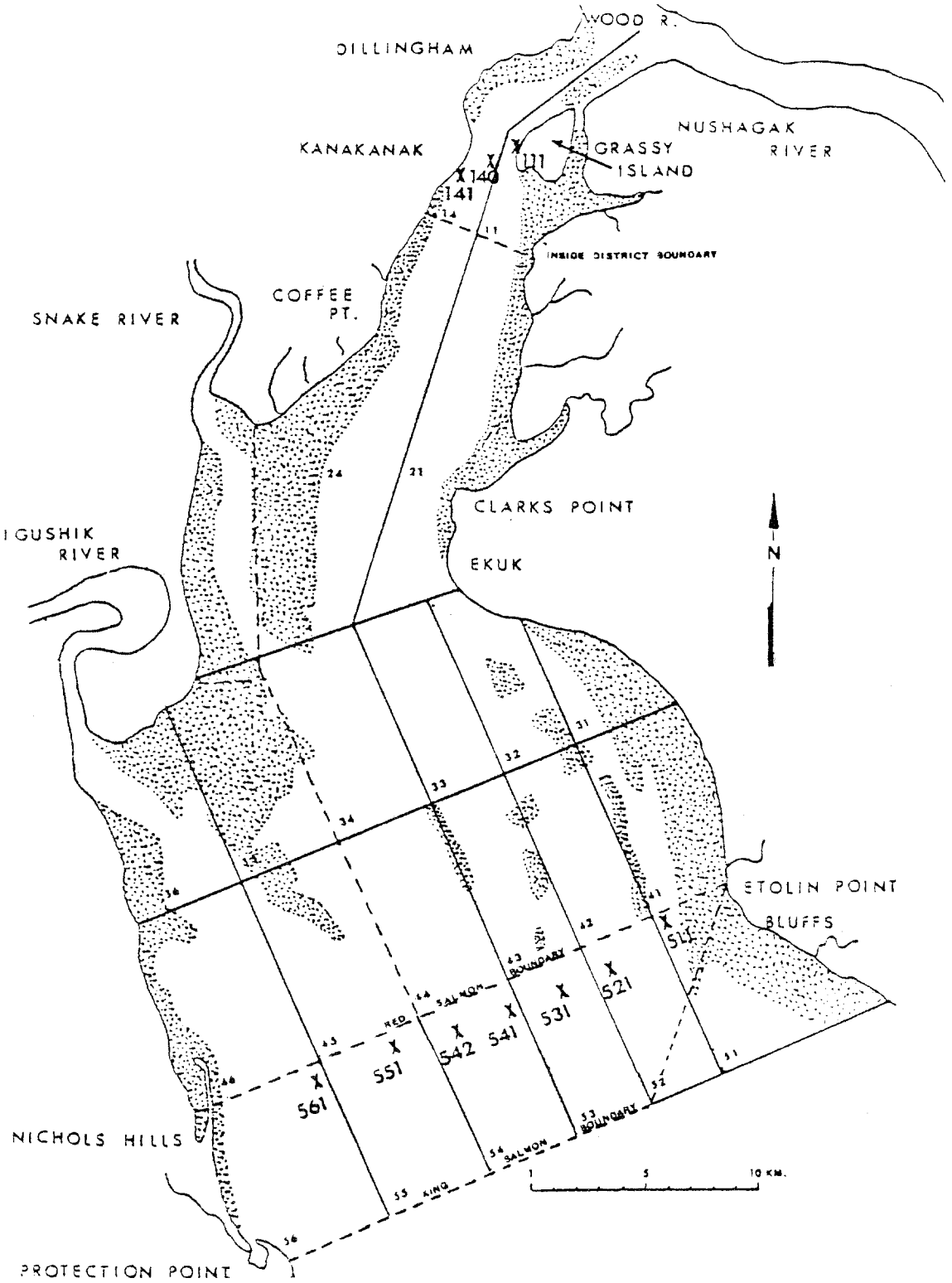

Figure 1. Nushagak Bay test fish stations, 1980. Stations 111, 140, and 141 were fished during the sockeye test fishery and stations 511 to 561 were fished during the pink test fishery.

The following information was recorded for each drift and are in Appendix Table 1: drift number (sequential through season), date, location, tide stage, fathoms of net, fishing times (start out, full out, start in, full in), catch by species, wind velocity (knots), wind direction (eight compass points), sea state, surface water temperature (°C), and ambient light. Fishing times were recorded in fractions of an hour. Sea state was classified according to the Beaufort Scale for wind force (Chapman 1957). A light meter (Vivitar model 45) was used to describe ambient light conditions at the time the net was set. The ASA value on the light meter was arbitrarily set to 100 which yielded EV readings from 0 (dark) to 18 (bright sunlight). Readings were taken with the opaque cover over the photocell and the light meter held at eye level pointing up. Fish length and sex were determined and a scale sample taken from all sockeye salmon captured. Length and sex information will be presented in another report (Robertson, in preparation). Also in Appendix Table 2 are the number and total weight of sockeye salmon delivered each day. Standard CPUE indices (fish per 100 fm hours) were calculated for each drift from the standard formula used by all Bristol Bay test fisheries:

$$\text{Index} = \frac{100 \text{ X Catch}}{\text{Net X Time}}$$

Where: Catch = number of salmon caught (by species)
Net = fathoms of gillnet fished
Time = fishing time (hours)
100 = constant to convert CPUE into catch per 100 fathom hours.

$$\text{Time} = \left[(C - B) + \frac{(B-A) + (D-C)}{2}\right]$$

A = start net out
B = net full out
C = start net in
D = net full in

Pink Salmon

Fishing for pink salmon was conducted from 18 July to 6 August along a transect between Nichols Hills and Etolin Point Bluffs, approximately 1 mi seaward from the sockeye salmon fishing district outside boundary. Seven test fish stations were established (Figure 1). Five or six of these stations made up a transect with the exception of 6 August when only one station was fished because of adverse weather. The transect was fished from west to east, the first set was usually made approximately one-half hour following actual low tide. Since the Nushagak Bay tide table was for Clarks Point, the correction of minus 22 minutes for Protection Point was used. Thus, the first set was made approximately 8 minutes after the time of low tide printed in the tide book. Pink salmon fishing was conducted from the F/V ILIASKA. The pink salmon gear used had 114 mm (4-1/2 inch) stretched mesh multifilament nylon webbing and was 28 meshes deep.

The same data was collected during the pink salmon sampling as was collected during the sockeye and chum salmon sampling with the addition of salinity, wave height, water depth, and boat count. Salinity was measured from a surface water sample with the aid of a hydrometer. An index of the number of commercial vessels fishing in the vicinity of the pink salmon sampling transect was made by counting all gillnetters visible in a 360° radius at the start of each drift. The qualitative observations of wind velocity, wind direction, sea state, wave height, and boat count were made up by the same person throughout the season. A record was kept of the total weight of all pink salmon delivered each day. All the above data are listed in Appendix Tables 3, 4, and 5. Computations of the CPUE indices for each drift was the same as for all Bristol Bay test fisheries.

RESULTS

Sockeye and Chum Salmon

During the sockeye and chum salmon sampling a total of 86 drifts were made at the three test fish stations. Total catches of sockeye and chum salmon were 1,827 and 349, respectively. A daily test fish index for sockeye salmon was calculated by summing together the mean daily indices from each station (Table 1).

The regression of daily sockeye salmon test fish indices on daily Wood and Nuyakuk River tower counts (Table 2) had the highest correlation coefficient ($R = 0.73022$) when Wood River tower and Nuyakuk River tower counts were lagged 2 and 11 days, respectively (Table 3). The daily test fish indices reflected the daily escapement to Wood River better than to Nuyakuk River (Figure 2).

A post-season estimate of the accumulative daily escapement of sockeye salmon past the test fish transect was made by dividing the estimated accumulative escapement past the Wood (2-day lag) and Nuyakuk River (11-day lag) towers by the accumulated test fish index (Table 4). Thus,

$$\frac{5,249,310}{31,380.2} = 167.3 \text{ escapement index points.}$$

The post-season estimated escapement of sockeye salmon past the test fish transect tended to be greater than the tower counts of escapement (Figure 3). The regression of the daily test fish estimated sockeye salmon escapement on the daily accumulative tower counts had a correlation coefficient of 0.943.

The daily indices for chum salmon peaked strongly on 1 July with small peaks on 11 and 14 July. The highest single index for chum salmon was 658.1 fish per 100 fm hours obtained at station 111 on 29 June.

Pink Salmon

While fishing for pink salmon a total of 103 drifts was made. A total of 2,101 pink salmon was caught in the seven stations. Peak test fish indices occurred between 28 and 30 July (Table 5). Stations on the eastside of the

Table 1. Sockeye salmon test fish indices by date and station, Nushagak Bay, 1980.

Date	Kanakanak (141)	Mid-Channel 140	Grassy Is. 111	Total
6/29	5.1	0.9	2,974.8	2,980.8
6/30	15.8	136.9	2,873.8	3,026.5
7/1	254.8[1]	100.6	12,342.9	12,698.3
7/2	493.9	65.7	4,314.8	4,874.4
7/3	286.1	14.5	179.0	479.6
7/4	107.0	51.9	611.5	770.4
7/5	32.5	22.3	16.5	71.3
7/6	252.2	3.9	1,637.3	1,893.4
7/7	258.5	13.9	1,466.2	1,738.6
7/8	235.3	3.9	1,191.7	1,430.9
7/9	3.7	3.8	951.4	958.9
7/10	21.0	3.7	2.1	26.8
7/11	12.4	59.8	258.5	330.7
7/12	10.5	27.9	33.6	72.0
7/13	0.0	0.0	5.9	5.9
7/14	1.9	3.9	15.9	21.7
7/15	0.0	0.0	0.0	0.0

[1] Estimated by taking average of adjacent days.

Table 2. Sockeye salmon escapement counts at Wood and Nuyakuk River towers, 1980.

Date	Daily Wood River Tower Counts	Daily Nuyakuk River Tower Counts
6/29	24,810	
6/30	120,912	
7/1	175,638	0
7/2	341,214	0
7/3	415,668	0
7/4	460,722	0
7/5	198,684	12,126
7/6	141,096	69,708
7/7	162,906	150,840
7/8	230,490	153,810
7/9	246,156	200,298
7/10	95,850	253,344
7/11	46,992	214,602
7/12	119,424	293,694
7/13	76,950	182,532
7/14	31,950	231,180
7/15	29,628	200,340
7/16	25,416	239,814
7/17	12,462	210,690
7/18	7,386	183,822
7/19	1,554	152,928
7/20		126,690
7/21		86,400
7/22		34,386
7/23		15,792
7/24		8,334
7/25		2,388
7/26		1,128
7/27		426
7/28		366
7/29		378
7/30		276

Table 3. Regression of daily sockeye salmon test fish index on daily Wood and Nuyakuk River sockeye salmon tower counts, 1980.

Lag Time (days)		
Wood River	Nuyakuk River	Correlation Coefficient
1	9	.51089
1	10	.54413
1	11	.59703
1	12	.52578
1	13	.56596
2	9	.68542
2	10	.67256
2	11	.73022*
2	12	.65410
2	13	.70525
3	9	.69774
3	10	.68320
3	11	.70292
3	12	.64145
3	13	.68213

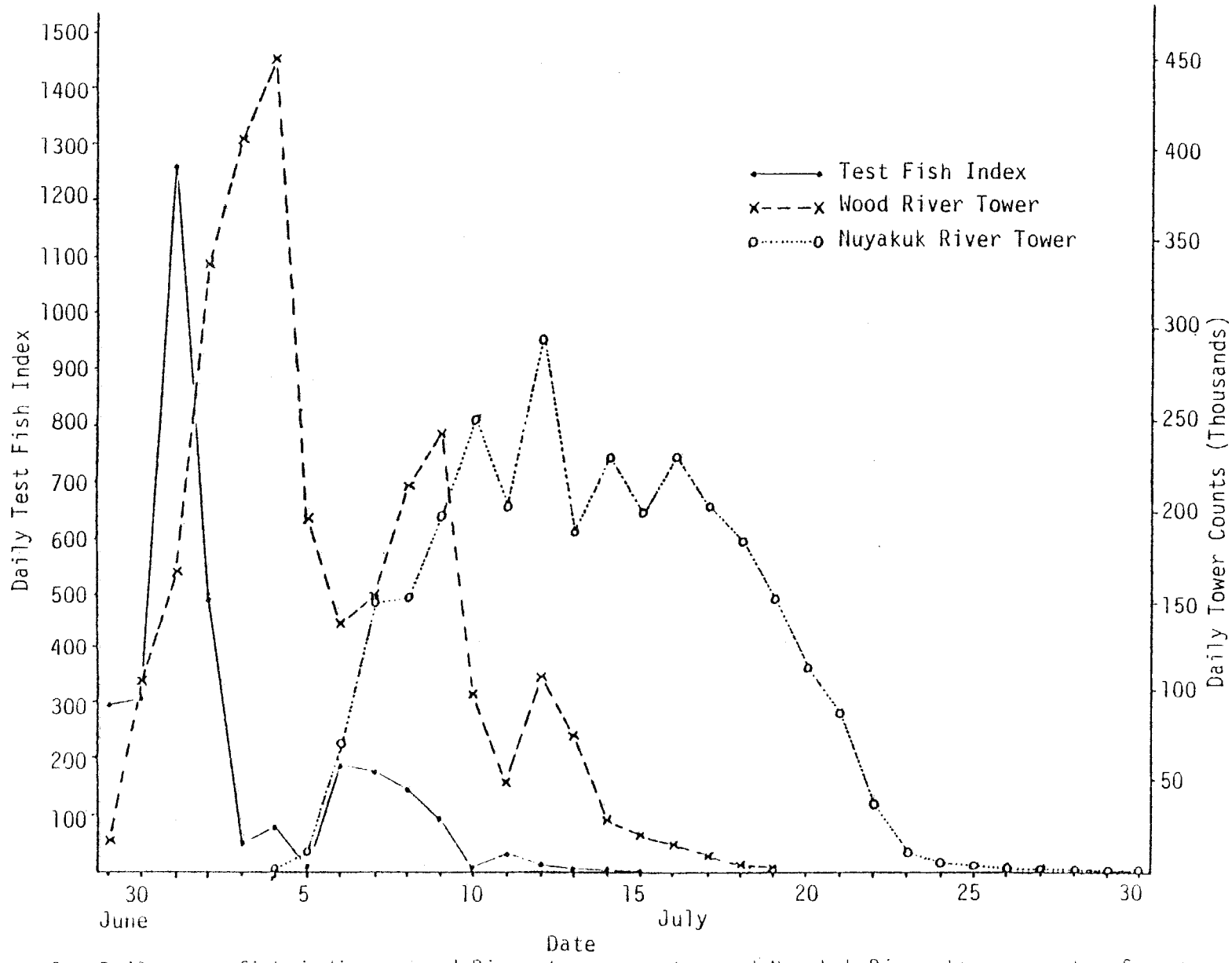

Figure 2. Daily test fish indices, Wood River tower counts, and Nuyakuk River tower counts of sockeye salmon, 1980.

Table 4. Sockeye salmon escapement into Wood and Nuyakuk Rivers as estimated by the Nushagak Bay test fishery, 1980.

Date	Accum. Index	Estimated Escapement past Test Fishery[1]	Estimated Escapement past Towers [2]	Accuracy [3]
6/29	2,980.8	498,631	428,982	1.16
6/30	6,007.3	1,004,907	984,798	1.02
7/1	18,705.6	3,129,092	1,694,160	1.84
7/2	23,580.0	3,944,486	2,337,414	1.68
7/3	24,059.6	4,024,714	2,767,278	1.45
7/4	24,830.0	4,153,587	3,108,714	1.33
7/5	24,901.3	4,165,514	3,511,434	1.18
7/6	26,794.7	4,482,244	3,952,614	1.13
7/7	28,533.3	4,773,079	4,382,592	1.09
7/8	29,964.2	5,012,441	4,631,370	1.08
7/9	30,823.1	5,172,847	4,805,052	1.07
7/10	30,949.9	5,177,330	5,010,876	1.03
7/11	31,280.6	5,232,650	5,122,212	1.02
7/12	31,352.6	5,244,694	5,169,954	1.01
7/13	31,358.5	5,245,681	5,207,916	1.01
7/14	31,380.2	5,249,311	5,235,720	1.00
7/15	31,380.2	5,249,310	5,249,310	1.00

[1] Estimated escapement past test fishery = (accum. test fish index on day n) X (numbers of spawners/index point).

[2] Estimated escapement past tower = (accum. escapement past Wood River tower on day n + 2) + (accum. escapement past Nuyakuk River tower on day n + 11).

[3] Accuracy = estimated escapement past test fishery/estimated escapement past towers.

