ADF&G TECHNICAL DATA REPORT NO. 153
(Limited Distribution)

STATE OF ALASKA
Bill Sheffield, Governor

1983 BRISTOL BAY PACIFIC SALMON TEST FISHING PROJECTS

Edited by:
Stephen M. Fried

August 1985

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

Don W. Collinsworth
Commissioner

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1983 BRISTOL BAY PACIFIC SALMON TEST FISHING PROJECTS

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

Edited by:

Stephen M. Fried

Alaska Department of Fish and Game
Division of Commercial Fisheries
Anchorage, Alaska 99502

August 1985

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ABSTRACT

Gillnet test fishing was conducted within Bristol Bay offshore waters during 9 June to 8 July 1983 to estimate sockeye *(Oncorhynchus nerka)* and chum *(O. keta)* salmon run timing and total abundance several days before these species actually reached commercial fishing districts. Gillnet test fishing was conducted within Nushagak District during 29 June to 2 July to determine movement patterns and index sockeye salmon abundance for stocks returning to systems within this District. Gillnet test fishing was conducted within the Kvichak, Egegik, Ugashik, and Igushik Rivers during 15 June to 26 July 1983 to estimate sockeye salmon spawning escapement from the commercial fishery several days before actual counts were available from tower sites further upriver in clear water. Such information was used by managers in determining when to open and close commercial fishing periods so that escapement goals could be met and surplus salmon could be harvested. Various methods of obtaining abundance estimates from test fishing catch data were examined and evaluated to determine which ones produced the most accurate results.

KEY WORDS: sockeye salmon, *(Oncorhynchus nerka)*, Bristol Bay, test fishing, migratory patterns, run abundance estimation.

FOREWORD

The common goal of Bristol Bay Pacific salmon *(Oncorhynchus* sp.*)* test fishing projects is to provide fishery managers with estimates of salmon entering (total run) and leaving (escapement) commercial fishing areas before actual catch or escapement statistics became available. Every major river and lake system within Bristol Bay is managed to achieve a specific salmon spawning escapement goal (i.e, the optimum number and distribution of salmon which results in highest salmon production), while maximizing the commercial harvest of salmon in excess of these goals.

The Port Moller offshore test fishing project was developed to provide estimates of total salmon abundance several days before salmon reach commercial fishing districts, located in turbid estuaries. District test fishing projects were developed to assess salmon abundance, distribution, and movement patterns within fishing districts during fishery closures. Escapement test fishing projects (i.e., within the Kvichak, Egegik, Ugashik, and Igushik Rivers) were developed to provide estimates of salmon escaping the fisheries to spawn in systems where visual counts cannot be made until several days after salmon pass through fishing districts. Visual counts are made from counting towers placed on river banks in clear water areas of rivers and from aircraft. In general, the basis of calculating estimates of salmon abundance from test fishing projects is catch per unit of effort expressed as:

$$\text{Index Points} = K\,[C/(F)(T)],$$

where C = number of salmon caught, F = length of gillnet fished, and K = a constant used to convert the index into the desired unit of effort. Since the beginning of these studies, the unit of effort has been defined as catch per 100 fathom-hours (182 meter-hours), where K = 60 minutes x 100 fathoms = 6,000. Estimates of actual salmon abundance are based upon the assumed catchability of the salmon (i.e., the fraction of the salmon population caught by each unit of effort). The inverse of catchability is an estimate of the total number of salmon represented by each index point (referred to as return or escapement per index point). Estimates of catchability based upon the past relationship to mean salmon size (length or weight) are used early in the season to estimate abundance. Later in the season estimates of lag time (the number of days required by salmon to travel from a specific test fishing site to an area in which other abundance estimates can be made) are used to determine catchability. More detailed discussions of analytical methods are included within individual papers presented in this report, the fifth in a series of Technical Data Reports concerning Bristol Bay test fishing projects.

1983 PORT MOLLER OFFSHORE TEST FISHING

By

Stephen M. Fried

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

INTRODUCTION

Offshore test fishing, conducted at Port Moler since 1967, has been used to predict total sockeye *(Oncorhynchus nerka)* and chum *(O. keta)* salmon run size about one week prior to arrival of these species at inshore commercial fishing districts within Bristol Bay (Randall 1977, Meacham 1979, Huttunen 1980 and 1982, Eggers 1984). Specific objectives of this project have been to:

1) Predict cumulative daily abundance of sockeye and chum salmon entering Bristol Bay;

2) Predict total run size of sockeye salmon into Bristol Bay; and

3) Obtain age composition information to monitor the performance of the pre-season sockeye salmon forecast.

This report presents results of the 1983 Port Moller sampling program and compares the performance of the various methods used to forecast run size within the season. During 1983 most methods used underestimated actual run size by 68% to 40%. Only the relationship between mean length and total run size past years provided an inseason forecast similar to (within 6% to 2%) the post-season estimate of 45.78 million sockeye salmon. However, performance of this model in past years has been quite variable (Eggers 1984), and it has proven difficult to choose the best estimate from among the different ones produced by the various methods. Use of pooled estimate, weighted by the past reliability of each method, would eliminate the dilemma of trying to choose the best estimate from among the various available ones.

METHODS

Test fishing was conducted at 11 stations, based at about 5 mi (8 km) intervals, along a transect extending from Port Moller towards Cape Newenham (Figure 1). Station one was about 28 mi (45 km) offshore of Port Moller, on the 20 fm (36.4 m) contour, while station 11 was about 78 mi (130 km) offshore. In general, odd-numbered stations were fished the same day on an outgoing trip, and even-numbered stations were fished the next day on an incoming trip. Fishing time was approximately one hour for each station,