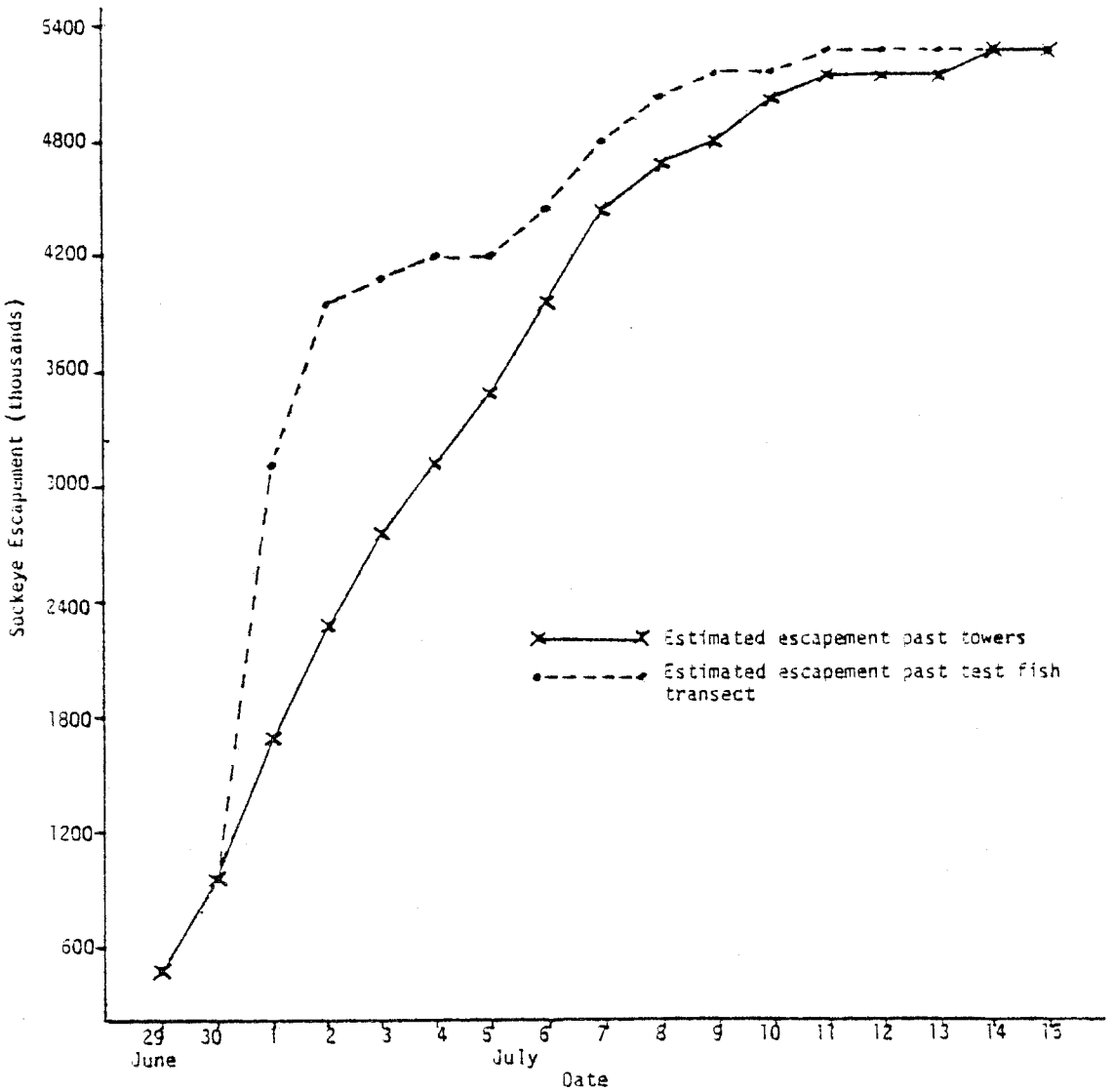

Figure 3. Comparison of the estimated sockeye salmon escapement past the Nushagak Bay test fish transect with the estimated sockeye salmon escapement past Wood and Nuyakuk River towers.

Table 5. Pink salmon test fish indices by date and station, Nushagak Bay, 1980.

Date	Station 551	542	541	531	521	511	Total
7/18	30.0	31.5 [1]	33.1	36.6 [1]	40.1	14.8	186.1
7/19	0.0	19.8 [1]	39.6	64.0 [1]	88.5	27.1	239.0
7/20	0.0	0.0 [1]	0.0	49.0 [1]	98.0	88.2	235.2
7/21	8.1	14.7	27.3	22.3	43.0	1.8	117.2
7/22	11.5	13.3	14.9	15.6	18.8	15.1	89.5
7/23	27.5	14.7	1.9	11.3	36.7	33.0	125.1
7/24	5.1	8.7	32.7	11.7	15.3	5.7	79.2
7/25	3.4	11.7	45.3	1.8	5.6	20.4	88.2
7/26	29.7	20.1	35.8	46.0	90.5	30.6	252.7
7/27	62.5	94.4	91.3	35.0	39.8	73.9	396.9
7/28	67.4	209.8	207.2	169.1 [1]	131.1	320.0	1,104.6
7/29	0.0	24.3	32.4	105.1	226.1	86.8	474.7
7/30	7.7	33.1	35.2	78.7	313.8	215.9	684.4
7/31	0.0	12.2	23.8	77.8	60.2	139.8	313.8
8/1	3.7	7.5	38.1	286.6	162.3	175.0	673.2
8/2							682.0 [2]
8/3							682.0 [2]
8/4	26.6	123.9	147.4	145.7	161.7	85.5	690.8
8/5	11.8	49.9	49.5	52.3	32.4	35.7	231.6
Totals	295.0	689.6	855.5	1,208.6	1,563.9	1,369.3	7,346.2
Percent	4.93	11.53	14.30	20.20	26.14	22.89	100.0

[1] Interpolated by taking average of adjacent drifts.
[2] Interpolated by taking average of 8/1 total index and 8/4 total index.

transect frequently had the highest indices. A daily test fish index for pink salmon was calculated by summing together the mean daily indices from each station.

There was a negative correlation ($r = -0.566$, $n = 19$, $p = .05$) between the pink salmon test fish indices and the indices of the number of boats along the test fish transect. Competition for fish between our net and the nets of commercial fishermen apparently occurs, thus, our test fish indices do not accurately reflect the abundance of pink salmon returning to Nushagak Bay. To improve the accuracy of our test fish index to pink salmon abundance relationship, the linear effect of commercial fishing pressure (boat index) was removed from our test fish indices with the aid of partial correlation analysis (Frane 1977). The test fish indices were adjusted to be uncorrelated with the boat indices by taking the difference between the actual test fish index and its value as predicted by the boat indices (Table 6). For convenience these residual values were set to be positive numbers by adding the value of the smallest residual to each one. These adjusted residual values, termed R-index, are uncorrelated with the number of boats fishing along the test fish transect and more accurately reflects the daily abundance of pink salmon moving accross the transect.

The regression of daily pink salmon test fish indices on the daily commercial Nushagak District catch plus the daily Nuyakuk River tower counts (Table 7) i.e., daily abundance, had the highest correlation coefficient when the catch was lagged 1 day and the tower counts lagged 6 to 8 days (Table 8).

A post-season estimate of the actual accumulative pink salmon abundance by day was made using the method similar to that described for sockeye salmon earlier. The accumulative pink salmon test fish index on the last day of test fishing was divided into the sum of catch (1-day lag) plus Nuyakuk tower counts (7-day lag). Thus,

$$\frac{3{,}894{,}273}{5.967.4} = 652.5913 \text{ pink abundance/index points}$$

Post-season estimates of the daily abundance of pink salmon crossing the transect are then made by multiplying this abundance/index point constant by the accumulative test fish index on each day (Table 9).

The regression of the accumulative abundance of pink salmon estimated post-season by the test fish project on the accumulative commercial catch plus accumulative tower counts had a correlation coefficient of 0.995 (Figure 4). The estimated number of pink salmon moving across the test fish transect each day closely followed the actual run as estimated by catch plus Nuyakuk River tower counts (Figure 5).

Table 6. Daily pink index residuals from partial correlation analysis of daily pink salmon test fish indices, daily pink salmon abundance and boat indices with new R-Index, Nushagak offshore test fishing, 1980.

Date	Daily Pink Index	Daily Boat Index	Residual of Index with Linear Effect of Boats Removed[1]	Adjusted Residual of Pink Index (R-Index)[2]
7/18	186.1	30	-316.4	0.0
7/19	239.0	50	-245.4	71.0
7/20	235.2	377	46.8	363.3
7/21	117.2	628	156.1	472.6
7/22	89.5	402	- 76.2	240.2
7/23	125.1	225	-200.9	115.6
7/24	79.2	385	-101.9	214.5
7/25	88.2	200	-260.4	56.0
7/26	252.7	222	- 76.0	240.4
7/27	396.9	0	-132.8	183.6
7/28	1,104.6	0	574.9	891.3
7/29	474.7	33	- 25.1	291.3
7/30	684.4	0	154.7	471.1
7/31	313.8	0	-215.9	100.5
8/1	673.2	0	143.5	459.9
8/2	682.0	0	152.3	468.7
8/3	682.0	150 [3]	288.1	604.5
8/4	690.8	208 [4]	342.2	658.6
8/5	231.6	212 [4]	-207.6	108.9

[1] Difference between daily pink indices and pink indices predicted from daily boat indices.

[2] Residual values adjusted to positive numbers by adding the value of the smallest residual (-316.4) to each one.

[3] Estimated.

[4] Half the actual boat index since nearly all boats were fishing shoreward of the test fish transect.

Table 7. Daily Nushagak District commercial catch and Nuyakuk River tower counts of pink salmon, 1980.

Date	Daily Nushagak district catch	Daily Nuyakuk tower counts
7/18	13,450	102
7/19	19,732	246
7/20	25,845	780
7/21	64,614	3,408
7/22	100,612	6,156
7/23	145,842	5,778
7/24	224,301	7,314
7/25	164,303	9,606
7/26	197,533	8,088
7/27	0	4,284
7/28	0	3,978
7/29	319,823	12,978
7/30	0	28,686
7/31	0	40,494
8/01	0	68,988
8/02	0	95,220
8/03	329,990	114,354
8/04	210,961	73,200
8/05	223,541	166,170
8/06	83,223	206,736
8/07	62,901	251,172
8/08		214,620
8/09		190,968
8/10		134,754
8/11		96,906
8/12		62,748
8/13		39,006
8/14		69,318
8/15		45,696
8/16		61,836
8/17		88,338
8/18		67,554
8/19		42,300

Table 8. Regression of daily and accumulative pink salmon R-Index on daily and accumulative Nushagak District commercial catch plus Nuyakuk River tower counts, 1980.

Lag Time (days)		Correlation Coefficient	
Catch	Tower	Daily	Accumulative
0	5	.260	.258
0	6	.268	.231
0	7	.132	.100
0	8	.185	.151
0	9	.123	.090
1	5	.604	.990
1	6	.634	.993
1	7	.575	.995*
1	8	.624	.994
1	9	.563	.991

Table 9. Daily pink salmon run into Nushagak Bay as estimated post-season by the Nushagak Bay test fishery, 1980.

Date	Accum. R-Index	Estimated Abundance [1]	Actual Abundance [2]	Accuracy [3]
7/18	0.0	0.0	29,341	
7/19	71.0	46,334	63,274	.73
7/20	434.3	283,420	132,172	2.14
7/21	861.9	562,468	236,762	2.38
7/22	1,102.1	719,221	395,582	1.82
7/23	1,217.7	794,660	648,569	1.22
7/24	1,432.2	934,641	853,366	1.09
7/25	1,488.2	971,186	1,119,887	.87
7/26	1,728.7	1,128,134	1,215,107	.93
7/27	1,912.3	1,247,950	1,329,461	.94
7/28	2,803.7	1,829,670	1,722,484	1.06
7/29	3,095.0	2,019,770	1,888,654	1.07
7/30	3,566.1	2,327,206	2,095,390	1.11
7/31	3,666.6	2,392,791	2,346,562	1.02
8/1	4,126.6	2,692,983	2,561,182	1.05
8/2	4,595.3	2,998,852	3,082,140	.97
8/3	5,199.8	3,393,344	3,427,855	.99
8/4	5,858.5	3,823,206	3,748,302	1.02
8/5	5,967.4	3,894,273	3,894,273	1.00

[1] Estimated abundance = (accum. test fish index on day n) X (652.59 abundance/index point).

[2] Actual abundance = (accum. Nushagak district catch on day n + 1) + (accum. Nuyakuk River tower counts on day n + 7).

[3] Accuracy = estimated abundance/actual abundance.

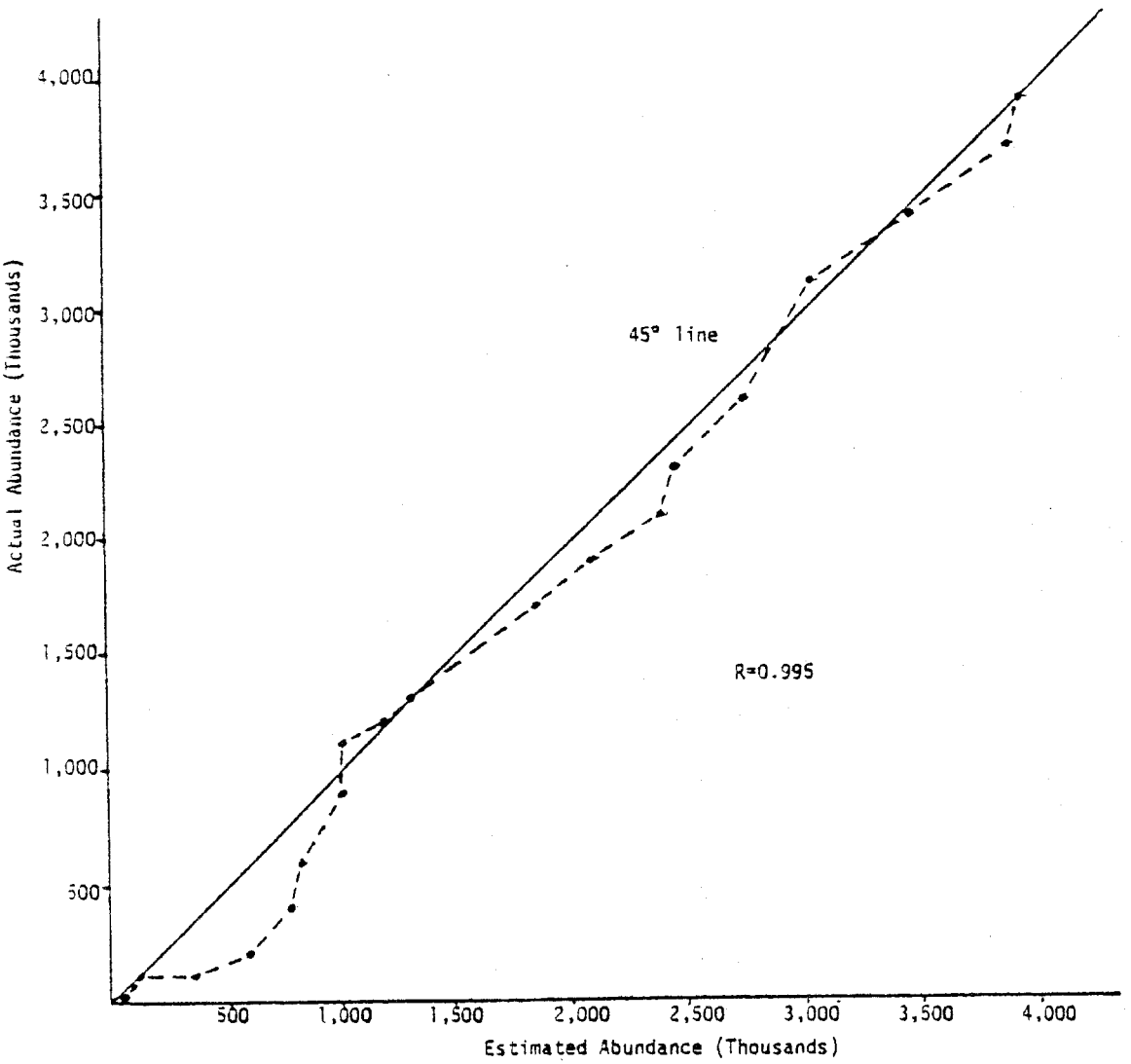

Figure 4. Comparison of the test fish abundance per index point estimates of Nushagak Bay pink salmon return with the estimated actual (catch + Nuyakuk tower counts) pink salmon return, 1980.

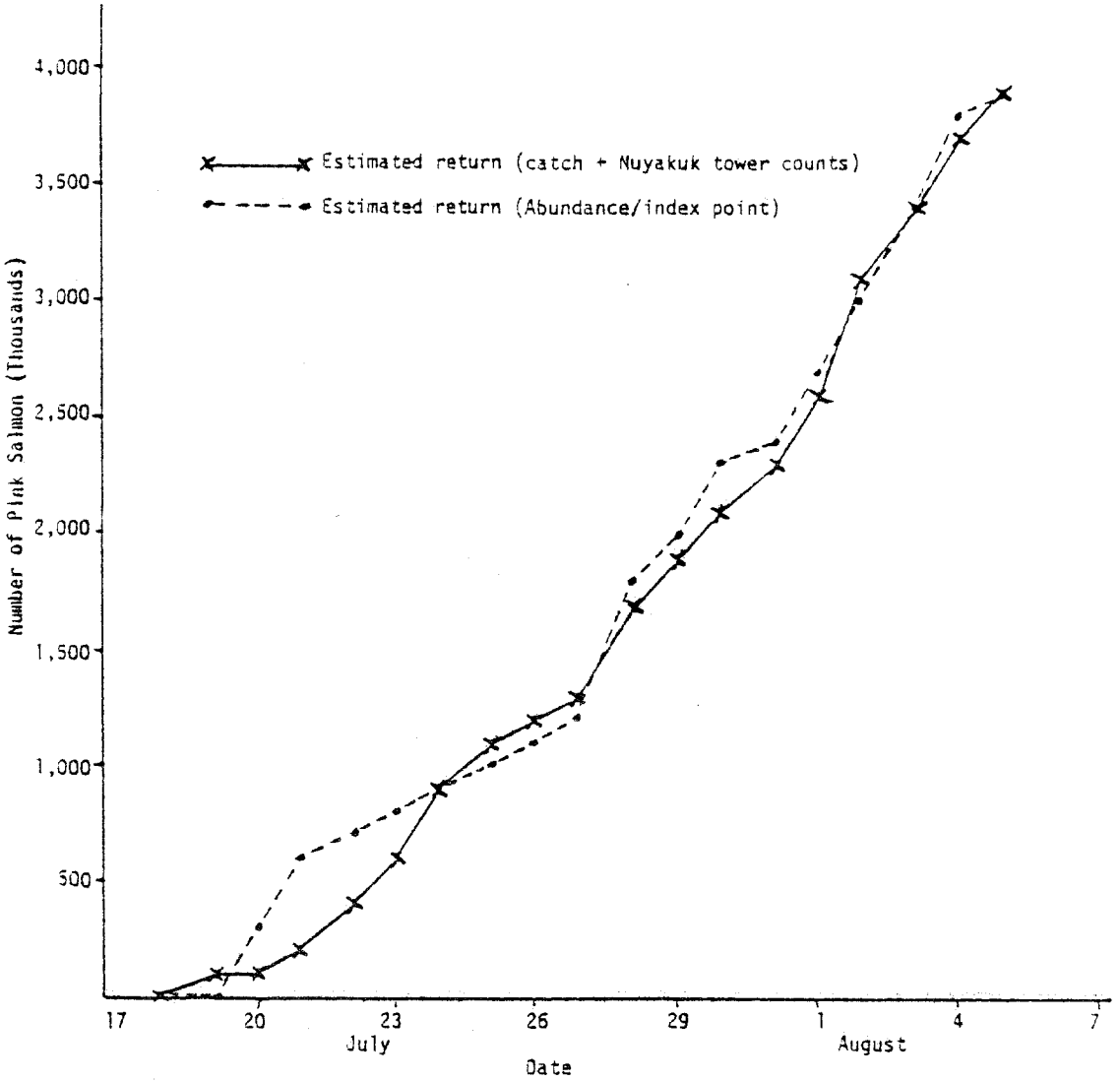

Figure 5. Comparison of the estimated actual (catch + Nuyakuk tower) daily return with the test fish estimates of daily return for Nushagak Bay pink salmon, 1980.

LITERATURE CITED

Chapman, D.F. 1957. Piloting, seamanship, and small boat handling. 51 st. ed. The Hearst Corporation, New York. p. 257.

Frane, James. 1977. Partial correlation and multivariate regression in W.J. Dixon (series editor) biomedical computer programs P-series. University of California Press. Berkeley, California. Pp. 697-710.

Robertson, T. (in press). Inventory and summary of scale data collected in the Nushagak drainage 1977-1980. Alaska Department of Fish and Game Technical Data Report.

Appendix Table 1. Catch, index, and climatological data collected during the Nushagak Bay sockeye and chum salmon offshore test fish project, 1980.

Date	Set No.	Sta No.	Tide[1]	Fath Net	Time Set	Fishing Time	Sockeye Catch	Sockeye Index	Chum Catch	Chum Index	Wind Vel. (Knots)	Wind[2] Dir. (Coded)	Sea[3] State (Coded)	Water Temp (Cent.)	Light[4] (Coded)
6/29	3	141	2	50	446	0.560	0	0.	0	0.	2	4	1	11	12
6/29	4	140	3	50	526	0.537	0	0.	0	0.	2	4	1	11	14
6/29	5	111	3	50	607	0.531	0	0.	0	0.	6	4	2	11	14
6/29	6	141	5	100	1500	0.583	6	10.3	1	1.7	10	4	3	12	16
6/29	7	140	6	100	1600	0.583	1	1.7	0	0.	10	4	3	12	16
6/29	8	111	7	50	1656	0.076	226	5949.5	25	658.1	10	4	3	12	16
6/30	9	141	1	100	503	0.577	1	1.7	0	0.	3	4	1	11	13
6/30	10	140	2	100	546	0.593	1	1.7	0	0.	3	4	1	12	13
6/30	11	111	3	50	634	0.558	25	89.5	6	21.5	3	4	1	12	14
6/30	12	141	6	100	1702	0.668	20	29.9	9	13.5	10	4	4	12	15
6/30	13	140	7	100	1803	0.176	48	272.1	61	345.8	10	4	3	12	15
6/30	14	111	7	25	1929	0.078	111	5658.0	0	0.	10	4	3	12	14
7/ 1	19	140	5	50	1550	0.318	16	100.6	55	345.9	10	5	3	11	14
7/ 1	20	111	5	25	1658	0.058	180	12342.9	5	342.9	10	5	2	11	14
7/ 2	21	141	1	50	643	0.132	61	922.7	4	60.5	20	4	3	10	10
7/ 2	22	111	1	50	720	0.043	43	1997.4	3	139.3	20	4	3	11	10
7/ 2	23	141	5	50	1742	0.552	18	65.2	6	21.7	15	3	3	11	14
7/ 2	24	140	5	50	1822	0.578	19	65.7	23	79.5	15	3	3	11	14
7/ 2	25	111	6	50	1914	0.044	146	6632.2	2	90.8	20	3	3	11	14
7/ 3	26	111	1	25	657	0.540	24	177.9	0	0.	16	5	4	11	13
7/ 3	27	140	2	50	743	0.550	4	14.5	1	3.6	16	5	4	11	13
7/ 3	28	141	2	50	825	0.648	89	274.7	0	0.	10	5	2	11	13
7/ 3	29	141	5	50	1859	0.296	44	297.5	1	6.8	10	5	2	11	13
7/ 3	30	111	6	25	1926	0.333	15	180.0	3	36.0	10	5	2	11	13
7/ 4	31	141	5	50	1918	0.598	32	107.0	4	13.4	7	5	2	11	13
7/ 4	32	140	5	50	2011	0.578	15	51.9	1	3.5	7	5	2	11	13
7/ 4	33	111	6	50	2054	0.307	93	611.5	4	26.1	7	5	2	11	13
7/ 5	34	141	5	50	1956	0.492	8	32.5	0	0.	15	4	3	11	13
7/ 5	35	140	5	50	2038	0.449	5	22.3	0	0.	15	4	4	11	12
7/ 5	36	111	6	50	2117	0.483	4	16.5	0	0.	15	4	4	11	12
7/ 6	37	141	6	50	2116	0.531	67	252.2	2	7.5	6	4	2	11	12
7/ 6	38	140	6	50	2205	0.509	1	3.9	0	0.	6	4	2	11	10
7/ 6	39	111	6	50	2245	0.101	83	1637.3	0	0.	6	4	2	11	9
7/ 7	40	141	1	50	956	0.295	26	176.2	4	27.1	6	4	2	10	14
7/ 7	41	140	1	50	1028	0.510	2	7.8	0	0.	3	4	2	11	14
7/ 7	42	111	2	50	1106	0.076	56	1466.2	0	0.	3	5	2	11	14
7/ 7	43	141	5	50	2359	0.235	40	340.8	0	0.	10	4	3	10	0
7/ 7	44	140	6	50	42	0.501	5	20.0	1	4.0	10	4	3	11	0
7/ 8	45	111	1	50	1011	0.081	48	1191.7	0	0.	6	5	2	11	15
7/ 8	46	141	1	50	1051	0.212	25	235.3	1	9.4	6	5	2	10	15

-Continued-

1. Tide Stage= 0-low low, 1-low flood, 2-high high, 3-high ebb, 4-high low, 5-high flood, 6-low high, 7-low ebb.
2. Wind Direction= 0-North, 1-Northeast, 2-East, 3-Southeast, 4-South, 5-Southwest, 6-West, 7-Northwest.
3. Sea State= 0-calm to 6-rough.
4. Lightness= 0-dark to 18-bright sunlight.

Appendix Table 1. Catch, index, and climatological data collected during the Nushagak Bay sockeye and chum salmon offshore test fish project, 1980 (continued).

Date	Set No.	Sta No.	Tide[1]	Fath Net	Time Set	Fishing Time	Sockeye Catch	Sockeye Index	Chum Catch	Chum Index	Wind Vel. (Knots)	Wind[2] Dir. (Coded)	Sea[3] State (Coded)	Water Temp (Cent.)	Light[4] (Coded)
7/ 8	47	140	2	50	1116	0.511	1	3.9	0	0.	6	5	2	10	14
7/ 9	48	141	1	50	27	0.524	1	3.7	0	0.	6	4	2	10	0
7/ 9	49	140	2	50	109	0.533	1	3.7	2	7.3	6	5	2	10	0
7/ 9	50	111	3	50	152	0.515	0	0.	1	3.9	10	5	3	10	0
7/ 9	51	141	5	50	1046	0.542	1	3.7	2	7.4	3	4	1	10	14
7/ 9	52	140	5	50	1128	0.518	1	3.9	0	0.	3	3	1	10	14
7/ 9	53	111	6	50	1221	0.078	74	1902.9	0	0.	6	3	2	10	14
7/10	54	141	1	50	35	0.460	5	21.7	0	0.	3	3	1	10	0
7/10	55	140	1	50	113	0.527	0	0.	0	0.	6	1	2	10	0
7/10	56	111	2	50	203	0.473	1	4.2	0	0.	6	1	2	10	0
7/10	57	141	5	50	1110	0.492	5	20.3	4	16.2	16	1	3	10	14
7/10	58	140	5	50	1150	0.548	2	7.3	1	3.6	10	1	3	10	14
7/10	59	111	5	50	1239	0.512	0	0.	1	3.9	10	1	3	10	14
7/11	60	141	1	50	105	0.496	4	16.1	13	52.4	10	5	3	10	0
7/11	61	140	1	50	214	0.541	7	25.9	6	22.2	10	5	3	10	0
7/11	62	111	2	50	305	0.581	10	34.4	1	3.4	10	5	3	10	0
7/11	63	141	5	50	1219	0.458	2	8.7	13	56.7	10	3	2	10	0
7/11	64	140	5	50	1300	0.469	22	93.7	6	25.6	10	3	3	10	14
7/11	65	111	5	50	1348	0.128	31	482.6	5	77.8	10	3	2	10	14
7/12	66	141	1	50	209	0.487	4	16.4	16	65.6	10	2	2	11	0
7/12	67	140	1	50	258	0.535	14	52.3	11	41.1	10	2	2	11	0
7/12	68	111	2	50	350	0.469	5	21.3	1	4.3	10	2	2	12	0
7/12	69	141	5	50	1325	0.449	1	4.5	1	4.5	6	3	1	11	15
7/12	70	140	5	50	1405	0.596	1	3.4	0	0.	6	3	1	11	14
7/12	71	111	6	50	1458	0.523	12	45.9	0	0.	6	3	1	12	14
7/13	72	141	1	50	243	0.499	0	0.	1	4.1	3	3	1	11	0
7/13	73	140	1	50	323	0.429	0	0.	0	0.	3	3	1	11	0
7/13	74	111	2	50	410	0.526	0	0.	0	0.	3	3	1	12	5
7/13	75	141	5	50	1437	0.525	0	0.	0	0.	6	3	2	12	16
7/13	76	140	5	50	1515	0.489	0	0.	0	0.	6	3	2	12	16
7/13	77	111	6	50	1557	0.502	3	11.9	0	0.	6	3	2	12	15
7/14	78	141	1	50	350	0.505	0	0.	1	4.0	0	4	3	12	1
7/14	79	140	1	50	432	0.510	2	7.8	10	39.2	10	4	3	12	8
7/14	80	111	2	50	523	0.487	3	12.3	8	32.9	10	4	3	12	11
7/14	81	141	5	50	1537	0.527	1	3.8	2	7.6	16	4	3	12	14
7/14	82	140	5	50	1618	0.526	0	0.	2	7.6	16	4	3	11	12
7/14	83	111	6	50	1703	0.511	5	19.6	18	70.4	16	4	4	12	6
7/15	84	141	1	50	429	0.535	0	0.	0	0.	3	4	1	12	6
7/15	85	140	1	50	510	0.521	0	0.	1	3.8	3	4	1	12	8
7/15	86	111	2	50	537	0.535	0	0.	0	0.	3	4	1	12	13

-Continued-

1. Tide Stage= 0-low low, 1-low flood, 2-high high, 3-high ebb, 4-high low, 5-high flood, 6-low high, 7-low ebb.
2. Wind Direction= 0-North, 1-Northeast, 2-East, 3-Southeast, 4-South, 5-Southwest, 6-West, 7-Northwest.
3. Sea State= 0-calm to 6-rough.
4. Lightness= 0-dark to 18-bright sunlight.

Appendix Table 2. The number, total weight, and mean weight of sockeye salmon caught and delivered during the sockeye salmon test fishery, Nushagak Bay, 1980.

Date	Number	Total Weight (kg) [1]	Mean Weight (kg)
6/29	233	687.7	2.95
6/30	169	486.7	2.88
6/30	25	65.8	2.63
7/01	196	493.1	2.52
7/01	56	164.7	2.94
7/02	104	289.4	2.78
7/02	146	506.2	3.47
7/03	155	501.7	3.24
7/04	149	401.0	2.69
7/06	147	346.6	2.36
7/07	56	161.5	2.88
7/08	106	306.6	2.89
7/09	43	113.4	2.64
7/10	13	34.9	2.69
7/11	54	145.1	2.69
7/12	49	122.9	2.51
Total	1,701	4,827.3	2.84

[1] Weight was taken from the commercial harvest fish tickets.

Appendix Table 3. Catch, index, and climatological data collected during the Nushagak Bay pink salmon offshore test fish project, 1980.

Date	Set No.	Sta No.	Tide[1]	Fath Net	Time Set	Fishing Time	Catch	Index	Wind Vel. (Knots)	Wind[2] Dir. (Coded)	Sea[3] State (Coded)	Water Temp (Cent.)	Light[4] (Coded)	Salinit (ppt)
7/18	1	561	1	100	1433	0.573	0	0.	6	7	1	14	15	17.3
7/18	2	551	1	100	1534	0.601	18	30.0	3	7	1	14	15	15.6
7/18	3	541	1	100	1646	0.634	21	33.1	3	5	1	14	15	15.7
7/18	4	531	1	100	1804	0.574	23	40.1	3	5	1	14	15	22.1
7/18	5	511	1	100	1921	0.541	8	14.8	3	5	1	14	14	23.4
7/19	6	561	1	100	1533	0.609	0	0.	3	5	1	14	16	13.3
7/19	7	551	1	100	1653	0.530	0	0.	6	5	2	14	16	13.2
7/19	8	541	1	100	1809	0.555	22	39.6	10	5	3	13	15	22.9
7/19	9	531	1	100	1919	0.497	44	88.5	16	5	4	14	14	23.1
7/19	10	511	1	100	2017	0.478	13	27.1	16	5	4	14	13	20.6
7/20	11	561	1	100	1551	0.544	1	1.8	3	3	1	17	15	13.5
7/20	12	551	1	100	1650	0.496	0	0.	6	4	3	15	14	12.2
7/20	13	541	1	100	1741	0.440	0	0.	6	4	3	14	14	12.0
7/20	14	531	1	100	1850	0.510	50	98.0	6	4	3	14	13	21.7
7/20	15	511	1	100	2000	0.510	45	88.2	6	4	3	14	13	24.3
7/21	16	551	1	100	1640	0.492	4	8.1	3	3	1	16	15	11.9
7/21	17	542	1	100	1730	0.477	7	14.7	3	3	1	15	15	16.2
7/21	18	541	1	100	1819	0.512	14	27.3	3	3	1	15	15	18.2
7/21	19	532	1	100	1913	0.494	11	22.3	3	3	1	14	13	20.5
7/21	20	531	1	100	2005	0.465	20	43.0	3	3	1	13	14	23.0
7/21	21	511	1	100	2102	0.554	1	1.8	3	3	1	15	14	22.0
7/22	22	551	5	100	445	0.576	3	5.2	10	4	3	14	5	12.0
7/22	23	541	5	100	557	0.565	6	10.6	6	4	2	14	12	18.0
7/22	24	532	5	100	651	0.544	2	3.7	6	4	2	14	13	23.1
7/22	25	531	5	100	752	0.594	1	1.7	3	4	1	14	13	20.4
7/22	26	511	5	100	845	0.586	6	10.2	3	4	1	14	14	23.1
7/22	27	551	1	100	1712	0.488	9	18.4	10	5	3	15	14	14.1
7/22	28	541	1	100	1812	0.524	10	19.1	10	5	3	15	14	17.7
7/22	29	532	1	100	1859	0.547	15	27.4	10	5	3	15	15	20.8
7/22	30	531	1	100	1945	0.641	23	35.9	10	5	3	15	14	18.3
7/22	31	511	1	100	2056	0.604	12	19.9	10	0	3	15	8	20.8
7/23	32	551	5	100	547	0.581	16	27.5	3	7	1	15	8	12.8
7/23	33	541	5	100	701	0.528	1	1.9	3	7	1	14	14	18.7
7/23	34	532	5	100	800	0.529	6	11.3	3	7	1	14	14	20.1
7/23	35	531	5	100	850	0.682	25	36.7	3	7	1	14	17	24.6
7/23	36	511	5	100	949	0.546	18	33.0	3	7	1	14	17	23.3
7/24	37	551	5	100	648	0.591	3	5.1	6	7	2	16	16	10.7
7/24	38	542	5	100	746	0.691	6	8.7	6	7	2	16	16	14.9
7/24	39	541	5	100	854	0.581	19	32.7	10	7	3	16	17	17.0
7/24	40	532	5	100	955	0.600	7	11.7	10	7	3	16	17	20.9
7/24	41	531	5	100	1053	0.589	9	15.3	10	7	3	16	17	23.5
7/24	42	511	5	100	1153	0.529	3	5.7	10	7	3	15	17	23.3
7/25	43	551	5	100	722	0.585	2	3.4	6	7	2	17	16	10.3
7/25	44	542	5	100	825	0.600	7	11.7	3	3	2	16	17	14.1

-Continued-

1. Tide Stage= 0-low low, 1-low flood, 2-high high, 3-high ebb, 4-high low, 5-high flood, 6-low high, 7-low ebb.
2. Wind Direction= 0-North, 1-Northeast, 2-East, 3-Southeast, 4-South, 5-Southwest, 6-West, 7-Northwest.
3. Sea State= 0-calm to 6-rough.
4. Lightness= 0-dark to 18-bright sunlight.