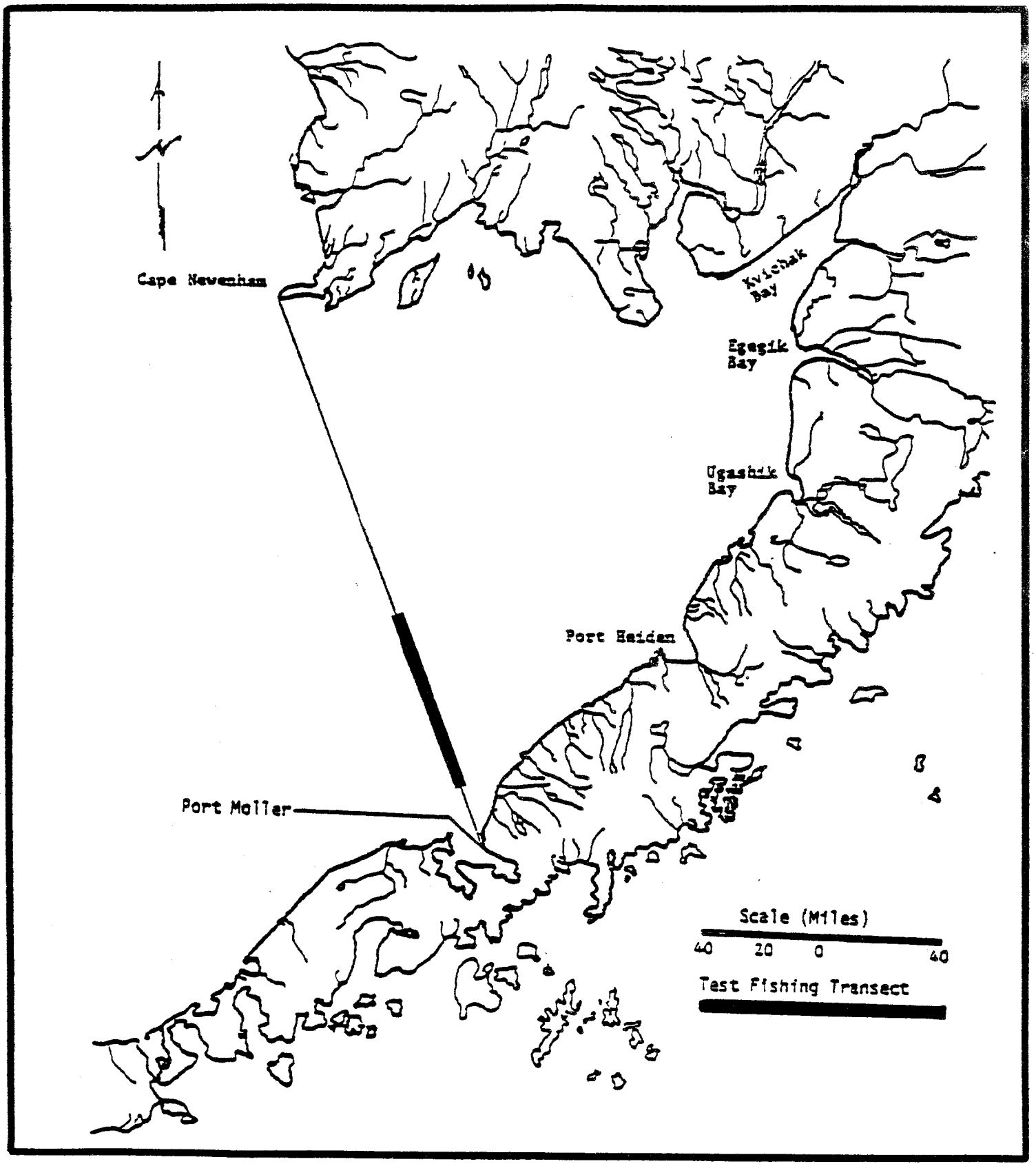

Figure 1. Transect fished during the Port Moller sockeye and chum salmon offshore gillnet test fishery, 1983.

but, since the net was picked as it was retrieved, stations with large catches had longer fishing times.

Fishing was done with gill nets 364 m (200 fm) long, doubly hung (60 meshes deep), having 13.7 cm (5-3/8 in) stretched mesh and made from twist cable lay nylon dyed green. Nets were fished from the F/V WALTER N, a 22 m (73 ft) vessel chartered for the 1983 season. Stations were located using Loran C coordinates. A hydraulic reel was used to set and retrieve the net, which was set parallel to the transect (i.e., perpendicular to the migration route of salmon into Bristol Bay).

Catches were standardized as salmon caught per 182 m (100 fm) of net fished per hour, hereafter referred to as index points (Appendix Tables 1 and 2). Index points from stations not fished due to inclement weather or mechanical breakdowns were estimated by linear interpolation. All sockeye salmon caught were aged (using scale samples), weighed (round weight, kg), measured (mid-eye to tail fork length, mm) and identified according to sex (Appendix Table 3). Mean lengths and weights from each station were weighted by station index points to calculate daily means (Appendix Table 4). Climatological data, including water surface and air temperatures, wind direction and velocity, tide stage and cloud cover, were recorded during each set (Appendix Tables 5 and 6).

Sockeye Salmon

Several models were used to estimate sockeye salmon abundance based upon data collected from previous test fishing operations at Port Moller (Appendix Table 7). In general, models could be classified into two general categories: (1) cumulative abundance estimators, and (2) total run size estimators.

Cumulative Abundance:

Cumulative numbers of sockeye salmon passing the Port Moller transect were calculated by multiplying cumulative sockeye salmon index points (C) by a return per index point (RPI) value. Two methods were used to estimate RPI. The first was based upon the past relationship between mean length (L, mm, mid-eye to tail fork) of sockeye salmon caught during Port Moller test fishing, and RPI calculated after the season. The equation used during 1983 was only based upon data from 1968-79; data from 1980 and 1981 were considered to be outliers (Eggers 1984):

$$1.1 \quad RPI_L = 5.417 \times 10^{54} L^{-19.48}.$$

The relationship between mean round weight and RPI was not used, since it performed poorly in past years (Huttunen 1982).

The second method determined RPI by finding the best least squares estimate of the number of days required for sockeye salmon to travel from Port Moller to inshore waters ($^{\circ}1$, lag time). For a given lag time, the RPI that minimized the sum of the squared deviations between predicted and observed cumulative inshore returns (the error function) was calculated using the following equation (Mundy and Mathisen 1981):

2.1 $RPI_{\Delta l} = \sum_{i=1}^{t+\Delta l} R_{i+\Delta l} \; C_i \; / \; \sum_{i=1}^{t+\Delta l} C_i^2$, where

i and t = i^{th} and t^{th} days of sampling, respectively, C_i = cumulative Port Moller index points on day i, $R_{i+\Delta l}$ = cumulative inshore returns on day $i+\Delta l$. The lag time and corresponding RPI which gave the minimum value for the equation, within a range of reasonable lag time values, was used to estimate the cumulative number of sockeye salmon which passed the Port Moller transect.

Total Run Size:

Two methods were used to estimate total run size (N). Both depended upon the occurrence of density dependent growth (i.e., growth decreased as abundance increased) during the time Bristol Bay sockeye salmon remained at sea (Rogers 1978; Huttunen 1979). The first method was based upon the historic relationship between mean length (L) or weight (W) of sockeye salmon caught during Port Moller test fishing and total run size. Equations used during the 1983 season were based upon data from 1968-81 in which mean length (L) was expressed in mm, but mean weight (W) was expressed in lbs:

3.1 $N_L = 415.4 - 0.702\ L$, and

3.2 $N_W = 7.8641 \times 10^6\ W^{-7.28}$.

The second method (length-temperature model) was based upon the historic relationship between mean length of sockeye salmon in the total inshore return (L_I), the sum of mean June Cold Bay air temperatures for the two years immediately preceding the return (i.e., an index of marine climate during ocean residence, X) and total inshore return (Huttunen 1979):

4.1 $\ln[N] = 18.789\text{-}10.791\ \ln[L_I] \times 11.518\ \ln[X]$.

However, mean length of sockeye salmon sampled from the inshore return (L_I) has tended to be smaller than mean length of sockeye salmon captured during Port Moller test fishing (L), due to the lower catchability of smaller sockeye salmon in test fishing gill nets. Therefore, L_I was estimated from L using the following relationship (Eggers 1984):

5.1 $L_I = -85.082 + 1.135\ L$.

Age Class Composition:

Age class composition of sockeye salmon caught at Port Moller was monitored during the season to indicate whether actual run size was likely to deviate from pre-season expectations. Port Moller age class composition estimates were adjusted during the season to account for the lower catchability of smaller sockeye salmon, since the proportion of two-ocean sockeye salmon in the total run has been about 6% higher than that in Port Moller test fishing catches (Eggers 1984).

While deviations from the expected age class composition indicate that actual run size will probably differ from the pre-season forecast, it is not possible to adjust the pre-season forecast based upon such observations. However, Eggers (1984) has shown that age data may be used to indicate whether the actual run will be less than the pre-season expectations. His method was based upon the relationship between deviations of actual (total inshore return) from forecasted (pre-season) total run size and deviations of actual (Port Moller) from forecasted (pre-season) proportion of two-ocean sockeye salmon. Total run size has always been less than the pre-season forecast whenever the proportion of two-ocean sockeye salmon within Port Moller catches has been at least 10% less than that in the pre-season forecast (Appendix Figure 1).

Chum Salmon

Cumulative numbers of chum salmon passing the Port Moller transect were calculated by multiplying cumulative chum salmon index points by the historic mean RPI of 9,946 chum salmon per index point. Chum salmon mean size has not proven to be a good predictor of RPI (Huttunen 1982). No attempts were made to forecast total run size within season.

RESULTS AND DISCUSSION

Sockeye Salmon

A total of 1,019 sockeye salmon were caught during Port Moller test fishing (Table 1). Daily catches ranged from 8 to 103 sockeye salmon. These catches resulted in a total of 645.15 index points, including interpolated values for missed fishing time. Overall mean length and weight of sockeye salmon captured were 528 mm (20.8 in) and 2.6 kg (5.7 lbs), respectively.