Appendix Table 3. Catch, index, and climatological data collected during the Nushagak Bay pink salmon offshore test fish project, 1980 (continued).

Date	Set No.	Sta No.	Tide[1]	Fath Net	Time Set	Fishing Time	Catch	Index	Wind Vel. (Knots)	Wind[2] Dir. (Coded)	Sea[3] State (Coded)	Water Temp (Cent.)	Light[4] (Coded)	Salinity (ppt)
7/25	45	541	5	100	930	0.551	25	45.3	3	3	2	16	17	17.3
7/25	46	532	5	100	1055	0.552	1	1.8	6	3	2	16	17	23.5
7/25	47	531	5	100	1145	0.535	3	5.6	6	3	2	16	17	24.2
7/25	48	511	5	100	1236	0.539	11	20.4	6	3	2	17	17	23.1
7/26	49	551	5	100	833	0.506	15	29.7	20	7	4	16	16	15.2
7/26	50	542	5	100	923	0.497	10	20.1	20	7	4	15	16	17.3
7/26	51	541	5	100	1015	0.503	18	35.8	20	7	4	16	17	19.6
7/26	52	532	5	100	1100	0.478	22	46.0	20	7	4	17	17	19.6
7/26	53	531	5	100	1144	0.542	49	90.5	20	7	4	16	17	23.5
7/26	54	511	5	100	1239	0.489	15	30.6	20	7	4	16	17	23.5
7/27	56	551	5	100	918	0.592	37	62.5	27	7	4	15	15	19.6
7/27	57	542	5	50	1020	0.530	25	94.4	27	7	5	15	17	18.0
7/27	58	541	5	50	1106	0.328	15	91.3	27	7	5	15	17	21.3
7/27	59	532	5	50	1146	0.571	10	35.0	27	7	5	15	17	19.3
7/27	60	531	5	50	1230	0.502	10	39.8	27	7	5	15	17	22.6
7/27	61	511	5	50	1310	0.487	18	73.9	21	7	5	15	17	21.3
7/28	62	551	5	50	947	0.593	20	67.4	21	7	4	15	15	20.0
7/28	63	542	5	50	1038	0.524	55	209.8	27	7	4	15	16	18.7
7/28	64	541	5	50	1129	0.501	52	207.2	27	7	5	15	16	17.4
7/28	65	531	5	50	1218	0.610	40	131.1	27	7	5	15	16	17.4
7/28	66	511	5	50	1311	0.594	95	320.0	27	7	5	15	16	16.7
7/29	67	551	5	50	1051	0.454	0	0.	21	7	4	15	16	18.7
7/29	68	542	5	50	1131	0.494	6	24.3	21	7	4	15	16	18.7
7/29	69	541	5	50	1218	0.556	9	32.4	21	7	5	15	17	18.0
7/29	70	532	5	50	1304	0.533	28	105.1	21	7	5	15	17	20.6
7/29	71	531	5	50	1350	0.504	57	226.1	21	7	5	15	17	22.6
7/29	72	511	5	50	1437	0.530	23	86.8	21	7	5	15	17	22.0
7/30	73	551	5	50	1132	0.520	2	7.7	21	7	4	15	17	21.3
7/30	74	542	5	50	1215	0.483	8	33.1	21	7	5	15	17	19.3
7/30	75	541	5	50	1300	0.511	9	35.2	21	7	5	15	17	19.3
7/30	76	532	5	50	1344	0.508	20	78.7	21	7	5	15	17	20.6
7/30	77	531	5	50	1428	0.542	85	313.8	21	7	5	15	17	20.6
7/30	78	511	5	50	1519	0.519	56	215.9	21	7	5	15	17	20.6
7/31	79	551	5	50	1217	0.528	0	0.	21	7	4	15	16	18.7
7/31	80	542	5	50	1301	0.490	3	12.2	21	7	5	15	17	18.0
7/31	81	541	5	50	1347	0.505	6	23.8	21	7	5	15	17	20.0
7/31	82	532	5	50	1427	0.514	20	77.8	21	7	5	15	17	20.0
7/31	83	531	5	50	1509	0.531	16	60.2	21	7	5	15	18	20.6
7/31	84	511	5	50	1550	0.544	38	139.8	21	7	5	15	18	18.7
8/ 1	85	551	5	50	1328	0.537	1	3.7	16	5	3	15	16	16.7
8/ 1	86	542	5	50	1420	0.534	2	7.5	16	5	3	15	17	16.7
8/ 1	87	541	5	50	1512	0.524	10	38.1	16	5	3	15	17	16.7
8/ 1	88	532	5	50	1600	0.558	80	286.6	10	5	3	15	16	18.0
8/ 1	89	531	5	50	1657	0.530	43	162.3	10	5	3	15	15	18.7

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1. Tide Stage= 0-low low, 1-low flood, 2-high high, 3-high ebb, 4-high low, 5-high flood, 6-low high, 7-low ebb.
2. Wind Direction= 0-North, 1-Northeast, 2-East, 3-Southeast, 4-South, 5-Southwest, 6-West, 7-Northwest.
3. Sea State= 0-calm to 6-rough.
4. Lightness= 0-dark to 18-bright sunlight.

Appendix Table 3. Catch, index, and climatological data collected during the Nushagak Bay pink salmon offshore test fish project, 1980.

Date	Set No.	Sta No.	Tide[1]	Fath Net	Time Set	Fishing Time	Catch	Index	Wind Vel. (Knots)	Wind[2] Dir. (Coded)	Sea[3] State (Coded)	Water Temp (Cent.)	Light[4] (Coded)	Salinity (ppt)
8/ 1	90	511	5	50	1743	0.503	44	175.0	10	5	2	15	17	19.3
8/ 4	91	551	5	100	1558	0.526	14	26.6	6	2	1	15	16	16.7
8/ 4	92	542	5	100	1644	0.444	55	123.9	6	2	1	15	15	17.4
8/ 4	93	541	5	100	1732	0.495	73	147.4	6	2	1	15	15	17.4
8/ 4	94	532	5	100	1848	0.535	78	145.7	6	2	1	15	15	19.3
8/ 4	95	531	5	100	1944	0.519	84	161.7	6	2	1	14	14	21.0
8/ 4	96	511	5	100	2044	0.561	48	85.5	6	2	1	15	12	22.6
8/ 5	97	551	5	100	1635	0.508	6	11.8	10	7	3	15	17	12.8
8/ 5	98	542	5	100	1729	0.521	26	49.9	10	7	3	15	16	14.1
8/ 5	99	541	5	100	1824	0.505	25	49.5	10	7	3	15	16	14.8
8/ 5	100	532	5	100	1910	0.516	27	52.3	10	7	3	15	16	16.7
8/ 5	101	531	5	100	2002	0.587	19	32.4	3	7	1	14	15	21.0
8/ 5	102	511	5	100	2110	0.533	19	35.7	3	7	1	15	12	20.6
8/ 6	103	551	5	50	1733	0.574	4	13.9	25	4	6	15	15	16.1

1. Tide Stage= 0-low low, 1-low flood, 2-high high, 3-high ebb, 4-high low, 5-high flood, 6-low high, 7-low ebb.
2. Wind Direction= 0-North, 1-Northeast, 2-East, 3-Southeast, 4-South, 5-Southwest, 6-West, 7-Northwest.
3. Sea State= 0-calm to 6-rough.
4. Lightness= 0-dark to 18-bright sunlight.

Appendix Table 4. The number, total weight, and mean weight of pink salmon caught and delivered during the pink salmon test fishery, Nushagak Bay, 1980.

Date	Number	Total Weight (kg) [1]	Mean Weight (kg)
7/18	11	13.6	1.24
7/19	79	112.5	1.42
7/20	93	129.3	1.39
7/21	66	83.9	1.27
7/22	18	22.7	1.26
7/22	69	96.2	1.39
7/23	66	88.5	1.34
7/24	47	68.0	1.45
7/25	49	74.8	1.53
7/26	131	183.7	1.40
7/28	262	374.2	1.43
7/29	123	172.8	1.41
7/30	178	231.3	1.30
8/04	352	489.9	1.39
Total	1,544	2,114.4	1.37

[1] Weight was taken from the commercial harvest fish tickets.

Appendix Table 5. Number of fishing boats counted around the test fish boat at the start of each drift as an index of the number of boats fishing along the pink salmon test fish transect.

	Test Fish Stations							
Date	561	551	542	541	531	521	511	Total
7/18 [1]								
7/19 [1]								
7/20 [1]								
7/21		18	101	164	147	124	74	628
7/22		11		59	72	78	59	279
7/22		57		126	155	160	27	525
7/23		9		59	74	54	29	225
7/24		15	42	100	107	0 [2]	1 [2]	265
7/25		8	25 [2]	10 [2]	38	42	26	149
7/26		9	45	44	41	51	32	222
7/27	Commercial fishery closed from 0900 27 July to 1300 29 July							
7/28								
7/29		0	0	0	10	11	12	33
7/30								
7/31	Commercial fishery closed from 0100 30 July to 0600 3 August							
8/01								
8/02	No test fishing							
8/03	No test fishing							
8/04		43	85	122	84	55	27	416
8/05		6	32	61	61	43	9	212
8/06		0	Not Fished					

[1] No counts made, there were few boats on 7/18, and 7/19, the number of boats on 7/20 was about 60% of the number on 7/21.
[2] Visibility hampered by fog.

1980 KVICHAK, EGEGIK, AND UGASHIK ESCAPEMENT TEST FISHING

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INTRODUCTION

The escapement test fishing program which began in 1960 was designed to provide an early indication of spawning escapement for management decisions. Since the Bristol Bay sockeye salmon escapement can not be enumerated at a counting tower until 3 to 15 days after passing through the commercial fishery, and about 80% of the salmon run occurs within a 2-week period, an early estimate of escapement is necessary for timely management decisions.

To be successful, a test fishery must: (1) forecast the escapement accurately, and (2) provide this information as soon as possible after the fish pass through the commercial fishing district. The difficulty in estimating escapements with test fish projects is the extreme variability in tower counts per test fish index values between years. Some of the variance in tower count per index values can be accounted for by considering the relative catchability of the fish as measured by their average weight and length. This relationship along with an entry pattern model which utilizes lag time (the time it takes for fish to pass from the test fishery to the counting tower) was used to forecast tower counts from test fishing indices.

METHODS AND MATERIALS

Test Fishing

Test fishing was conducted in the river mouths, usually immediately upstream from the commercial fishing district boundaries (Figure 1). Each tide was fished for 30 minutes or less with 25 to 50 fm of 137 mm (5-3/8 inch) stretch mesh gillnet (Appendix Table 1). The objective was to minimize the catch while still obtaining a good estimate of fish passage rates. Fishing began at the start of the floodtide on the Kvichak River, 1-1/2 hours before high slack tide on the Egegik River, and at 1-1/2 hours prior to low slack at the Ugashik River.

Catch per unit of effort data was obtained from each set along with a representative sample of age, weight, length, and sex from the catch. Sampling was also done on the commercial catch at its point of landing and on the escapement at the counting towers. Unlike test fish and commercial samples which were obtained with gillnets, escapement samples were obtained with a beach seine.

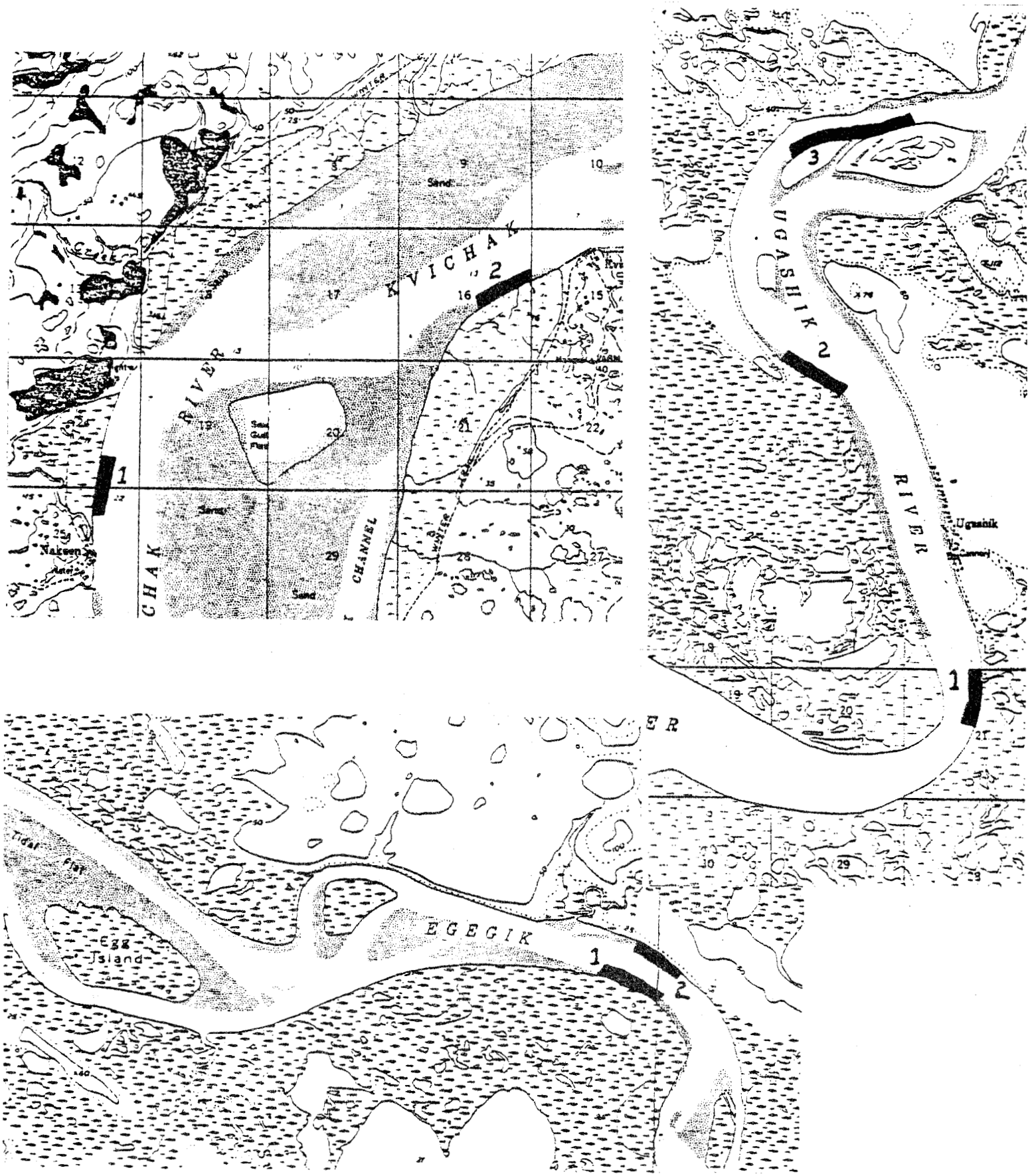

Figure 1. Locations of inside test fishing sites, Kvichak, Egegik, Ugashik Rivers, 1980.

Tagging Studies

Tagging of sockeye salmon occurred at each test fish site. The purpose was to determine: (1) lag time between the test fish site and the counting tower, and (2) the degree of flushing down river and straying between river systems. Capture of the fish for tagging was accomplished with gillnet on the Kvichak River (2 July) and beach seine on the Egegik (8 July) and Ugashik (12 July) Rivers. A 0.6 meter piece of surveyors tape was inserted just under the skin and behind the dorsal fin and tied on each tagged fish. A unique color was used for each tagging project. On the Kvichak River 120 yellow tags were deployed with 113 white and 160 yellow and black tags deployed on the Egegik and Ugashik Rivers, respectively.

Escapement Estimates

Daily escapement estimates were made from the test fisheries located on the Kvichak and Egegik Rivers using: (1) a relationship between tower count per test fish index point and mean length of the fish, and (2) using lag time to compare tower counts to test fish index points. This latter method was the only one used for the Ugashik project.

The daily test fish index was calculated as follows:

$$I = \frac{6000\ (C)}{(F)(T)}$$

Where C = catch
F = fathoms of net
T = total time fished in minutes with F fathoms of net
6000 = constant to convert indices into catch per 100 fathom - hours (60 minutes x 100 fathoms)

The relationship between fish length and catchability was determined from historic data (Appendix Table 2) with a power regression curve:

$$Y = ax^b$$

Where Y = tower count/test fish index point

x = mean length of fish (mm)

a,b are constants

Escapement estimates were made by multiplying the cumulative test fish indices by the expected tower count per index point calculated from the cumulative mean length of fish caught. Lengths used for in-season forecasting were from the fish caught by the individual test fish project.

The second forecast procedure was based solely on lag time. Lag time was determined: (1) by matching cumulative test fish curves with cumulative escapement curves, and (2) from tagging data. After lag time was determined, the actual cumulative escapement was compared with the associated cumulative test fish indices to generate another count per index value.