Cumulative Abundance:

During the first half of the season, estimates of sockeye salmon cumulative abundance were made using the relationship between mean length and RPI (equation 1.1) (Table 2). Mean length fluctuated most during the first four days of sampling (521-531 mm), but quickly stabilized for the remainder of the season (527-529 mm) (Table 1). RPI values calculated using daily updated (running) mean lengths ranged from 44,558 at a mean length of 531 mm to 64,531 at a mean length of 521 mm.

Lag time analysis (equation 2.1) was first used on 28 June and produced estimates of daily passage similar to those based upon mean length until 3 July, when lag time analysis estimates began to exceed those based upon mean length (Table 2). During the season, lag time estimates ranged from six to 10 days. In past years, lag time estimates made after the season have ranges from five to 12 days (mean 6.7 days; standard deviation 2.0 days).

The best estimates of cumulative passage of sockeye salmon across the transect were considered to be those calculated after the season using a lag time of seven days (Table 2). Comparisons of these estimates with those made during

Table 1. Daily summary of sockeye salmon catch and index, running mean weight and length, and estimated passage for the Port Moller offshore test fishery, 1983.

Date	Stations Fished	Catch	Index	Running Mean Weight (kg)	Running Mean Length (mm)[1]	Passage[2] Daily	Passage[2] Cumulative
6/09	5	10	5.16	2.67	528	355,713	355,713
6/10	5	10	5.03	2.79	531	347,205	702,918
6/11	6	21	11.36	2.60	523	783,654	1,486,573
6/12	5	19	9.29	2.60	521	640,883	2,127,456
6/13	6	25	12.58	2.66	527	867,556	2,995,013
6/14	5	17	8.61	2.68	527	594,315	3,589,329
6/15	2	20	19.57	2.69	527	1,349,932	4,939,261
6/16	5	65	30.53	2.70	529	2,105,943	7,045,204
6/17	6	9	4.85	2.69	529	344,532	7,379,737
6/18	5	57	28.51	2.70	529	1,966,695	9,346,433
6/19	3	20	12.95	2.68	528	893,729	10,240,162
6/20	0	13	13.75	2.68	528	948,604	11,188,766
6/21	6	27	14.55	2.69	529	1,003,574	12,192,341
6/22	5	74	37.07	2.65	527	2,557,272	14,749,614
6/23	0	33	33.33	2.65	527	2,299,416	17,049,030
6/24	5	55	29.56	2.64	527	2,039,502	19,088,534
6/25	6	8	4.33	2.64	527	298,419	19,386,954
6/26	2	82	38.90	2.63	527	2,683,470	22,070,424
6/27	6	26	14.31	2.63	527	987,485	23,057,908
6/28	5	60	31.86	2.64	528	2,197,746	25,255,654
6/29	4	23	11.25	2.64	528	776,282	26,031,938
6/30	5	103	51.86	2.60	527	3,578,116	29,610,054
7/01	6	37	19.53	2.60	527	1,347,396	30,957,452
7/02	5	89	46.81	2.60	527	3,229,448	34,186,900
7/03	6	45	24.51	2.60	527	1,690,973	35,877,879
7/04	5	80	43.38	2.59	527	2,992,465	38,870,340
7/05	2	37	32.08	2.59	528	2,213,140	41,083,474
7/06	0	22	22.40	2.59	528	1,545,362	42,628,840
7/07	6	21	11.91	2.60	528	821,922	43,450,764
7/08	4	26	15.32	2.60	528	1,056,849	44,507,614

[1] Includes interpolated values for missed fishing time. Length measured from mid-eye to tail fork.

[2] Based upon 68,989 sockeye salmon per index point and a 7-day lag time. Calculated from least squares fit of cumulative inshore returns through 7/08 (36,376,674) and cumulative index points through 7/01 (448).

Table 2. Daily cumulative estimates of sockeye salmon passage across the Port Moller transect and comparisons with the post-season estimates, 1983.

Date	Cumulative Passage Across Transect: Within Season Estimates: Method I[1]	Within Season Estimates: Method II[2]	Post-season Estimate (7 day lag time)	Estimated Within Season Accuracy[3]: Method I	Estimated Within Season Accuracy[3]: Method II
6/09	256,748		355,713	-0.278	
6/10	454,046		702,918	-0.354	
6/11	1,290,628		1,486,573	-0.132	
6/12	1,990,134		2,127,456	-0.065	
6/13	2,241,743		2,995,013	-0.252	
6/14	2,686,271		3,589,329	-0.252	
6/15 *	2,713,119		4,939,261	-0.451	
6/16	3,055,416		7,045,204	-0.566	
6/17	4,196,199		7,379,737	-0.431	
6/18	5,495,026		9,346,433	-0.412	
6/19 *	6,102,444		10,240,162	-0.404	
6/20 *	8,070,159		11,188,766	-0.279	
6/21	8,382,245		12,193,341	-0.313	
6/22	10,644,705		14,749,614	-0.278	
6/23 *	12,759,660		17,049,030	-0.252	
6/24	14,225,204		19,088,534	-0.255	
6/25	14,403,681		19,386,954	-0.257	
6/26	16,509,356		22,070,424	-0.253	
6/27	16,991,892		23,057,908	-0.263	
6/28	18,188,794		25,255,654	-0.280	
6/29	18,618,430	14,712,346 (7 days)	26,031,938	-0.285	-0.435
		21,489,304 (10 days)			-0.175
6/30	21,469,404	16,401,425 (9 days)	29,610,054	-0.275	-0.446
7/01	22,609,474	22,392,364 (7 days)	30,957,452	-0.270	-0.277
		21,096,056 (9 days)			-0.319
7/02	24,838,500	25,859,878 (7 days)	34,186,900	-0.273	-0.244
7/03	26,132,982	29,917,984 (7 days)	35,877,870	-0.273	-0.166
7/04	29,090,002		38,870,340	-0.252	
7/05 *	28,361,436	37,787,644 (7 days)	41,083,474	-0.310	-0.080
7/06 *			42,628,840		
7/07		36,797,780 (6 days)	43,450,764		-0.153
7/08		39,053,934 (6 days)			-0.123
			Mean	-0.295	-0.213 or -0.241

* Within season estimate includes interpolated values for missed fishing time.

[1] Based on relationship between mean length and RPI.

[2] Based on assumed lag time from Port Moller to inshore waters.

[3] [(Within season estimate) - (Post-season estimate)]/Post-season estimate.

the season showed that within-season both methods (equations 1.1 and 2.1) underestimated actual abundance. Length model estimates were about 30% lower and lag time analysis estimates were about 20 to 24% lower than post-season estimates.

Total Run Size:

Estimates of total run size inshore return based upon the length, weight, and length-temperature models varied greatly during the season (Table 3). The length model (equation 3.1) produced estimates (final estimate, 44.7 million) closest to the actual post-season total run size estimate (45.8 million). The weight and length-temperature models (equations 3.2 and 4.1, respectively) produced final total run size estimates (24.4 and 26.9 million, respectively) that were 68 and 40% lower than the post-season estimate, respectively.

Age Class Composition:

The age composition of the Port Moller sockeye salmon catch was very similar to that of the pre-season forecast (Table 4). The adjusted two-ocean age composition of the Port Moller sockeye salmon catch (76.4%) was higher than that of the pre-season forecast (69.3%). However, a greater than forecast proportion of two-ocean sockeye salmon in Port Moller catches has not proven to be a reliable indicator of actual inshore returns in past years (Appendix Figure 1). The actual proportion of two-ocean sockeye salmon in the 1983 inshore return (81.1%), as well as actual total run size, was greater than that predicted prior to the season and from Port Moller catch data. The deviations of actual from predicted returns were mostly due to a much larger than anticipated return of age 4_2 sockeye salmon to the Kvichak River system.

Chum Salmon

A total of 97 chum salmon were caught during Port Moller test fishing (Table 5). These catches resulted in a total of 55.21 index points, including interpolated values for missed fishing time.

A total of 657,639 chum salmon were estimated to have passed the Port Moller transect during the season. The post-season estimate of total run size was 1.8 million, about 174% greater than Port Moller catches predicted. Reasons for the large discrepancy between the prediction made during the season and the estimate made after the season are not known at this time.

Table 3. Daily forecasts of sockeye salmon total run for Bristol Bay, 1983, using Port Moller test fishing data. The post-season estimate (catch and escapement) was 45.78 million sockeye salmon.

	Total Run Size Estimates (millions of sockeye)		
Date	Length Model	Weight Model	Length-Temperature Model
6/09	44.7	20.0	26.9
6/10	42.6	14.6	25.4
6/11	48.3	24.1	29.9
6/12	49.7	24.1	31.4
6/13	45.5	20.2	27.5
6/14	45.5	19.5	27.5
6/15	45.5	19.0	27.5
6/16	44.0	18.3	26.4
6/17	44.0	19.0	26.4
6/18	44.0	18.5	26.4
6/19	44.7	19.5	26.9
6/20	44.7	19.0	26.9
6/21	44.0	19.0	26.4
6/22	45.5	20.7	27.5
6/23	45.5	20.7	27.5
6/24	45.5	21.8	27.5
6/25	45.5	21.8	27.5
6/26	45.5	22.4	27.5
6/27	45.5	22.1	27.5
6/28	44.7	21.8	26.9
6/29	44.7	21.5	26.9
6/30	45.5	23.8	27.5
7/01	45.5	23.8	27.5
7/02	45.5	24.1	27.5
7/03	45.5	24.1	27.5
7/04	45.5	24.7	27.5
7/05	44.7	24.7	26.9
7/06	44.7	24.7	26.9
7/07	44.7	24.4	26.9
7/08	44.7	24.4	26.9

Table 4. Comparisons of age class composition predicted prior to and within the season to the actual estimated age class composition of the total Bristol Bay sockeye salmon run, 1983.

	Age Class Proportions			
Age Class	Pre-season Forecast	Port Moller Catch	Within Season Forecast[1]	Inshore Total Run
4	49.8	50.8	-	60.4
5	19.5	18.8	-	20.7
Total two-ocean	69.3	69.6	76.4	81.1
5	20.7	19.7	-	15.1
6	10.0	9.5	-	2.8
Total three-ocean	30.7	29.2	23.6	17.9
Others	0.0	1.2	-	1.0

[1] Based upon adjusted proportion of two-ocean sockeye salmon in Port Moller catch. Calculated from equation Y=5.539+1.018X, where Y = estimated proportion of two-ocean sockeye salmon in inshore return and X = proportion of two-ocean sockeye salmon in Port Moller catch (Eggers 1984).

Table 5. Daily summary of chum salmon catch and index, and estimated passage for the Port Moller offshore test fishery, 1983.

Date	# of Stations Fished	Catch	Index	Passage[1] Daily	Passage[1] Cumulative
6/09	5	0	0.00	0	0
6/10	5	2	1.01	10,029	10,029
6/11	6	3	1.53	15,240	25,269
6/12	5	3	1.44	14,329	39,599
6/13	6	2	1.04	10,385	49,984
6/14	5	1	.48	4,812	54,797
6/15	2	2	2.07 *	20,588	75,385
6/16	5	10	4.73	47,000	122,385
6/17	6	2	1.07	10,644	133,049
6/18	5	8	3.98	39,618	172,668
6/19	3	1	.69 *	6,867	179,535
6/20	0	1	1.16	11,537	191,072
6/21	6	3	1.63	16,181	207,254
6/22	5	5	2.73	27,188	234,443
6/23	0	1	1.90 *	18,897	253,340
6/24	5	2	1.07	10,619	263,959
6/25	6	0	0.00	0	263,959
6/26	2	3	1.36	13,495	277,455
6/27	6	1	.54	5,376	282,831
6/28	5	6	3.34	33,198	316,030
6/29	4	4	2.00	19,912	335,942
6/30	5	5	2.57	25,574	361,516
7/01	6	7	3.59	35,718	397,235
7/02	5	2	1.05	10,428	407,664
7/03	6	5	2.72	27,017	434,681
7/04	5	14	7.51	74,702	509,384
7/05	2	0	6.14	61,068	570,452
7/06	0	0	4.77	47,442	617,894
7/07	6	6	3.40	33,778	651,672
7/08	4	1	.60	5,967	657,639

* Includes interpolated values for missed fishing time.

[1] Based upon 9,946 chum inshore returns per index point. Calculated from mean return per index point observed in past years.

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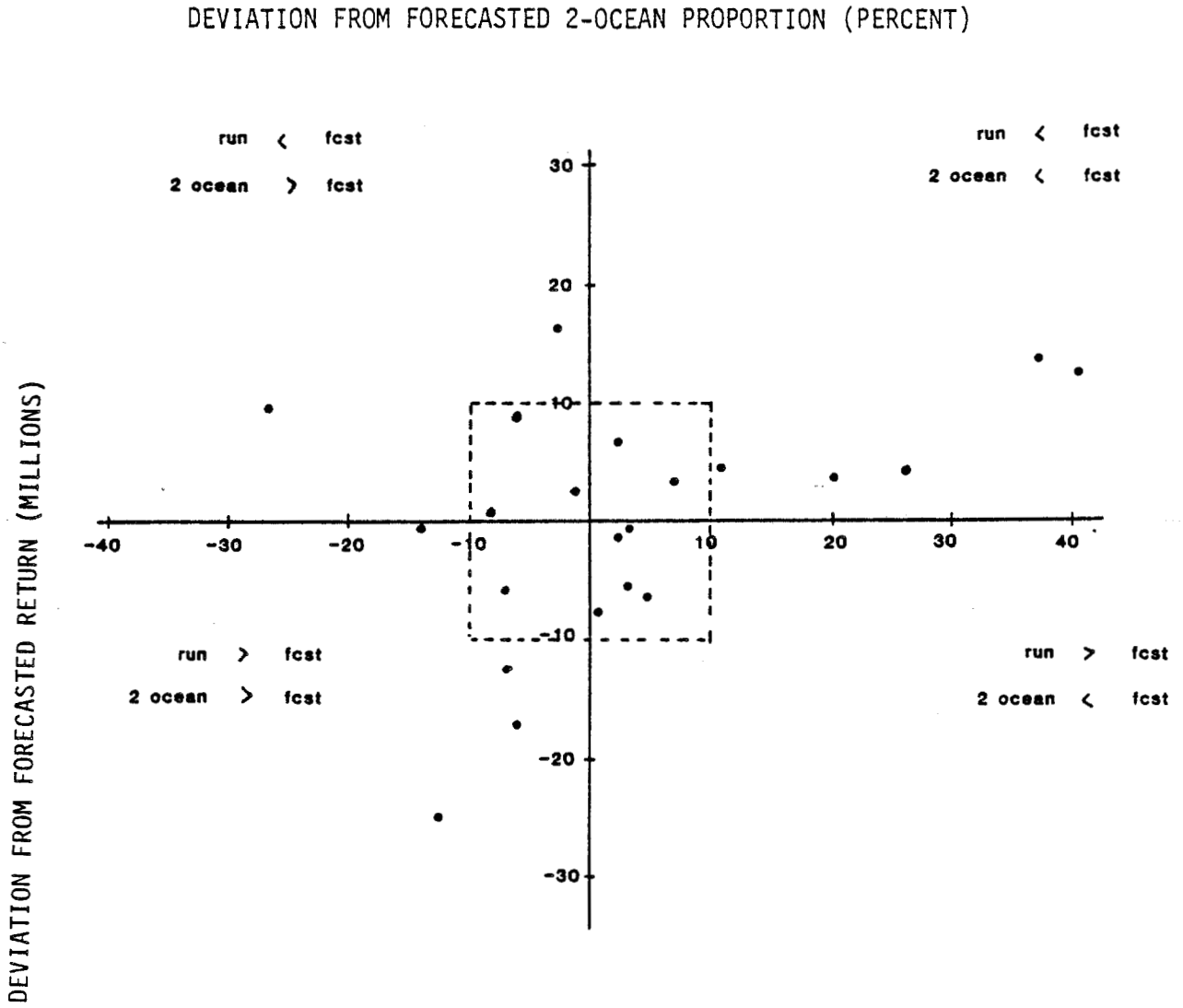
APPENDIX



Appendix Figure 1. Relationship between deviations from the forecast (observed minus forecasted values) for 2-ocean proportion and total run size of sockeye salmon, 1961-1982.