RESULTS

Kvichak River

Test fishing began 19 June and continued to 9 July 1980 when the project was terminated prematurely because of the achievement of escapement requirements and problems with the test fish boat. At the end of the project, 2,345 fish had been caught resulting in 95,168.05 index points (Table 1). See Appendix Table 1 for individual sets and stations. The mean sockeye length was 514.50 mm and the mean weight was 2.20 kg. This lead to an estimated 373.14 salmon passing per index point based on mean length and an estimated escapement at the time of project termination of 35,511,064 fish. Actual tower counts, 4 days after the termination of the test fish project, was 20,268,084. This resulted in an overestimation of 75% using the catchability model. Lag time between the test fishing site and the counting tower was variable, increasing as the run progressed (Figure 2). Lag time based on curve matching was 4 days. Lag time based on tagging ranged from 85 to 174 hours and averaged 130 hours or about 5-1/2 days. This is slightly higher than the curve matching estimate of lag time but could be possibly explained by the use of a gill net to capture the fish tagged. The estimated escapement based on a 4 day lag time was 20,409,869 compared to the actual escapement of 4 days later of 20,268,084, or an overestimation of 1%. The final escapement was 22,505,268 on 24 July.

Egegik River

Test fishing began 18 June and continued to 16 July. This was the second season that the new upriver site was used. At the end of the season 904 fish had been caught, resulting in 8,335.64 index points (Table 1). The mean sockeye length was 524.60 mm and the mean weight was 2.19 kg. This lead to an estimated 123 salmon passing per index point based on mean length and an estimated escapement of 1,021,438 fish. The actual final tower count was 1,060,860. This resulted in an underestimate of 4% using the catchability model. Lag time between the test fishing site and the counting tower was variable, decreasing as the run progressed (Figure 2). Lag time based on curve matching was 2 days. Lag time based on tagging ranged from 19 to 46 hours with a mean of 24 hours or 1 day. Some minimal straying was observed when two fish were sited at Ugashik tower 8 days after tagging. The estimated escapement based on a 2 day lag time was 1,077,984 fish compared to the actual final escapement of 1,060,860 fish, or an overestimation of 2%.

Ugashik River

Test fishing began 23 June and ended 18 July. At the termination of test fishing 1,710 sockeye salmon had been caught resulting in 76,375.09 index points (Table 1). The mean sockeye salmon length was 520.5 mm and the mean weight was 2.30 kg. No relationship could be determined for the number of fish passing per index value based on mean fish size and therefore no forecast of escapement using this technique was possible. Lag time between the test fishing site and the counting tower was variable, increasing as the run progressed (Figure 2). Lag time based on curve matching was 3 days. Lag time based on tagging ranged from 44 to 221 hours with mean of 107 hours or about

Table 1. Test fish daily and accumulative index values, weight (kg) and length (mm) statistics summarized by day for the Kvichak, Egegik, and Ugashik Rivers, 1980.

Kvichak River

Date	Fishing Time	Catch	Daily Index	Accum. Index	Mean wt.	Mean ln.
6 19	61.00	1	1.97	1.97	1.88	488.00
6 20	24.00	32	160.00	161.97	2.41	533.50
6 21	67.50	5	8.90	170.86	2.41	546.00
6 22	76.50	1	1.57	172.43	2.40	536.00
6 23	115.50	0	0.	172.43	0.	0.
6 24	78.50	3	4.60	177.03	2.25	537.70
6 25	111.50	11	11.80	188.84	2.34	533.90
6 26	13.00	250	3076.92	3265.76	2.27	517.71
6 27	4.50	97	5173.33	8439.09	2.49	511.58
6 28	5.50	81	3534.53	11973.63	2.15	519.46
6 29	8.00	217	6510.19	18483.82	2.24	508.45
6 30	7.00	214	7337.14	25820.96	2.34	511.12
7 1	4.50	166	8853.33	34674.30	2.33	510.20
7 2	4.50	270	14400.00	49074.30	2.16	515.19
7 3	4.00	249	14940.00	64014.30	2.25	514.93
7 4	4.50	157	8373.33	72387.63	2.14	510.23
7 5	4.50	70	3733.33	76120.96	2.30	512.03
7 6	4.25	201	11350.59	87471.53	2.11	516.59
7 7	4.50	125	6666.67	94138.22	2.35	526.88
7 8	27.17	122	580.84	94719.05	2.22	515.23
7 9	19.50	73	449.00	95168.05	2.01	504.58
Total		2345	95168.05			
Mean					2.20	514.50

-continued-

Table 1. Test fish daily and accumulative index values, weight (kg) and length (mm) statistics summarized by day for the Kvichak, Egegik, and Ugashik Rivers, 1980 (continued).

Egegik River

Date	Fishing Time	Catch	Daily Index	Accum. Index	Mean wt.	Mean ln.
6 18	51.49	1	4.66	4.66	2.25	523.00
6 19	91.00	4	10.55	15.21	2.65	532.00
6 20	84.50	7	19.88	35.09	2.34	530.96
6 21	103.50	7	16.23	51.32	2.38	526.12
6 22	101.50	9	21.28	72.61	1.94	504.97
6 23	72.00	4	13.33	85.94	2.10	518.97
6 24	51.75	0	0.	85.94	0.	0.
6 25	79.25	1	3.03	88.97	2.80	583.00
6 26	84.00	1	2.86	91.82	2.55	542.00
6 27	67.50	4	14.22	106.05	1.94	496.00
6 28	76.02	4	12.63	118.68	2.07	512.64
6 29	76.75	13	40.65	159.33	2.21	546.46
6 30	83.75	5	14.33	173.66	2.52	533.60
7 1	40.50	58	343.70	517.36	2.29	533.44
7 2	53.50	40	179.44	696.80	2.05	520.67
7 3	46.00	29	151.30	848.10	2.41	537.35
7 4	12.50	135	2592.00	3440.10	2.18	523.63
7 5	34.00	47	331.76	3771.87	2.22	513.73
7 6	50.00	21	100.78	3872.65	2.12	524.43
7 7	26.00	64	590.77	4463.42	2.40	537.02
7 8	36.50	47	309.04	4772.46	2.11	513.76
7 9	19.25	35	436.36	5208.82	2.70	549.22
7 10	17.75	41	554.36	5763.18	2.45	525.15
7 11	20.00	67	804.00	6567.18	2.12	521.20
7 12	28.00	84	720.00	7287.18	2.44	525.46
7 13	35.00	54	370.29	7657.47	1.91	504.03
7 14	39.00	58	356.92	8014.39	2.09	533.93
7 15	46.00	54	281.74	8296.13	2.17	525.85
7 16	60.75	10	39.51	8335.64	2.47	530.07
Total		904	8335.64			
Mean					2.19	524.60

-continued-

Table 1. Test fish daily and accumulative index values, weight (kg) and length (mm) statistics summarized by day for the Kvichak, Egegik, and Ugashik Rivers, 1980 (continued).

Ugashik River

Date	Fishing Time	Catch	Daily Index	Accum. Index	Mean wt.	Mean ln.
6 23	32.50	5	36.92	36.92	2.48	540.60
6 24	39.50	5	30.38	67.30	2.24	516.00
6 25	46.75	3	15.40	82.70	2.24	523.67
6 26	53.00	11	49.81	132.51	2.21	522.40
6 27	58.60	17	69.63	202.44	2.41	528.86
6 28	52.00	15	69.23	271.67	2.13	513.60
6 29	42.05	13	74.19	345.86	2.39	535.93
6 30	52.25	7	32.15	378.01	2.55	548.62
7 1	48.40	8	39.67	417.68	2.06	520.74
7 2	43.20	5	27.78	445.46	2.34	530.67
7 3	45.45	21	110.89	556.35	2.63	528.50
7 4	27.75	18	165.36	721.71	2.43	532.28
7 5	39.10	44	270.07	991.78	2.17	521.02
7 6	33.00	59	429.08	1420.86	2.30	522.53
7 7	39.25	56	342.42	1763.28	2.24	523.28
7 8	29.00	61	504.82	2268.10	2.45	522.70
7 9	14.63	94	1542.02	3810.12	2.16	509.66
7 10	25.13	64	592.14	4402.26	2.61	515.54
7 11	16.63	75	1082.39	5484.65	2.46	525.36
7 12	6.01	149	5950.04	11434.69	2.26	516.70
7 13	3.85	232	14397.39	25832.08	2.34	520.10
7 14	3.38	218	15479.28	41311.36	2.41	519.56
7 15	3.00	212	16960.00	58271.36	2.31	516.77
7 16	3.50	189	12960.00	71231.36	2.43	518.15
7 17	4.38	73	4000.20	75231.56	2.64	521.94
7 18	11.75	56	1143.53	76375.09	2.63	530.34
Total		1710	76375.09			
Mean					2.30	520.5

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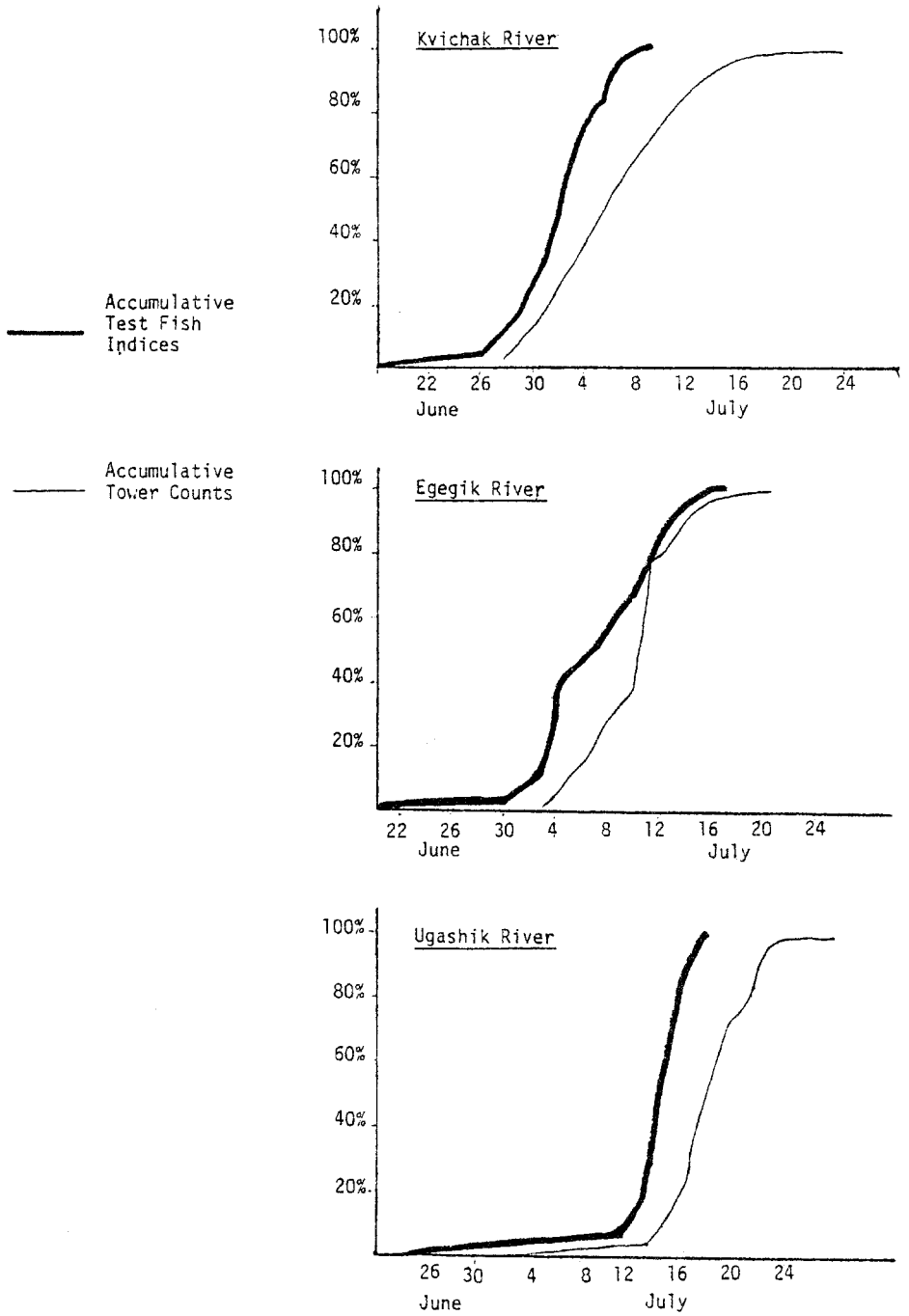

Figure 2. Accumulative test fishing indices and tower counts by 4-day periods, 1980.

4-1/2 days. The estimated escapement based on a 3 day lag time was 2,790,768 compared to the final escapement of 3,321,384 or an underestimation of 16%.

Age-Weight-Length Composition

Comparisons of age class structure and physical fish size were made between samples from each of the three test fisheries and from samples taken from the associated commercial catch and escapement. Age composition for each of the test fisheries was between the values obtained for the commercial catch and escapement (Table 2). This was also observed for fish size in the 2-ocean component (ages 4_2, 5_3). Without exception, both weight (Table 3) and length (Table 4) were largest in the commercial catch and smallest in the escapement. For the larger 3-ocean sockeye (ages 5_2, 6_3) sizes were mixed. These results are attributed to fish size and gear selectivity and illustrate the importance of sampling fish from the test fishery as opposed to using data from either the tower escapement samples or commercial catch samples when determining catchability from fish lengths. See Appendix Table 2 for historical mean weights, lengths, and return per index values.

Table 2. Age class and sex composition of sockeye salmon from the Kvichak, Egegik, and Ugashik River systems, 1980.

	n	4_2(%)	5_2(%)	5_3(%)	6_3(%)	Male (%)	Female (%)
Kvichak							
Test fish	1,803	13	6	79	2	46	54
Escapement	2,325	13	3	82	2	48	52
Comm. Catch [1]	1,991	16	11	69	5	49	51
Egegik							
Test fish	754	15	7	60	14	45	55
Escapement	1,153	14	2	64	10	43	57
Comm. Catch	1,292	17	8	60	13	55	45
Ugashik							
Test fish	850	62	11	26	1	63	37
Escapement	1,748	48	14	33	1	51	49
Comm. Catch	892	47	12	36	5	56	44

[1] Taken from commercial catch samples from the Naknek-Kvichak district.

Table 3. Mean weight (kg) comparisons of the major age classes of sockeye salmon from the Kvichak, Egegik, and Ugashik River systems, 1980.

	n	4_2	5_2	5_3	6_3	Total
Kvichak						
Test fish	281	2.05	2.64	2.19	2.79	2.20
Commercial Catch [1]	289	2.32	3.15	2.32	2.94	2.45
Egegik						
Test fish	253	1.91	2.92	2.08	2.97	2.19
Commercial Catch	119	2.26	2.83	2.29	2.88	2.41
Ugashik						
Test fish	309	2.19	3.14	2.21	3.08	2.30
Commercial Catch	86	2.33	2.96	2.47	3.02	2.46

[1] Taken from commercial catch samples from the Naknek-Kvichak district.

Table 4 . Mean length (mm) comparisons of the major age classes of sockeye salmon from the Kvichak, Egegik, and Ugashik River systems, 1980.

	n	4_2	5_2	5_3	6_3	Total
Kvichak						
Test Fish	1,803	506.2	563.4	511.0	572.3	514.6
Escapement	2,325	498.5	575.9	507.0	566.7	508.2
Commercial Catch[1]	1,991	514.6	574.1	522.6	568.2	528.7
Test fish Male	836	514.2	581.0	518.0	582.2	521.5
Test fish Female	967	499.5	551.8	504.8	567.2	508.6
Egegik						
Test fish	754	502.6	565.7	515.5	575.9	524.6
Escapement	1,153	501.8	574.9	509.5	580.4	510.6
Commercial Catch	1,292	519.4	571.4	527.0	577.8	535.6
Test fish Male	338	512.4	580.4	525.1	584.7	534.4
Test fish Female	416	494.1	551.0	508.2	568.4	516.7
Ugashik						
Test fish	850	512.0	570.3	518.2	593.8	520.5
Escapement	1,748	511.2	584.5	517.4	581.1	521.8
Commercial Catch	892	522.9	579.8	529.1	580.6	535.0
Test fish Male	537	515.9	585.3	525.7	603.4	523.7
Test fish Female	313	502.9	558.5	509.0	577.0	515.0

[1] Taken from commercial catch samples from the Naknek-Kvichak district.

Appendix Table 1. Test fish sockeye catch, mean fishing time, index, mean weight (kg), mean length (mm) by set and river system, 1980.