Appendix Table 1. Port Moller sockeye salmon daily test fishing index values summarized by station, 1983. (Interpolated values indicated by asterisks).

	Station											
Date	1	2	3	4	5	6	7	8	9	10	11	Total
6/09	0.66	-	0.00	-	3.47	-	1.03	-	0.00	-	-	5.16
6/10	-	0.00	-	0.96	-	1.55	-	1.15	-	1.01	-	5.03
6/11	0.50	-	0.00	-	3.79	-	3.60	-	3.47	-	0.00	11.36
6/12	-	3.50	-	3.90	-	0.00	-	1.40	-	0.49	-	9.29
6/13	0.00	-	6.45	-	0.00	-	5.59	-	0.00	-	0.54	12.58
6/14	-	2.16	-	3.50	-	1.93	-	1.02	-	0.00	-	8.61
6/15	0.52	-	0.00	-	-	-	-	-	-	-	-	19.57 *
6/16	-	12.66	-	2.65	-	5.41	-	6.72	-	3.09	-	30.53
6/17	0.51	-	1.04	-	1.09	-	1.10	-	0.00	-	1.10	4.84
6/18	-	2.50	-	4.03	-	11.16	-	10.82	-	0.00	-	28.51
6/19	-	-	-	-	4.95	-	3.75	-	0.55	-	-	12.95*
6/20	-	-	-	-	-	-	-	-	-	-	-	13.75*
6/21	3.34	-	0.52	-	2.14	-	0.51	-	7.50	-	0.54	14.55
6/22	-	3.43	-	2.12	-	0.00	-	13.34	-	18.18	-	37.07
6/23	-	-	-	-	-	-	-	-	-	-	-	33.33*
6/24	-	3.27	-	4.29	-	0.00	-	8.79	-	13.21	-	29.56
6/25	-	-	0.56	-	0.56	-	1.06	-	0.58	-	0.00	4.33[1]
6/26	-	16.73	-	22.16	-	-	-	-	-	-	-	38.89
6/27	0.57	-	4.53	-	0.54	-	3.65	-	0.54	-	4.49	14.32
6/28	-	0.57	-	9.07	-	5.61	-	0.00	-	16.61	-	31.86
6/29	0.00	-	1.09	-	10.16	-	0.00	-	-	-	-	11.25
6/30	-	4.86	-	4.66	-	30.47	-	10.19	-	1.68	-	51.86
7/01	0.56	-	0.00	-	10.08	-	4.95	-	3.40	-	0.54	19.53
7/02	-	18.06	-	7.50	-	7.64	-	2.40	-	11.21	-	46.81
7/03	2.18	-	5.56	-	11.05	-	1.14	-	2.83	-	1.75	24.51
7/04	-	6.79	-	8.00	-	13.85	-	4.12	-	10.62	-	43.38
7/05	3.22	-	3.50	-	-	-	-	-	-	-	0.00	32.08*
7/06	-	-	-	-	-	-	-	-	-	-	-	22.40*
7/07	0.57	-	4.53	-	3.96	-	0.00	-	2.86	-	0.00	11.92
7/08	-	-	-	3.60	-	0.00	-	7.06	-	4.66	-	15.32
Total	12.63	74.53	27.78	74.46	51.79	77.62	26.38	67.37	21.73	80.76	8.96	645.15
%	2.4	14.3	5.3	14.2	9.9	14.8	5.0	12.9	4.1	15.4	1.7	

[1] Station 12 fished: index = 1.57

Appendix Table 2. Port Moller chum salmon daily test fishing index values summarized by station, 1983. (Interpolated values indicated by asterisks).

	Station											
Date	1	2	3	4	5	6	7	8	9	10	11	Total
6/09	0.00	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	0.00
6/10	-	0.00	-	0.00	-	0.00	-	0.50	-	0.50	-	1.00
6/11	0.00	-	0.00	-	0.54	-	0.00	-	0.99	-	0.00	1.53
6/12	-	0.00	-	0.98	-	0.00	-	0.47	-	0.00		1.45
6/13	0.00	-	0.54	-	0.00	-	0.51	-	0.54	-	0.00	1.55
6/14	-	0.00	-	0.00	-	0.48	-	0.00	-	0.00	-	0.48
6/15	0.00	-	0.00	-	-	-	-	-	-	-	-	2.60*
6/16	-	0.00	-	1.06	-	0.98	-	2.24	-	0.44	-	4.72
6/17	0.00	-	0.52	-	0.00	-	0.55	-	0.00	-	0.00	1.07
6/18	-	1.00	-	1.51	-	0.93	-	0.54	-	0.00	-	3.98
6/19	-	-	-	-	0.00	-	0.00	-	0.55	-	-	3.20*
6/20	-	-	-	-	-	-	-	-	-	-	-	2.42*
6/21	0.56	-	0.00	-	0.54	-	0.00	-	0.54	-	0.00	1.64
6/22	-	0.57	-	0.00	-	2.16	-	0.00	-	0.00	-	2.73
6/23	-	-	-	-	-	-	-	-	-	-	-	1.90*
6/24	-	0.00	-	0.00	-	0.00	-	0.52	-	0.55	-	1.07
6/25	-	-	0.00	-	0.00	-	0.00	-	0.00	-	0.00	0.00
6/26	-	0.82	-	0.54	-	-	-	-	-	-	-	1.36
6/27	0.00	-	0.00	-	0.54	-	0.00	-	0.00	-	0.00	0.54
6/28	-	0.00	-	0.50	-	1.12	-	1.18	-	0.54	-	3.34
6/29	0.55	-	0.00	-	1.45	-	0.00	-	-	-	-	2.96*
6/30	-	0.00	-	1.17	-	1.41	-	0.00	-	0.00	-	2.58
7/01	0.00	-	0.00	-	3.02	-	0.00	-	0.57	-	0.00	3.59
7/02	-	0.49	-	0.00	-	0.00	-	0.00	-	0.56	-	1.05
7/03	0.00	-	0.00	-	1.58	-	0.57	-	0.57	-	0.00	2.72
7/04	-	1.76	-	1.14	-	3.08	-	0.00	-	1.59	-	7.51
7/05	0.00	-	0.00	-	-	-	-	-	-	-	-	6.14*
7/06	-	-	-	-	-	-	-	-	-	-	-	4.77*
7/07	0.57	-	0.57	-	2.26	-	0.00	-	0.00	-	0.00	3.40
7/08	-	-	-	0.60	-	0.00	-	0.00	-	0.00	-	0.60
Actual										Interpolated	Total	71.90
Total	1.68	4.58	1.59	7.50	9.93	10.16	1.63	5.45	3.76	4.18	0.00	50.46
%	3.3	9.1	3.2	14.9	19.6	20.1	3.2	10.8	7.5	8.3	0.00	100.0

Appendix Table 3. Age, length (mid-eye to tail fork, mm), and weight (round weight, kg) statistics for sockeye salmon caught during Port Moller test fishing, 1983.