AREA IDENT.	YR	MO	DY	SET NO.	STATION IDENT.	GEAR LENGTH (FMS)	MEAN FISHING TIME (MIN)	SOCKEYE CATCH	TEST FISHING INDEX (DAILY)	MEAN WT	MEAN LN	TIDE
05KVICHAK	80	6	19	1	2	50	31.00	0	0.	0.	0.	4
05KVICHAK	80	6	19	2	2	50	30.00	1	4.0	1.88	488.00	4
05KVICHAK	80	6	20	3	2	50	24.00	32	160.0	2.41	533.50	4
05KVICHAK	80	6	21	4	2	50	19.50	5	30.8	2.41	546.00	4
05KVICHAK	80	6	21	5	2	50	24.00	0	0.	0.	0.	4
05KVICHAK	80	6	21	6	2	50	24.00	0	0.	0.	0.	4
05KVICHAK	80	6	22	7	1	50	25.00	1	4.8	2.40	536.00	4
05KVICHAK	80	6	22	8	2	50	21.00	0	0.	0.	0.	4
05KVICHAK	80	6	22	9	2	50	30.50	0	0.	0.	0.	4
05KVICHAK	80	6	23	10	1	50	32.00	0	0.	0.	0.	4
05KVICHAK	80	6	23	11	2	50	28.50	0	0.	0.	0.	4
05KVICHAK	80	6	23	12	1	50	27.00	0	0.	0.	0.	4
05KVICHAK	80	6	23	13	2	50	28.00	0	0.	0.	0.	4
05KVICHAK	80	6	24	14	1	50	28.00	0	0.	0.	0.	4
05KVICHAK	80	6	24	15	2	50	27.50	0	0.	0.	0.	4
05KVICHAK	80	6	24	16	2	50	23.00	3	15.7	2.25	537.70	4
05KVICHAK	80	6	25	17	1	50	30.50	2	7.8	2.19	530.00	4
05KVICHAK	80	6	25	18	2	50	28.50	0	0.	0.	0.	4
05KVICHAK	80	6	25	19	1	50	24.00	3	15.0	2.24	521.30	4
05KVICHAK	80	6	25	20	2	50	28.50	6	25.2	2.45	542.60	4
05KVICHAK	80	6	26	21	1	25	4.00	102	6120.0	2.21	514.50	4
05KVICHAK	80	6	26	22	2	50	6.50	44	812.3	2.36	533.80	4
05KVICHAK	80	6	26	23	1	25	1.50	68	10880.0	2.36	517.60	4
05KVICHAK	80	6	26	24	2	25	1.00	36	8640.0	2.18	518.60	4
05KVICHAK	80	6	27	25	1	25	1.50	29	4640.0	2.61	514.30	4
05KVICHAK	80	6	27	26	2	25	1.50	18	2880.0	2.43	496.60	4
05KVICHAK	80	6	27	27	1	25	1.50	50	8000.0	2.45	515.40	4
05KVICHAK	80	6	28	28	2	25	1.50	17	2720.0	2.00	550.80	4
05KVICHAK	80	6	28	29	1	25	1.00	44	10560.0	2.21	511.80	4
05KVICHAK	80	6	28	30	2	25	3.00	20	1600.0	1.97	516.70	4
05KVICHAK	80	6	29	31	1	25	1.00	52	12480.0	2.30	517.30	4
05KVICHAK	80	6	29	32	2	25	4.50	32	1707.0	2.21	514.30	4
05KVICHAK	80	6	29	33	1	25	1.00	49	11760.0	2.26	517.70	4
05KVICHAK	80	6	29	34	2	25	1.50	84	13440.0	2.17	491.40	4
05KVICHAK	80	6	30	35	1	25	1.50	38	6080.0	2.33	517.90	4
05KVICHAK	80	6	30	36	2	25	1.00	29	6960.0	2.12	503.30	4
05KVICHAK	80	6	30	37	1	25	2.00	69	8280.0	2.25	513.00	4
05KVICHAK	80	6	30	38	2	25	2.50	78	7488.0	2.66	510.80	4
05KVICHAK	80	7	1	39	1	25	1.50	50	8000.0	2.34	508.90	4
05KVICHAK	80	7	1	40	2	25	1.00	36	8640.0	2.38	512.40	4
05KVICHAK	80	7	1	41	1	25	1.00	37	8880.0	2.40	513.30	4
05KVICHAK	80	7	1	42	2	25	1.00	43	10320.0	2.22	506.70	4
05KVICHAK	80	7	2	43	1	25	1.00	84	20160.0	0.	0.	4
05KVICHAK	80	7	2	44	2	25	1.00	30	7200.0	2.47	521.60	4
05KVICHAK	80	7	2	45	1	25	1.25	117	22464.0	2.14	511.70	4
05KVICHAK	80	7	2	46	2	25	1.25	39	7488.0	1.92	519.50	4
05KVICHAK	80	7	3	47	1	25	1.00	62	14880.0	2.37	518.20	4
05KVICHAK	80	7	3	48	2	25	1.00	32	7680.0	2.19	515.50	4

-continued-

Appendix Table 1. Test fish sockeye catch, mean fishing time, index, mean weight (kg), mean length (mm) by set and river system, 1980 (continued).

AREA IDENT.	YR	MO	DY	SET NO.	STATION IDENT.	GEAR LENGTH (FMS)	MEAN FISHING TIME (MIN)	SOCKEYE CATCH	TEST FISHING INDEX (DAILY)	MEAN WT	MEAN LN	TIDE
05KVICHAK	80	7	3	49	1	25	1.00	53	12720.0	2.07	521.60	4
05KVICHAK	80	7	3	50	2	25	1.00	102	24480.0	2.30	509.30	4
05KVICHAK	80	7	4	51	1	25	1.00	85	20400.0	2.06	510.60	4
05KVICHAK	80	7	4	52	2	25	1.00	30	7200.0	2.51	514.40	4
05KVICHAK	80	7	4	53	1	25	1.50	18	2880.0	2.30	519.20	4
05KVICHAK	80	7	4	54	2	25	1.00	24	5760.0	1.85	499.20	4
05KVICHAK	80	7	5	55	1	25	1.00	31	7440.0	2.24	511.90	4
05KVICHAK	80	7	5	56	2	25	1.00	11	2640.0	2.26	514.10	4
05KVICHAK	80	7	5	57	1	25	1.00	21	5040.0	2.48	512.80	4
05KVICHAK	80	7	5	58	2	25	1.50	7	1120.0	2.01	504.50	4
05KVICHAK	80	7	6	59	1	25	1.00	61	14640.0	2.23	517.90	4
05KVICHAK	80	7	6	60	2	25	1.25	37	7104.0	2.15	511.00	4
05KVICHAK	80	7	6	61	1	25	1.00	64	15360.0	2.04	512.30	4
05KVICHAK	80	7	6	62	2	25	1.00	39	9360.0	2.00	525.80	4
05KVICHAK	80	7	7	63	1	25	1.00	48	11520.0	2.33	524.10	4
05KVICHAK	80	7	7	64	2	25	1.00	12	2880.0	2.13	518.60	4
05KVICHAK	80	7	7	65	1	25	1.50	38	6080.0	2.33	535.20	4
05KVICHAK	80	7	7	66	2	25	1.00	27	6480.0	2.51	527.70	4
05KVICHAK	80	7	8	67	1	25	1.30	27	5169.0	2.26	516.40	4
05KVICHAK	80	7	8	68	2	25	2.25	28	2986.0	2.21	515.00	4
05KVICHAK	80	7	8	69	1	50	9.12	48	631.0	2.01	507.60	4
05KVICHAK	80	7	8	70	2	50	14.50	19	157.0	1.69	511.80	4
05KVICHAK	80	7	9	71	1	50	9.00	19	253.0	2.05	511.10	4
05KVICHAK	80	7	9	72	2	50	10.50	54	617.0	1.99	501.90	4

-continued-

Appendix Table 1. Test fish sockeye catch, mean fishing time, index, mean weight (kg), mean length (mm) by set and river system, 1980 (continued).

AREA IDENT.	YR	MO	DY	SET NO.	STATION IDENT.	GEAR LENGTH (FMS)	MEAN FISHING TIME (MIN)	SOCKEYE CATCH	TEST FISHING INDEX (DAILY)	MEAN WT	MEAN LN	TIDE
05EGEGIK	80	6	18	1	1	25	27.25	0	0.	0.	0.	4
05EGEGIK	80	6	18	2	2	25	24.24	1	9.9	2.25	523.00	4
05EGEGIK	80	6	19	3	1	25	18.25	0	0.	0.	0.	4
05EGEGIK	80	6	19	4	2	25	26.25	4	36.6	2.65	552.00	4
05EGEGIK	80	6	19	5	1	25	28.25	0	0.	0.	0.	4
05EGEGIK	80	6	19	6	2	25	18.25	0	0.	0.	0.	4
05EGEGIK	80	6	20	7	1	25	16.25	0	0.	0.	0.	4
05EGEGIK	80	6	20	8	2	25	22.25	6	64.7	2.20	519.00	4
05EGEGIK	80	6	20	9	1	25	20.25	0	0.	0.	0.	4
05EGEGIK	80	6	20	10	2	25	25.75	1	9.3	3.30	614.00	4
05EGEGIK	80	6	21	11	1	25	21.75	2	22.1	1.82	478.00	4
05EGEGIK	80	6	21	12	2	25	29.25	5	41.0	2.68	552.00	4
05EGEGIK	80	6	21	13	1	25	21.25	0	0.	0.	0.	4
05EGEGIK	90	6	21	14	2	25	31.25	0	0.	0.	0.	4
05EGEGIK	80	6	22	15	1	25	26.25	0	0.	0.	0.	4
05EGEGIK	80	6	22	16	2	25	25.25	2	19.0	1.93	515.00	4
05EGEGIK	80	6	22	17	1	25	23.75	5	50.5	1.97	503.00	4
05EGEGIK	80	6	22	18	2	25	26.25	2	18.3	1.87	500.00	4
05EGGGIK	80	6	23	19	1	25	25.75	3	28.0	2.23	527.00	4
05EGEGIK	80	6	23	20	2	25	27.75	1	8.6	1.68	493.00	4
05EGEGIK	80	6	23	21	1	25	14.25	0	0.	0.	0.	4
05EGEGIK	80	6	23	22	2	25	4.25	0	0.	0.	0.	4
05EGEGIK	80	6	24	23	1	25	16.25	0	0.	0.	0.	4
05EGEGIK	80	6	24	24	2	25	15.25	0	0.	0.	0.	4
05EGEGIK	80	6	24	25	1	25	20.25	0	0.	0.	0.	4
05EGEGIK	80	6	25	26	2	25	25.75	0	0.	0.	0.	4
05EGEGIK	80	6	25	27	1	25	27.25	1	8.8	2.80	583.00	4
05EGEGIK	80	6	25	28	2	25	26.25	0	0.	0.	0.	4
05EGEGIK	80	6	26	29	1	25	14.25	0	0.	0.	0.	4
05EGEGIK	80	6	26	30	2	25	11.25	1	21.3	2.55	542.00	4
05EGEGIK	80	6	26	31	1	25	25.25	0	0.	0.	0.	4
05EGEGIK	80	6	26	32	2	25	33.25	0	0.	0.	0.	4
05EGEGIK	80	6	27	33	1	25	12.75	0	0.	0.	0.	4
05EGEGIK	80	6	27	34	2	25	21.25	4	45.2	1.94	496.00	4
05EGEGIK	80	6	27	35	1	25	20.25	0	0.	0.	0.	4
05EGEGIK	80	6	27	36	2	25	13.25	0	0.	0.	0.	4
05EGEGIK	80	6	28	37	1	25	19.25	2	24.9	1.89	492.50	4
05EGEGIK	80	6	28	38	2	25	18.50	2	26.0	2.25	532.00	4
05EGEGIK	80	6	28	39	1	25	17.12	0	0.	0.	0.	4
05EGEGIK	80	6	28	40	2	25	21.15	0	0.	0.	0.	4
05EGEGIK	80	6	29	41	1	25	17.75	0	0.	0.	0.	4
05EGEGIK	80	6	29	42	2	25	15.75	11	167.6	2.21	552.60	4
05EGEGIK	80	6	29	43	1	25	20.75	2	23.1	2.19	502.00	4
05EGEGIK	80	6	29	44	2	25	22.50	0	0.	0.	0.	4
05EGEGIK	80	6	30	45	1	25	16.50	0	0.	0.	0.	4
05EGEGIK	80	6	30	46	2	25	15.75	4	60.9	2.60	536.50	4
05EGEGIK	80	6	30	47	1	25	25.25	1	9.5	1.98	515.00	4
05EGEGIK	80	6	30	48	2	25	26.25	0	0.	0.	0.	4

-continued-

Appendix Table 1. Test fish sockeye catch, mean fishing time, index, mean weight (kg), mean length (mm) by set and river system, 1980 (continued).

AREA IDENT.	YR	MO	DY	SET NO.	STATION IDENT.	GEAR LENGTH (FMS)	MEAN FISHING TIME (MIN)	SOCKEYE CATCH	TEST FISHING INDEX (DAILY)	MEAN WT	MEAN LN	TIDE
05EGEGIK	80	7	1	49	1	25	11.25	1	21.3	3.70	590.00	4
05EGEGIK	80	7	1	50	2	25	11.75	1	20.4	1.55	487.00	4
05EGEGIK	80	7	1	51	1	25	10.25	13	304.4	2.11	530.00	4
05EGEGIK	80	7	1	52	2	25	7.25	43	1423.4	2.32	534.00	4
05EGEGIK	80	7	2	53	1	25	11.25	1	21.3	2.20	512.00	4
05EGEGIK	80	7	2	54	2	25	12.75	32	602.3	2.03	520.00	4
05EGEGIK	80	7	2	55	1	25	11.25	6	128.0	2.06	523.00	4
05EGEGIK	80	7	2	56	2	25	18.25	1	13.1	2.43	543.00	4
05EGEGIK	80	7	3	57	1	25	11.25	5	106.7	2.05	515.00	4
05EGEGIK	80	7	3	58	2	25	10.25	18	421.5	2.56	546.00	4
05EGEGIK	80	7	3	59	1	25	11.25	3	64.0	2.12	523.00	4
05EGEGIK	80	7	3	60	2	25	13.25	3	54.3	2.31	531.00	4
05EGEGIK	80	7	4	61	1	25	6.25	12	460.8	2.15	524.00	4
05EGEGIK	80	7	4	62	2	25	3.25	62	4578.5	2.39	521.00	4
05EGEGIK	80	7	4	63	1	25	2.25	17	1813.3	1.77	504.00	4
05EGEGIK	80	7	4	64	2	25	0.75	44	14080.0	2.16	527.00	4
05EGEGIK	80	7	5	65	1	25	6.25	7	268.8	2.40	510.00	4
05EGEGIK	80	7	5	66	2	25	4.25	35	1976.5	2.21	514.00	4
05EGEGIK	80	7	5	67	1	25	10.25	2	46.8	1.84	512.00	4
05EGEGIK	80	7	5	68	2	25	13.25	3	54.3	2.06	524.00	4
05EGEGIK	80	7	6	69	1	25	15.25	9	141.6	2.12	523.00	4
05EGEGIK	80	7	6	70	2	25	8.25	8	232.7	2.01	520.00	4
05EGEGIK	80	7	6	71	1	25	12.25	1	19.5	3.60	594.00	4
05EGEGIK	80	7	6	72	2	25	14.25	3	50.5	2.09	522.00	4
05EGEGIK	80	7	7	73	1	25	3.25	28	2067.7	2.39	542.00	4
05EGEGIK	80	7	7	74	2	25	6.25	20	768.0	2.56	535.00	4
05EGEGIK	80	7	7	75	1	25	6.25	9	345.6	2.11	515.00	4
05EGEGIK	80	7	7	76	2	25	10.25	7	163.9	2.32	530.00	4
05EGEGIK	80	7	8	77	1	25	4.50	21	1120.0	2.13	510.00	4
05EGEGIK	80	7	8	78	2	25	8.00	11	330.0	1.97	522.00	4
05EGEGIK	80	7	8	79	1	25	11.25	9	192.0	2.20	519.00	4
05EGEGIK	80	7	8	80	2	25	12.75	6	112.9	2.23	518.00	4
05EGEGIK	80	7	9	81	1	25	3.25	11	812.3	2.60	552.00	4
05EGEGIK	80	7	9	82	2	25	4.25	22	1242.4	2.79	550.00	4
05EGEGIK	80	7	9	83	1	25	11.75	2	40.8	1.70	470.00	4
05EGEGIK	80	7	10	84	2	25	12.25	7	137.1	2.75	552.00	4
05EGEGIK	80	7	10	85	1	25	2.25	17	1813.3	2.35	526.00	4
05EGEGIK	80	7	10	86	2	25	3.25	17	1255.4	2.57	521.00	4
05EGEGIK	80	7	11	87	1	25	8.25	15	436.4	2.15	516.00	4
05EGEGIK	80	7	11	88	2	25	4.25	28	1581.2	2.46	514.00	4
05EGEGIK	80	7	11	89	1	25	5.25	7	320.0	2.63	531.00	4
05EGEGIK	80	7	11	90	2	25	2.25	17	1813.3	1.72	527.00	4
05EGEGIK	80	7	12	91	1	25	6.25	15	576.0	2.16	529.00	4
05EGEGIK	80	7	12	92	2	25	4.25	45	2541.2	2.67	534.00	4
05EGEGIK	80	7	12	93	1	25	3.25	15	1107.7	2.07	503.00	4
05EGEGIK	80	7	12	94	2	25	14.25	9	151.6	2.43	533.00	4
05EGEGIK	80	7	13	95	1	25	10.25	11	257.6	1.85	515.00	4
05EGEGIK	80	7	13	96	2	25	9.25	18	467.0	1.91	505.00	4

-continued-

Appendix Table 1. Test fish sockeye catch, mean fishing time, index, mean weight (kg), mean length (mm) by set and river system, 1980 (continued).