	AGE GROUP								
	4 1	4 2	5 2	5 3	6 2	6 3	6 4	7 3	TOTAL
MALES									
PERCENT	0.40	30.10	9.40	12.50	0.20	2.50	0.10	0.10	55.30
MEAN LENGTH	559.25	519.90	561.33	530.13	558.50	581.83	549.00	595.00	532.67
STD ERROR	12.28	1.27	3.27	1.88	17.50	7.97	0.00	0.00	1.06
SAMPLE SIZE	4	268	85	113	2	23	1	1	497
MEAN WEIGHT	2.93	2.54	3.13	2.62	3.45	3.47	0.00	0.00	2.71
STD ERROR	.23	.03	0.07	0.04	0.00	0.21	0.00	0.00	0.02
SAMPLE SIZE	4	160	54	67	1	13	0	0	299
FEMALES									
PERCENT	0.00	23.30	10.00	8.40	0.20	2.70	0.00	0.10	44.70
MEAN LENGTH	0.00	509.00	547.11	517.95	539.50	550.68	0.00	557.00	521.97
STD ERROR	0.00	1.21	2.48	1.82	19.50	6.27	0.00	0.00	0.99
SAMPLE SIZE	0	207	90	76	2	25	0	1	401
MEAN WEIGHT	0.00	2.30	2.80	2.46	3.30	2.88	0.00	3.00	2.48
STD ERROR	0.00	0.02	0.04	0.04	0.00	0.10	0.00	0.00	0.02
SAMPLE SIZE	0	124	65	43	1	18	0	1	252
SEXES COMBINED									
PERCENT	0.40	53.40	19.40	20.90	0.40	5.20	0.10	0.20	100.00
MEAN LENGTH	559.25	515.14	554.00	525.23	549.00	565.66	549.00	576.00	527.89
STD ERROR	12.28	0.89	2.04	1.34	13.10	5.02	0.00	0.00	0.73
SAMPLE SIZE	4	475	175	189	4	48	1	2	898
MEAN WEIGHT	2.93	2.44	2.96	2.56	3.38	3.16	0.00	3.00	2.61
STD ERROR	0.23	0.02	0.04	0.03	0.00	0.10	0.00	0.00	0.02
SAMPLE SIZE	4	284	119	110	2	31	0	1	551

Appendix Table 4. Port Moller sockeye salmon daily test fishing indices and mean lengths (mid-eye to tail fork) by ocean age, 1983.

	Total			2-Ocean			3-Ocean		
Date	Catch	Index	Mean Length (mm)	Percent	Index	Mean Length (mm)	Percent	Index	Mean Length (mm)
6/09	10	5.16	528.00	40.00	2.06	517.00	60.00	3.10	535.33
6/10	10	5.03	534.10	70.00	3.52	519.57	30.00	1.51	568.00
6/11	21	11.36	517.75	80.00	9.09	504.62	20.00	2.27	570.25
6/12	19	9.29	508.27	36.36	3.38	479.25	63.64	5.91	524.86
6/13	25	12.58	542.73	45.45	5.72	527.40	54.55	6.86	555.50
6/14	17	8.61	529.76	58.82	5.06	507.50	41.18	3.55	561.57
6/15	1	19.57	573.00	0.00	0.00	0.00	100.00	19.57	573.00
6/16	65	30.53	531.14	65.45	19.98	515.72	34.55	10.55	560.37
6/17	9	4.85	520.00	55.56	2.69	517.40	44.44	2.16	523.25
6/18	57	28.51	528.62	66.00	18.82	515.24	34.00	9.69	554.59
6/19	17	12.95	518.88	76.47	9.90	516.69	23.53	3.05	526.00
6/20	0	13.75	-	70.73	9.73	-	29.27	4.02	-
6/21	27	14.55	531.68	59.09	8.60	518.38	40.91	5.95	550.89
6/22	74	37.07	522.27	81.82	30.33	517.98	18.18	6.74	541.58
6/23	0	33.33	-	70.73	23.57	-	29.27	9.76	-
6/24	55	29.56	521.65	81.63	24.13	514.97	18.37	5.43	551.33
6/25	8	4.33	534.86	71.43	3.09	517.40	28.57	1.24	578.50
6/26	82	38.90	527.95	80.00	31.12	519.39	20.00	7.78	562.21
6/27	26	14.31	531.18	63.64	9.11	528.07	36.36	5.20	536.62
6/28	60	31.86	534.51	66.04	21.04	519.94	33.96	10.82	562.83
6/29	23	11.25	531.57	80.95	9.11	524.29	19.05	2.14	562.50
6/30	103	51.86	524.27	86.67	44.95	517.86	13.33	6.91	565.92
7/01	37	19.53	524.49	81.82	15.98	517.30	18.18	3.55	556.83
7/02	89	46.81	529.79	77.63	36.34	520.20	22.37	10.47	563.06
7/03	45	24.51	525.68	82.86	20.31	514.48	17.14	4.20	579.83
7/04	80	43.38	528.24	85.14	36.93	522.71	14.86	6.45	559.91
7/05	12	32.08	548.63	45.45	14.58	516.00	54.55	17.50	575.83
7/06	0	22.40	-	70.73	15.84	-	29.27	6.56	-
7/07	21	11.91	530.80	75.00	8.93	519.07	25.00	2.98	566.00
7/08	26	15.32	527.76	80.95	12.40	517.94	19.05	2.92	569.50
Total	1019	645.15			456.32			188.83	
Mean			527.602			518.53			558.97

Appendix Table 5. Daily surface water temperature (C) recorded at Port Moller test fishing stations, 1983.

	Station												
Date	1	2	3	4	5	6	7	8	9	10	11	12	Mean
6/09	8.0	-	8.5	-	8.0	-	8.0	-	8.0	-	-	-	8.1
6/10	-	10.0	-	9.0	-	9.0	-	8.0	-	7.0	-	-	8.6
6/11	8.5	-	8.5	-	9.5	-	9.0	-	8.5	-	8.5	-	8.8
6/12	-	9.0	-	8.0	-	8.0	-	8.5	-	8.0	-	-	8.5
6/13	8.5	-	9.0	-	9.0	-	8.5	-	9.0	-	9.0	-	8.8
6/14	-	9.0	-	9.5	-	9.5	-	-	-	8.5	-	-	9.1
6/15	10.5	-	9.5	-	-	-	-	-	-	-	-	-	10.0
6/16	-	9.0	-	9.5	-	9.0	-	9.0	-	9.0	-	-	9.1
6/17	9.5	-	9.5	-	9.0	-	9.0	-	9.0	-	8.5	-	9.1
6/18	-	9.0	-	9.5	-	9.5	-	9.5	-	9.0	-	-	9.3
6/19	-	-	-	-	9.5	-	9.5	-	9.0	-	-	-	9.3
6/20	-	-	-	-	-	-	-	-	-	-	-	-	-
6/21	8.5	-	9.0	-	9.0	-	9.5	-	10.0	-	9.5	-	9.3
6/22	-	9.5	-	9.5	-	9.5	-	9.5	-	9.0	-	-	9.4
6/23	-	-	-	-	-	-	-	-	-	-	-	-	-
6/24	-	9.0	-	9.5	-	9.5	-	9.5	-	9.5	-	-	9.4
6/25	-	-	11.0	-	9.5	-	9.5	-	9.5	-	9.5	-	9.7
6/26	-	9.0	-	9.0	-	-	-	-	-	-	-	-	9.0
6/27	7.0	-	8.0	-	8.5	-	9.5	-	9.5	-	9.5	-	8.7
6/28	-	9.5	-	9.5	-	9.0	0	9.5	-	9.5	-	-	9.4
6/29	8.0	-	9.0	-	9.0	-	9.5	-	-	-	-	-	8.9
6/30	-	9.5	-	9.5	-	10.0	-	10.0	0	10.0	-	-	9.8
7/01	9.0	-	9.0	-	10.0	-	10.5	-	11.5	-	11.0	-	10.2
7/02	-	11.0	-	11.0	-	11.0	-	11.0	-	11.0	-	-	11.0
7/03	9.5	-	10.0	-	10.5	-	10.5	-	11.5	-	11.0	-	10.5
7/04	-	11.0	-	11.0	-	11.0	-	11.0	-	11.0	-	-	11.0
7/05	11.0	-	10.5	-	-	-	-	-	-	-	-	-	10.8
7/06	-	-	-	-	-	-	-	-	-	-	-	-	-
7/07	8.5	-	9.5	-	10.0	-	10.5	-	11.0	-	11.0	-	10.1
7/08	-	-	-	10.5	-	11.0	-	11.0	-	11.0	-	-	10.9
Mean	8.9	9.5	9.3	9.6	9.3	9.7	9.5	9.7	9.7	9.4	9.7	9.0	9.5

Appendix Table 6. Daily wind velocities (km/h) recorded at Port Moller test fishing stations, 1983.