AREA IDENT.	YR	MO	DY	SET NO.	STATION IDENT.	GEAR LENGTH (FMS)	MEAN FISHING TIME (MIN)	SOCKEYE CATCH	TEST FISHING INDEX (DAILY)	MEAN WT	MEAN LN	TIDE
05EGEGIK	80	7	13	97	1	25	2.25	13	1386.7	1.94	499.00	4
05EGEGIK	80	7	13	98	2	25	13.25	12	217.4	1.74	521.00	4
05EGEGIK	80	7	14	99	1	25	5.25	6	274.3	2.23	537.00	4
05EGEGIK	80	7	14	100	2	25	11.25	28	597.3	1.85	527.00	4
05EGEGIK	80	7	14	101	1	25	10.25	12	281.0	1.78	523.00	4
05EGEGIK	80	7	14	102	2	25	12.25	12	235.1	2.91	561.00	4
05EGEGIK	80	7	15	103	1	25	8.25	6	174.5	2.14	512.00	4
05EGEGIK	80	7	15	104	2	25	9.25	8	207.6	1.95	507.00	4
05EGEGIK	80	7	15	105	1	25	11.25	12	256.0	2.17	526.00	4
05EGEGIK	80	7	15	106	2	25	17.25	28	389.6	2.29	542.00	4
05EGEGIK	80	7	16	107	1	25	22.25	3	32.4	2.03	518.00	4
05EGEGIK	80	7	16	108	2	25	16.25	2	29.5	1.71	496.00	4
05EGEGIK	80	7	16	109	1	25	8.25	4	116.4	2.80	544.00	4
05EGEGIK	80	7	16	110	2	25	14.00	1	17.1	2.32	517.00	4

-continued-

Appendix Table 1. Test fish sockeye catch, mean fishing time, index, mean weight (kg), mean length (mm) by set and river system, 1980 (continued).

AREA IDENT.	YR	MO	DY	SET NO.	STATION IDENT.	GEAR LENGTH (FMS)	MEAN FISHING TIME (MIN)	SOCKEYE CATCH	TEST FISHING INDEX (DAILY)	MEAN WT	MEAN LN	TIDE
05UGASHIK	80	6	23	1	1	25	5.00	1	48.0	2.65	535.00	3
05UGASHIK	80	6	23	2	3	25	10.75	2	44.7	2.63	535.00	3
05UGASHIK	80	6	23	3	1	25	6.00	0	0.	0.	0.	3
05UGASHIK	80	6	23	4	3	25	10.75	2	44.7	2.25	549.00	3
05UGASHIK	80	6	24	5	1	25	11.25	4	93.7	2.17	512.00	3
05UGASHIK	80	6	24	6	3	25	8.00	0	0.	0.	0.	3
05UGASHIK	80	6	24	7	1	25	7.25	1	17.1	2.52	532.00	3
05UGASHIK	80	6	24	8	3	25	13.00	0	0.	0.	0.	3
05UGASHIK	80	6	25	9	1	25	11.50	0	0.	0.	0.	3
05UGASHIK	80	6	25	10	3	25	11.00	0	0.	0.	0.	3
05UGASHIK	80	6	25	11	1	25	7.50	1	32.0	2.20	518.00	3
05UGASHIK	80	6	25	12	3	25	16.75	2	28.7	2.28	530.00	3
05UGASHIK	80	6	26	13	1	25	15.25	4	62.9	2.57	541.00	3
05UGASHIK	80	6	26	13	3	25	11.85	0	0.	0.	0.	4
05UGASHIK	80	6	26	15	1	25	10.25	4	93.7	2.12	515.00	3
05UGASHIK	80	6	26	16	3	25	15.65	3	46.0	1.90	512.00	3
05UGASHIK	80	6	27	17	1	25	7.65	3	94.1	2.31	514.00	3
05UGASHIK	80	6	27	18	3	25	18.95	0	0.	0.	0.	3
05UGASHIK	80	6	27	19	1	25	11.50	5	104.4	2.40	530.00	3
05UGASHIK	80	6	27	20	3	25	20.50	9	105.4	2.52	541.00	3
05UGASHIK	80	6	28	21	1	25	13.50	8	142.2	2.27	520.80	3
05UGASHIK	80	6	28	22	3	25	12.50	1	19.2	0.	502.00	3
05UGASHIK	80	6	28	23	1	25	10.75	1	22.3	2.30	527.00	3
05UGASHIK	80	6	28	24	3	25	15.25	5	78.7	1.82	499.60	0
05UGASHIK	80	6	29	25	1	25	6.15	2	78.0	2.52	540.50	3
05UGASHIK	80	6	29	26	3	25	14.00	0	0.	0.	0.	3
05UGASHIK	80	6	29	27	1	25	9.75	10	246.1	2.29	529.10	3
05UGASHIK	80	6	29	28	3	25	12.15	1	19.8	3.12	603.00	3
05UGASHIK	80	6	30	29	1	25	8.75	4	109.7	2.81	559.80	3
05UGASHIK	80	6	30	30	3	25	12.50	0	0.	0.	0.	3
05UGASHIK	80	6	30	31	1	25	15.10	2	31.8	2.09	526.00	3
05UGASHIK	80	6	30	32	3	25	15.90	1	15.1	1.66	515.00	3
05UGASHIK	80	7	1	33	1	25	11.50	3	62.6	2.37	541.00	3
05UGASHIK	80	7	1	34	3	25	11.90	1	20.2	1.66	502.00	3
05UGASHIK	80	7	1	35	1	25	15.50	3	46.4	2.09	521.00	3
05UGASHIK	80	7	1	36	3	25	9.50	1	25.3	1.55	485.00	3
05UGASHIK	80	7	2	37	1	25	14.65	3	49.2	2.57	548.70	3
05UGASHIK	80	7	2	38	3	25	11.40	0	0.	0.	0.	3
05UGASHIK	80	7	2	39	1	25	17.15	2	28.0	1.93	499.00	3
05UGASHIK	80	7	3	40	3	25	13.00	0	0.	0.	0.	3
05UGASHIK	80	7	3	41	1	25	11.25	14	298.7	2.85	539.00	3
05UGASHIK	80	7	3	42	3	25	6.20	0	0.	0.	0.	3
05UGASHIK	80	7	3	43	1	25	15.00	7	112.0	2.04	500.50	3
05UGASHIK	80	7	4	44	3	25	11.00	3	65.4	2.09	521.00	3
05UGASHIK	80	7	4	45	1	25	6.75	14	537.6	2.52	535.00	3
05UGASHIK	80	7	4	46	3	25	10.00	1	24.0	1.44	502.00	3
05UGASHIK	80	7	5	47	1	25	11.60	16	331.0	2.23	513.40	3
05UGASHIK	80	7	5	48	3	25	8.40	4	114.3	2.33	533.00	3

-continued-

Appendix Table 1. Test fish sockeye catch, mean fishing time, index, mean weight (kg), mean length (mm) by set and river system, 1980 (continued).

AREA IDENT.	YR	MO	DY	SET NO.	STATION IDENT.	GEAR LENGTH (FMS)	MEAN FISHING TIME (MIN)	SOCKEYE CATCH	TEST FISHING INDEX (DAILY)	MEAN WT	MEAN LN	TIDE
05UGASHIK	80	7	5	49	1	25	8.60	19	530.2	2.14	526.00	3
05UGASHIK	80	7	5	50	3	25	10.50	5	114.3	1.99	508.00	3
05UGASHIK	80	7	6	51	1	25	8.00	30	900.0	2.30	527.00	3
05UGASHIK	80	7	6	52	3	25	8.50	4	112.9	2.96	543.00	3
05UGASHIK	80	7	6	53	1	25	4.50	19	1013.3	2.28	518.00	3
05UGASHIK	80	7	6	54	3	25	12.00	6	120.0	1.84	508.00	3
05UGASHIK	80	7	7	55	1	25	6.00	12	480.0	2.28	516.00	3
05UGASHIK	80	7	7	56	3	25	16.00	2	30.0	2.21	513.00	3
05UGASHIK	80	7	7	57	1	25	3.00	39	3120.0	2.23	524.00	3
05UGASHIK	80	7	7	58	3	25	14.25	3	50.5	2.34	554.00	3
05UGASHIK	80	7	8	59	1	25	4.00	32	1920.0	2.45	521.00	3
05UGASHIK	80	7	8	60	3	25	13.75	0	0.	0.	0.	3
05UGASHIK	80	7	8	61	1	25	4.75	15	757.9	2.53	535.00	3
05UGASHIK	80	7	8	62	3	25	6.50	14	516.9	2.34	511.00	3
05UGASHIK	80	7	9	63	1	25	2.63	40	3650.0	1.85	505.00	3
05UGASHIK	80	7	9	64	3	25	6.50	11	406.2	1.81	517.00	3
05UGASHIK	80	7	9	65	1	25	2.50	37	3552.0	2.46	511.40	3
05UGASHIK	80	7	9	66	3	25	3.00	6	480.0	2.64	526.00	3
05UGASHIK	80	7	10	67	1	25	2.00	27	3240.0	2.73	514.00	3
05UGASHIK	80	7	10	68	3	25	9.00	10	266.7	2.96	533.80	3
05UGASHIK	80	7	10	69	1	25	7.00	9	240.0	2.39	515.20	3
05UGASHIK	80	7	10	70	3	25	7.13	18	605.9	1.90	515.90	3
05UGASHIK	80	7	11	71	1	25	2.13	27	3042.3	1.85	514.20	3
05UGASHIK	80	7	11	72	3	25	7.50	2	64.0	2.65	560.40	3
05UGASHIK	80	7	11	73	1	25	1.00	34	8160.0	2.71	529.90	3
05UGASHIK	80	7	11	74	3	25	6.00	12	480.0	1.95	514.30	3
05UGASHIK	80	7	12	75	1	25	1.00	63	15120.0	2.33	514.60	3
05UGASHIK	80	7	12	76	3	25	2.63	16	1460.0	2.32	533.60	3
05UGASHIK	80	7	12	77	1	25	0.88	50	13636.3	2.15	515.50	3
05UGASHIK	80	7	12	78	3	25	1.50	20	3200.0	2.33	524.00	3
05UGASHIK	80	7	13	79	1	25	0.84	82	23428.5	2.26	523.70	3
05UGASHIK	80	7	13	80	3	25	1.38	23	4000.0	2.54	525.60	3
05UGASHIK	80	7	13	81	1	25	0.88	71	19363.6	2.50	518.60	3
05UGASHIK	80	7	13	82	3	25	0.75	56	17586.7	2.24	515.70	3
05UGASHIK	80	7	14	83	1	25	0.88	67	18272.7	2.60	518.50	3
05UGASHIK	80	7	14	84	3	25	0.75	48	15360.0	2.35	513.70	3
05UGASHIK	80	7	14	85	1	25	0.75	66	21120.0	2.38	522.40	3
05UGASHIK	80	7	14	86	3	25	1.00	37	8880.0	2.20	525.10	3
05UGASHIK	80	7	15	87	1	25	0.75	71	22720.0	2.39	528.50	3
05UGASHIK	80	7	15	88	3	25	0.75	18	5760.0	2.12	494.30	3
05UGASHIK	80	7	15	89	1	25	0.75	66	21120.0	2.34	509.30	3
05UGASHIK	80	7	15	90	3	25	0.75	57	18240.0	2.23	517.90	3
05UGASHIK	80	7	16	91	1	25	1.00	83	19920.0	2.50	521.80	3
05UGASHIK	80	7	16	92	3	25	0.75	33	10560.0	2.31	523.60	3
05UGASHIK	80	7	16	93	1	25	0.75	28	8960.0	2.38	511.00	3
05UGASHIK	80	7	16	94	3	25	1.00	45	10800.0	2.48	512.00	3
05UGASHIK	80	7	17	95	1	25	0.75	20	6400.0	2.56	525.00	3

Appendix Table 2. Historic data on mean weight, mean length, and return per index values for Kvichak, Egegik, and Ugashik test fisheries.

Kvichak River

YEAR	MEAN WEIGHT (kg) [1]	MEAN LENGTH (mm) [2]	RETURN/INDEX
1969	2.31	516.7	553.3
1970	2.18	497.7	966.4
1971	2.54	536.1	184.9
1972	2.77	540.9	150.4
1973	3.04	538.8	55.1
1974	-	-	-
1975	2.39	508.3	537.8
1976	2.63	529.1	296.6
1977	3.08	534.6	141.3
1978	2.39 [3]	499.1	386.6
1979	2.50 [3]	519.3 [3]	271.6
1980	2.20 [3]	514.6 [3]	214.5

[1] From commercial processors reports.
[2] From tower samples
[3] From inside test fish samples.

$Y = ax^b$

Y = Return/Index
x = mean length (mm)
a = 3.059×10^{63}
b -22.46

-continued-

Appendix Table 2. Historic data on mean weight, mean length, and retrun per index values for Kvichak, Egegik, and Ugashik test fisheries (continued).

Egegik River

YEAR	MEAN WEIGHT (kg)[1]	MEAN LENGTH (mm)[2]	RETURN/INDEX
1969	2.49	537.0	293.5
1970	2.18	492.4	359.9
1971	2.68	560.0	217.6
1972	2.72	530.1	206.0
1973	3.22	587.7	78.2
1974	-	-	-
1975	2.58	557.4	104.6
1976	2.68	542.7	49.6
1977	2.87	567.8	121.8
1978	3.04[3]	571.4	80.4
1979	2.69[3]	546.5[3]	60.6[4]
1980	2.19[3]	524.6[3]	124.9[4]

[1] From commercial processors reports.
[2] From tower samples.
[3] From inside test fish samples.
[4] Return/index value for 1979 and 1980 are not comparable with those of prior years due to relocation of test fish project up river.

$Y = ax^b$

Y = Return/Index
x = mean length (mm)
a = 1.071×10^{49}
b = -17.259

-continued-

Appendix Table 2. Historic data on mean weight, mean length, and return per index values for Kvichak, Egegik, and Ugashik test fisheries (continued).

Ugashik River

YEAR	MEAN WEIGHT (kg)[1]	MEAN LENGTH (mm)[2]	RETURN/INDEX
1961	-	572.7	36.5
1962	-	536.0	15.1
1963	2.81	-	37.1
1964	2.40	-	23.7
1965	2.40	506.1	55.0
1966	2.95	544.6	59.4
1967	2.86	-	26.5
1968	2.68	-	13.3
1978	2.90[3]	543.0	3.8
1979	2.61[3]	538.0[3]	46.1
1980	2.30[3]	520.5[3]	78.6

[1] From commercial processors reports.
[2] From tower samples.
[3] From test fish samples.

1980 IGUSHIK RIVER ESCAPEMENT TEST FISHING

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INTRODUCTION

An escapement test fishing project for the Igushik River system has been conducted annually since 1976 (McBride 1978; McBride and Clark 1979). The objective of the project is to obtain timely estimates of sockeye salmon escapement into the lower portion of the Igushik River soon after the fish pass through the commercial fishery (Figure 1). This information is necessary to facilitate management decisions as final enumeration of the Igushik River salmon escapement occurs at the counting tower at the outlet of Amanka Lake, approximately 2 to 10 days after the fish swim past the commercial fishery.

METHODS AND MATERIALS

Test Fishing

The location and methodology for gillnet test fishing were similar to that used in 1979 (McBride and Clark 1979). A 25 fm set gillnet (137 mm or 5-3/8 inch stretched mesh) was fished during each high tide at a single location on the left bank facing upstream. The gillnet was set 1/2 hour before each high tide, as indicated in the local tide books, and remained fishing 30 minutes or until approximately 25 salmon were caught, whichever came first. The objective was to minimize the catch while still obtaining a good estimate of fish passage rates.

The standard test fish index (catch per 100 fm-hours) was calculated for each set. Samples of length and weight composition also were obtained throughout the migration.

Tagging Studies

A single tagging experiment was conducted in addition to the index gillnetting program during 1980, Methodology for deployment of the tags ("flag" tags) was identical to previous tagging studies conducted in conjunction with this project (McBride and Clark 1979). The objectives of the tagging experiment were to determine: (1) "lag time" for sockeye salmon migrating from the test fishing site to the counting tower, (2) the proportion of the migrating sockeye salmon population that "flushed" in and out of the Igushik River between the test fishing site and the commercial fishing district, and (3)

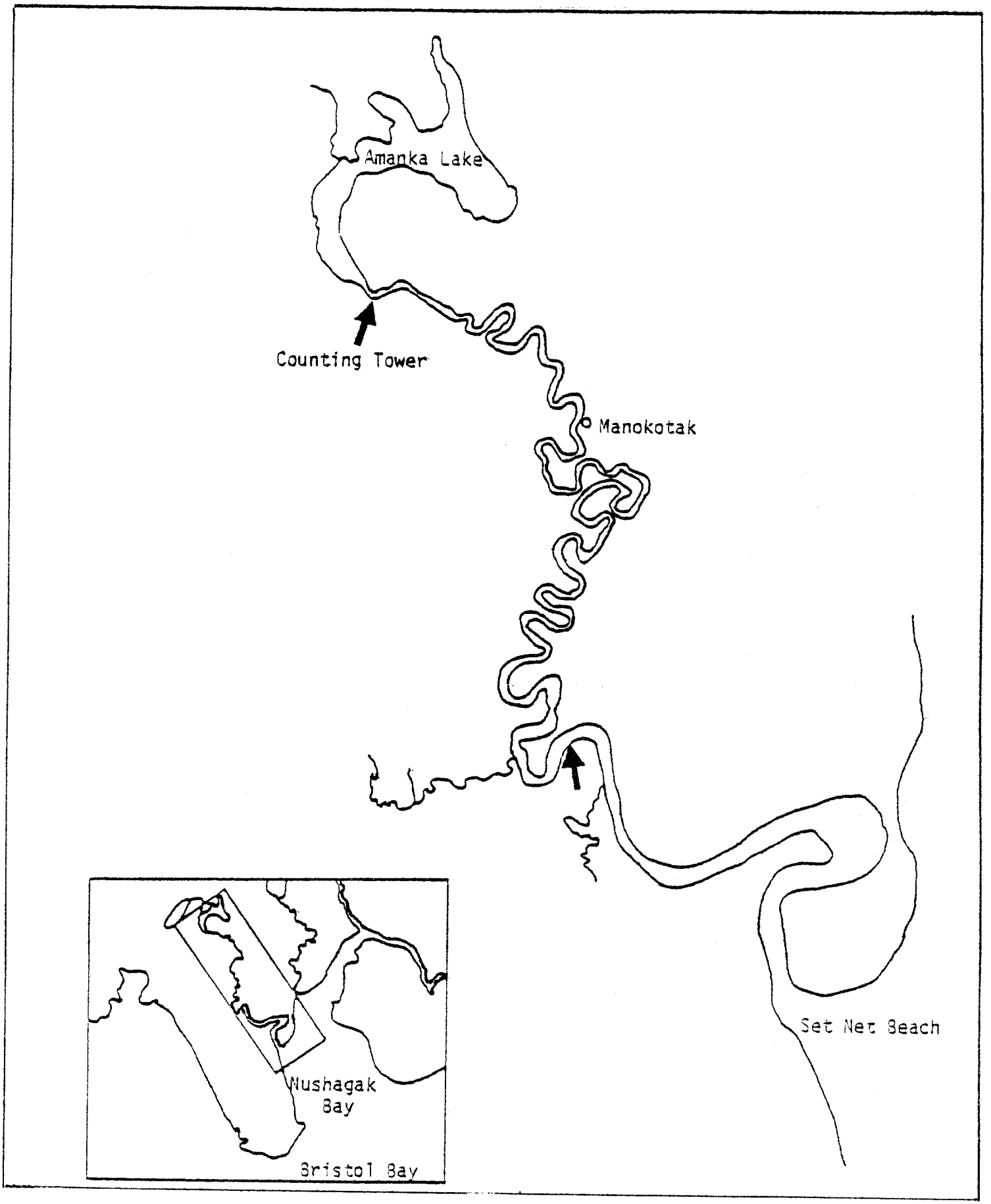

Figure 1. Location of the Igushik River counting tower, the village of Manokotak and the Igushik inside test fishing site.

the proportion of the migrating sockeye salmon population indexed at the test fishing site that "drifted" from the Igushik River to other river systems.