	Station												
Date	1	2	3	4	5	6	7	8	9	10	11	12	Mean
6/09	5.6	-	9.3	-	27.8	-	27.8	-	22.2	-	-	-	18.5
6/10	-	3.7	-	3.7	-	3.7	-	3.7	-	3.7	-	-	3.7
6/11	24.1	-	3.7	-	3.7	-	3.7	-	18.5	-	20.4	-	12.4
6/12	-	22.2	-	14.8	-	18.5	-	18.5	-	27.8	-	-	20.4
6/13	3.7	-	3.7	-	9.3	-	18.5	-	13.0	-	9.3	-	9.6
6/14	-	22.2	-	27.8	-	20.4	-	14.8	-	14.8	-	-	20.0
6/15	11.1	-	11.1	-	-	-	-	-	-	-	-	-	11.1
6/16	-	22.2	-	27.8	-	33.3	-	33.3	-	33.3	-	-	30.0
6/17	7.4	-	3.7	-	0.0	-	0.0	-	5.6	-	3.7	-	3.4
6/18	-	0.0	-	0.0	-	3.7	-	7.4	-	22.2	-	-	6.7
6/19	-	-	-	-	5.6	-	5.6	-	5.6	-	-	-	5.6
6/20	-	-	-	-	-	-	-	-	-	-	-	-	-
6/21	13.0	-	9.3	-	13.0	-	13.0	-	13.0	-	9.3	-	11.8
6/22	-	37.0	-	42.6	-	27.8	-	13.0	-	7.4	-	-	25.6
6/23	-	-	-	-	-	-	-	-	-	-	-	-	-
6/24	-	18.5	-	11.1	-	20.4	-	27.8	-	18.5	-	-	19.3
6/25	-	-	0.0	-	9.3	-	9.3	-	9.3	-	9.3	9.3	7.8
6/26	-	37.0	-	55.6	-	-	-	-	-	-	-	-	46.3
6/27	27.8	-	18.5	-	27.8	-	33.3	-	18.5	-	18.5	-	24.1
6/28	-	0.0	-	0.0	-	0.0	-	0.0	-	0.0	-	-	0.0
6/29	5.6	-	20.4	-	27.8	-	46.3	-	0.0	-	-	-	20.0
6/30	-	0.0	-	0.0	-	0.0	-	7.4	-	3.7	-	-	2.2
7/01	0.0	-	0.0	-	7.4	-	9.3	-	0.0	-	0.0	-	2.8
7/02	-	3.7	-	3.7	-	7.4	-	9.3	-	3.7	-	-	5.6
7/03	9.3	-	10.2	-	13.0	-	13.0	-	13.0	-	13.0	-	11.9
7/04	-	9.3	-	16.7	-	16.7	-	13.0	-	9.3	-	-	13.0
7/05	27.8	-	27.8	-	-	-	-	-	-	-	-	-	27.8
7/06	-	-	-	-	-	-	-	-	-	-	-	-	-
7/07	1.9	-	1.9	-	9.3	-	13.0	-	27.8	-	27.8	-	13.6
7/08	-	-	-	0.0	-	0.0	-	0.0	-	0.0	-	0.0	0.0
Mean	12.5	14.7	9.2	15.7	12.8	11.7	16.1	12.4	12.4	11.8	12.4	4.7	14.9

Appendix Table 7. Total inshore return and mean length of sockeye salmon in relation to Port Moller test fishing and Cold Bay air temperature indices, Bristol Bay, 1968-1983.

Year	Inshore Return (Million)	Port Moller Index	Inshore Return (Thousands) Per Index Point	Cold Bay[1] Air Temperature Index (F)	Port Moller[2] Mean Weight (kg)	Port Moller[2] Mean Length (mm)	Inshore Mean Length (mm)[2]
1968	8.00	305.95	26.15	91.0	2.54	545.53	534.7
1969	19.97	602.97	32.16	92.2	2.40	537.79	520.2
1970	39.39	823.38	47.84	92.3	2.22	526.11	510.5
1971	15.82	680.50	23.35	94.7	2.65	549.37	552.4
1972	5.37	97.72	54.95	88.3	2.94	553.70	543.7
1973	2.42	339.60	7.13	82.1	3.31	582.87	572.9
1974	10.94	-	-	84.1	-	-	527.6
1975	24.20	1289.30	18.77	88.3	2.38	547.13	522.7
1976	11.47	688.60	16.66	92.0	2.78	552.95	543.5
1977	9.47	782.10	12.11	90.8	3.18	565.67	557.5
1978	19.65	446.54	44.01	94.2	2.76	541.25	536.8
1979	40.80	1034.45	39.44	96.6	2.71	546.53	538.8
1980	62.28	526.78	118.23	97.6	2.68	542.71	524.6
1981	34.58	1052.15	32.27	95.9	3.00	566.49	556.0
1982	22.13	758.94	29.16	93.5	3.06	567.00	560.8
1983	45.78	645.15	70.96	92.6	2.61	527.89	528.8

[1] Sum of mean June Cold Bay air temperatures for the two years prior to the inshore spawning return.

[2] Length measured from mid-eye to tail fork.

1983 NUSHAGAK DISTRICT TEST FISHING

By

Michael L. Nelson
Alaska Department of Fish and Game
Division of Commercial Fisheries
Dillingham, Alaska

INTRODUCTION

District test fishing is conducted both within the commercial fishing boundaries and in areas adjacent to these boundaries (Figure 1). This phase of the test fishing program was initiated in Naknek-Kvichak District in 1962, but since then programs have also been developed for use in Egegik, Ugashik, and Nushagak Districts.

The primary goal of district test fishing is to monitor abundance, distribution, and movement patterns of sockeye salmon within a district during closed fishing periods. This information is used by fishery managers to set and adjust fishing periods. In Nushagak District test fishing is used to index escapement and salmon abundance when milling and holding salmon begin to move into the various river systems. For example, if a large amount of fishing effort is present, fishery closures are needed to protect milling salmon until they resume migration into their spawning systems. On the other hand, if large concentrations of salmon are present, fishery openings of sufficient duration are needed to allow maximum harvest.

During 1983 test fishing was needed within Nushagak District to determine the abundance of sockeye salmon, since escapements to both the Wood and Nuyakuk-Nushagak River systems had decreased greatly after two 12-hour commercial fishing periods on 26 and 28 June. Although the total run to the District was forecasted to be 5.8 million sockeye salmon, the commercial catch had already reached 1.0 million out of a cumulative run to date of 1.1 million. Since Nuyakuk and Nushagak system stocks sometimes arrived earlier in the season than other stocks, they could have comprised a large proportion of the commercial catch and, then, extreme care would have been required to achieve escapement goals for these systems.