Escapement Estimates

Test fish indices were calculated for each high tide and averaged for each day to yield a daily test fish index value. In-season estimates of the accumulative escapement at the test fishing site for a particular day were calculated by multiplying the accumulative test fish index for that day by the best estimate of the escapement per test fish index point at that time. In-season estimates of escapement per index point were determined in two ways. First, it was estimated from the relationship between the average size of sockeye salmon caught in the test fishery and escapement per index point determined in prior years. Second, it was calculated by correlating accumulative test fish indices with accumulative actual escapements at the counting tower with various lag times (Paulus 1968).

RESULTS

Test fishing was conducted from 20 June until 15 July 1980 (Table 1). Correlation analysis of the accumulative test fish indices with the accumulative tower escapement estimates showed that a 4-day lag time produced the best statistical fit between tower counts and test fish indices (Table 2).

A total of 200 flag tags were deployed on July 6 (Table 3). A total of 37 tags were observed at Igushik tower. Average lag time (geometric mean) for salmon to migrate from the test fishing site to the tower was 8 days. For the second consecutive year, tagging data yielded substantially larger estimates of lag time than correlation analysis. Only five fish (3% of the total) were recovered in the commercial fishing district. No tags were recovered from other river systems.

Accumulative test fish indices closely parallel the actual accumulative tower counts of escapement (Figure 2). Post-season escapement estimates based on test fish indices remained within 30% of the actual escapement after 2 July when 23% of the total escapement had entered the river (Table 4). The relationship of the escapement per index point for 1980 was calculated by dividing the total tower count of escapement by the accumulative test fish indices with a 4-day lag time:

1,945,758 escapement/38,673.1 indices = 50.3 escapement/index point.

Individual mean weight of sockeye salmon caught at the test fish site was 3.1 kg. Both statistics were included in the long-term prediction model of catchability (Figure 3).

Table 1. Sockeye salmon escapement into the Igushik River system as indexed at the test fish site and enumerated at the counting tower, 1980.

	Test Fish Indices			Tower Counts	
		Average of both Tides for each day			
Date	Test Fish Index	Daily Test Fish Index	Accumulative Test Fish Index	Daily Counts	Accumulative Counts
June 20	105.8	105.8	105.8	0	0
21	144.2				
21	260.3	202.2	308.0	0	0
22	159.3				
22	114.3	136.8	444.8		
23	143.6	143.6	588.4	2,352	2,352
24	7.6				
24	184.3	96.0	684.4	1,020	3,372
25	128.5				
25	147.2	137.8	822.2	2,610	5,982
26	32.9				
26	28.7	30.8	853.0	4,650	10,632
27	14.7				
27	33.7	24.2	877.2	7,530	18,162
28	28.9				
28	101.9	65.4	932.6	3,954	22,116
29	122.7				
29	140.7	131.7	1,064.3	2,400	24,516
30	411.4				
30	320.0	365.7	1,430.0	3,666	28,182
July 1	1,651.8				
1	1,851.8	1,751.8	3,181.0	3,036	31,218
2	2,228.6				
2	4,586.6	3,407.6	6,588.6	21,276	52,494
3	5,280.0				
3	4,480.0	4,880.0	11,468.6	58,140	110,634
4	3,109.0				
4	3,600.0	3,354.5	14,823.1	104,232	214,866
5	2,223.4				
5	2,790.7	2,507.0	17,330.1	113,652	328,518
6	2,640.0				
6	3,720.0	3,180.0	20,510.1	120,234	448,752
7	2,400.0				
7	3,456.0	2,928.0	23,468.1	156,936	605,688
8	1,297.0				
8	2,142.0	1,720.0	25,188.1	148,842	754,530
9	2,788.6	2,788.6	27,976.7	192,924	947,454
10	1,824.0				
10	3,323.1	2,573.6	30,550.3	143,658	1,091,112
11	3,360.0				
11	2,816.0	3,088.0	33,638.3	121,380	1,212,492
12	3,200.0				
12	2,640.0	2,920.0	36,558.3	122,208	1,334,700
13	1,097.0				
13	1,029.0	1,063.0	37,621.3	138,336	1,473,036
14	888.8				
14	542.6	715.7	38,337.0	142,884	1,615,920
15	500.8				
15	172.1	336.4	38,673.1	104,394	1,720,314
16				101,076	1,821,390
17				56,778	1,878,168
18				38,526	1,916,694
19				29,064	1,945,758
20				19,380	1,965,138
21				11,220	1,976,358
22				6,192	1,982,550
23				4,308	1,986,858
24				672	1,987,530

Table 2. Correlation analysis of accumulative test fish indices with accumulative escapement counts at Igushik tower with lag times from 1 to 7 days, 1980.

Lag Time	Correlation Coefficient
1 day lag	.96805
2 day lag	.98294
3 day lag	.99343
4 day lag	.99842*
5 day lag	.99748
6 day lag	.99061
7 day lag	.97804

* highest r value and used in this project.

Table 3. Summary of Igushik River tagging studies, 1980.

Tag Color	Date Tagged	Number Tagged	Number of Days Between Tagging and Subsequent Sightings at Igushik Tower											Total Number	Percent of Total	Geometric Average	Fish Sighted at Other Locations		
			4	5	6	7	8	9	10	11	12	13	14				Number	Percent of Total	Location
Blue	7/6/80	200	4	1	4	8	7	3	4	4	1		1	37	19	8	5	3	District Catch

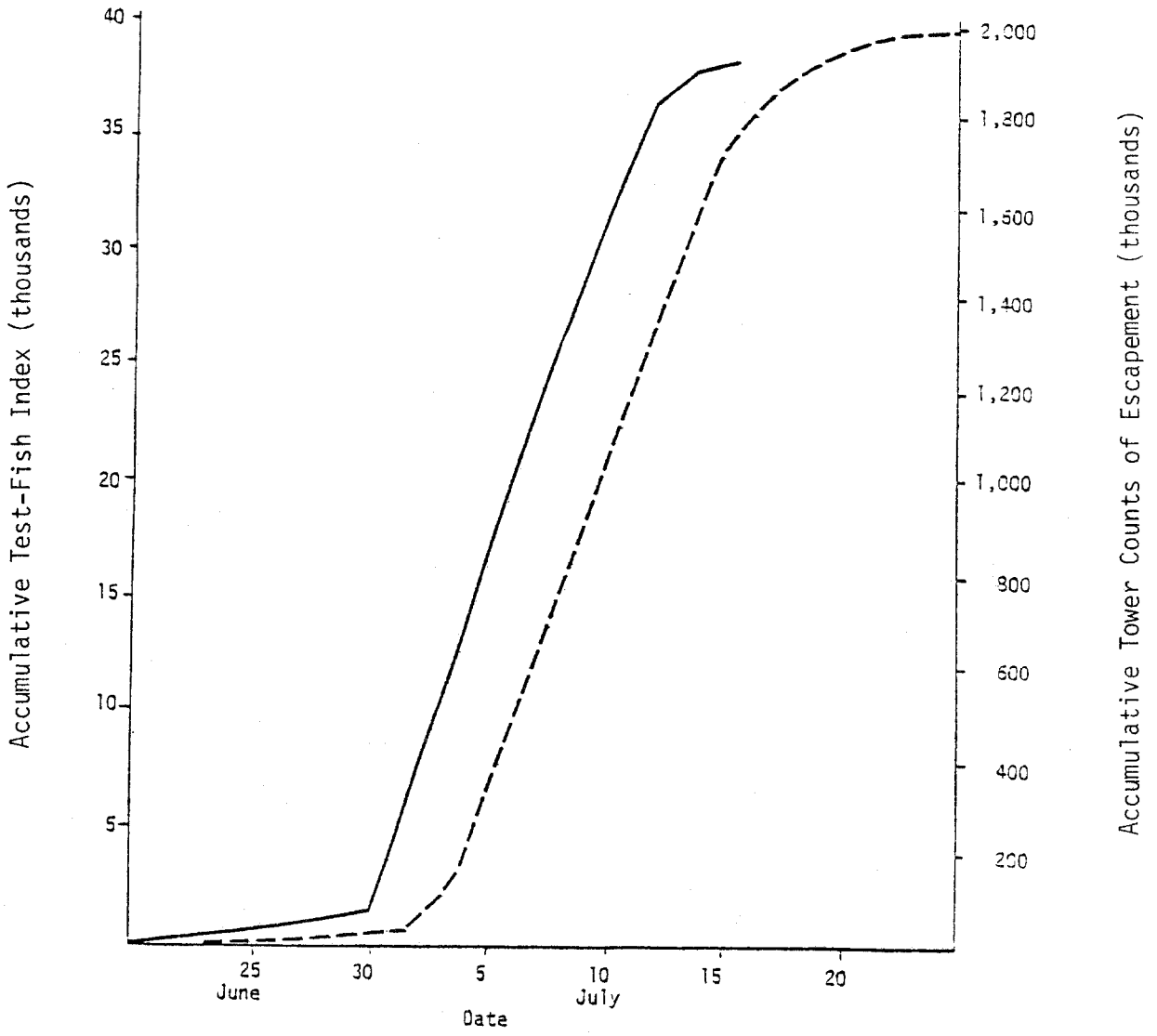

Figure 2. Igushik River accumulative test fishing indices and tower counts, 1980.

Table 4. Sockeye salmon escapement into the Igushik River system as estimated by the Igushik River inside test fishing project, 1980.

Date	Accumulative Test Fish Index	Post-Season Estimated Escapement[1]	Actual Escapement[2]	Accuracy[3]
June 20	105.8	5,322	3,372	1.6
21	308.0	15,492	5,982	2.6
22	444.8	22,373	10,632	2.1
23	588.4	29,597	18,162	1.6
24	684.4	34,425	22,116	1.6
25	822.2	41,357	24,516	1.7
26	853.0	42,906	28,182	1.5
27	877.2	44,123	31,218	1.4
28	932.6	46,910	52,494	0.9
29	1,064.3	53,534	110,634	0.5
30	1,430.0	71,929	214,866	0.3
July 1	3,181.0	160,004	328,518	0.5
2	6,588.6	331,406	448,752	0.7
3	11,468.6	576,871	605,688	1.0
4	14,823.1	745,602	754,530	1.0
5	17,330.1	871,704	947,454	0.9
6	20,510.1	1,031,205	1,091,112	0.9
7	23,468.1	1,180,445	1,212,492	1.0
8	25,188.1	1,266,961	1,334,700	0.9
9	27,976.7	1,407,228	1,473,036	1.0
10	30,550.3	1,536,680	1,615,920	1.0
11	33,638.3	1,692,006	1,720,314	1.0
12	36,558.3	1,838,882	1,821,390	1.0
13	37,621.3	1,892,351	1,878,168	1.0
14	38,337.0	1,928,351	1,916,694	1.0
15	38,673.1	1,945,257	1,945,758	1.0

[1] Estimated escapement = (accumulative test fish index) X (No. spawners/ index point).
[2] Acutal escapement = accumlative escapement on day n + 4 (4 day lag time).
[3] Accuracy = estimated escapement/actual escapement.

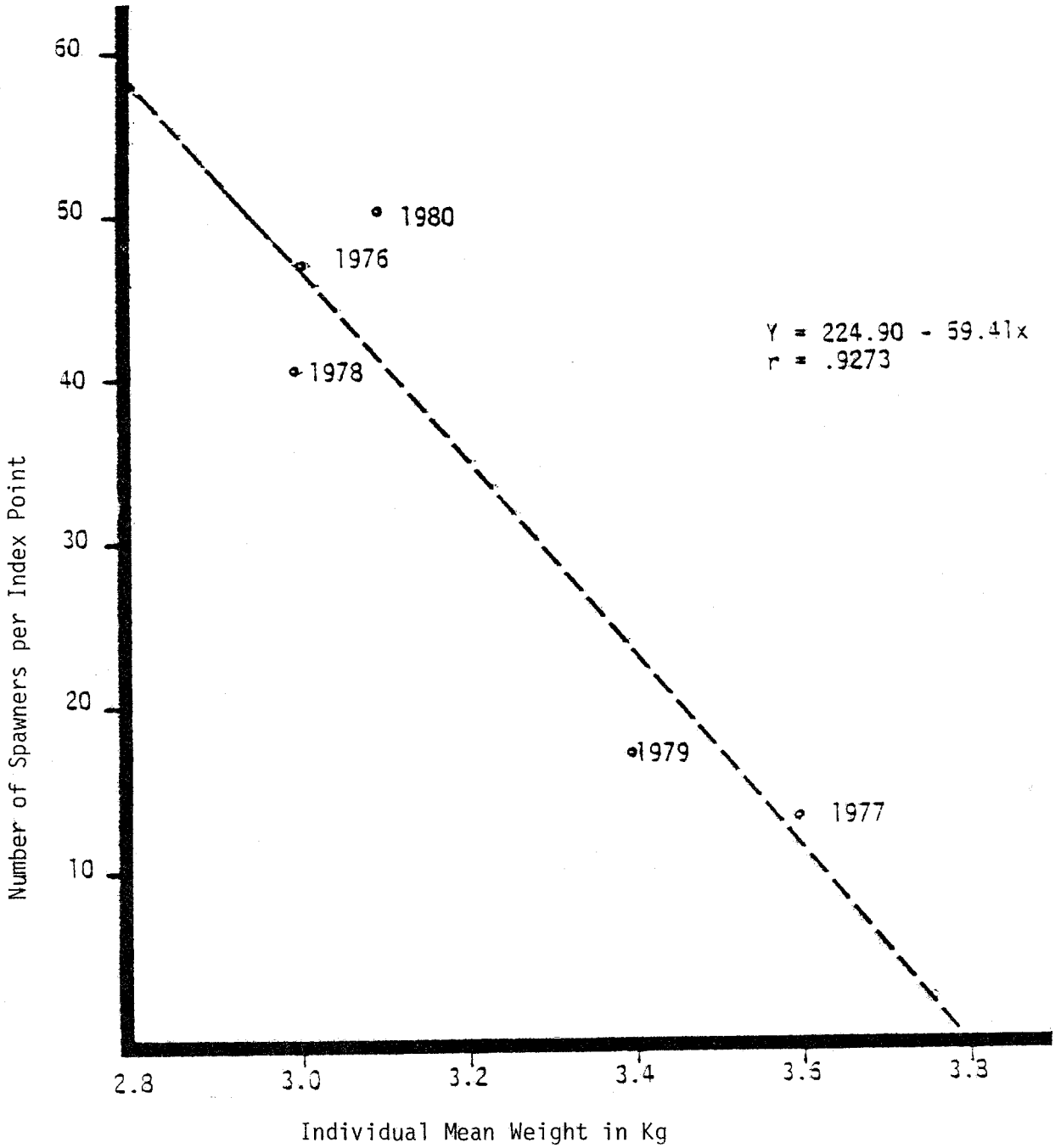

Figure 3. Correlation analysis of individual mean weight of Igushik River system sockeye salmon with the number of spawners per test fishing index point, 1976-1980.

LITERATURE CITED

McBride, D. N. 1978. Igushik River inside test fishing, 1976-1978. Division of Commercial Fisheries, Alaska Department of Fish and Game. Bristol Bay Data Report No. 67. 45 pp.

McBride, D. N. and J. H. Clark. 1979. 1979 Igushik River inside test fishing. Pages 37-51. In H. Yuen, ed. 1979 Bristol Bay sockeye salmon test fishing projects. Alaska Department of Fish and Game Technical Data Report No. 56.

Paulus, R. D. 1968. Inside test fishing in Bristol Bay, 1960-1967. Division of Commercial Fisheries, Alaska Department of Fish and Game. Bristol Bay Data Report No. 22. 13 pp.

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