METHODS

District test fishing is conducted only during closed fishing periods, as commercial landings provide similar information during open periods. One or two chartered fishing vessels, with Alaska Department of Fish and Game observers aboard, are used for test fishing. Test drifts of ten minutes or less are made with 18 to 91 mm (10 to 50 fm) of gill net having 137 mm (5-3/8 in) stretched mesh. It has proven most useful to make many short

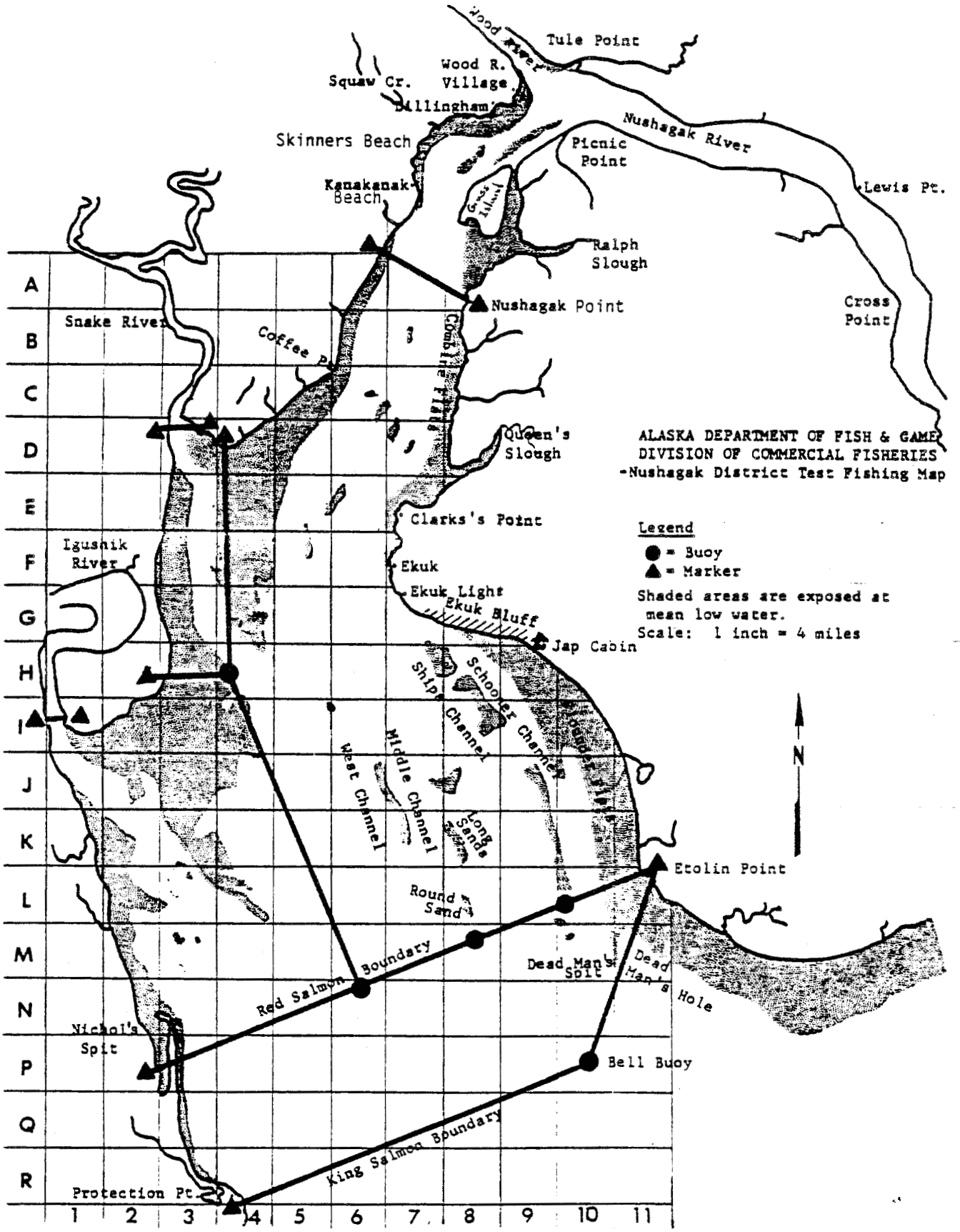


Figure 1. Nushagak test fishing areas.

drifts throughout the district to provide the best information on salmon distribution, abundance, and movement. Salmon catch per drift is adjusted according to amount of gear fished and duration of drift so that comparisons can be made among locations. Information from each drift is immediately transmitted to the area office via radio, so that timely management decisions can be made.

RESULTS AND DISCUSSION

In 1983, the district test fishing program provided critical information on abundance and movement patterns of sockeye salmon within Nushagak District and contributed to decisions that helped ensure achievement of spawning escapement goals and optimal harvest of the resource. A total of 1,383 sockeye salmon were caught by the chartered fishing vessel during 47 drifts within Nushagak District over a four-day period, 29 June through 2 July (Table 1; Figure 1; Appendix Table 1). Test fish indices from 29 June through the morning flood tide of 2 July were always greatest in the middle of the District, indicating that a large concentration of sockeye salmon was milling and holding within the District. However, on the evening flood tide of 2 July, test fish indices were greatest above the inside District boundary, indicating that sockeye salmon had begun to leave the District and travel up the Wood and Nushagak Rivers. This information played an important role in the Department's decision to open the District to commercial fishing for a 12-hour period on the morning of 3 June. Escapement of sockeye salmon into the Nuyakuk, Nushagak-Mulchatna, and Wood River systems during the evening flood tide of 2 July proved to be sufficient to achieve spawning goals for all these systems.

Table 1. Summary of Nushagak District sockeye salmon test fishing indices by area and date, Bristol Bay, 1983.

	Date						
	June 29	June 30		July 1		July 2	
Index Area	P.M.	A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
Nushagak River							19,600
Wood River							
Kanakanak Beach	133		40		0	0	229
Grassy Island	600		72		0	125[1]	30,000
Nushagak Point	3,154	60	155	0	97	930[2]	41,400
Coffee Point		0					
Combine Flats	3,397		320	27[1]	345		
Clarks Point	1,307	0	76		1,340[1]	4,982	
Ekuk Bluff	480		0		913[1]	2,412	
Schooner Channel:							
Northwest				20			
Southeast							
Ships Channel:							
Northwest		0	1,593	405			
Southeast							
Middle Channel:							
Northwest		1,190		343			
Southeast							
West Channel:							
Northwest		394		120			
Southeast							
Dead Man's Spit							
Nichols Spit							

[1] Mean of two consecutive drifts in same index area.

[2] Mean of four consecutive drifts in same index area.

APPENDIX

Appendix Table 1. Nushagak District test fishing catches, fishing times, gill net lengths, sockeye salmon indices, and tide stages by date and index area, Bristol Bay, 1983.

Date	Set	Index Area [1]	Gill Net Length (m) [2]	Drift Time (min)	Sockeye Salmon Catch	Sockeye Salmon Index [3]	Chinook Salmon Catch	Chum Salmon Catch	Tide Stage
					Trip No. 1				
June 29	1	Grassy	91	7.00	35	600	0	1	S
	2	Kanak	91	4.50	5	133	0	0	E
	3	A8	91	3.50	92	3,154	0	0	E
	4	C7	91	3.25	92	3,397	1	0	E
	5	E7	91	4.50	49	1,307	1	0	E
	6	F6	91	7.00	28	480	0	0	E
June 30	7	G7	91	8.25	0	0	0	7	F
	8	H7	91	7.00	0	0	0	4	F
	9	H6	91	6.25	62	1,190	0	8	F
	10	H5	91	7.00	23	394	0	1	F/H
	11	B8	91	10.00	5	60	0	0	E
	12	A6	91	6.00	0	0	0	0	E
					Trip No. 2				
June 30	1	Grassy	91	10.00	6	72	0	0	F
	2	Kanak	91	6.00	2	40	0	1	F
	3	A8	91	8.50	11	155	0	0	F
	4	C7	91	7.50	20	320	0	0	H
	5	E7	91	9.50	6	76	0	2	H
	6	F7	91	8.50	0	0	0	0	E
	7	H7	91	5.50	73	1,593	0	2	E
July 1	8	J6	91	11.00	11	120	1	5	F
	9	J7	91	10.50	30	343	0	7	F
	10	J8	91	8.00	27	405	0	0	F
	11	H8	91	6.00	1	20	0	2	F
	12	D7	91	9.00	4	53	0	0	H
	13	C6	91	5.00	0	0	0	0	H
	14	A8	91	7.50	0	0	0	0	E
					Trip No. 3				
July 1	1	Grassy	91	8.35	0	0	0	0	F
	2	Kanak	91	6.17	0	0	0	0	F
	3	A7	91	11.10	9	97	5	1	E
	4	C7	91	5.92	17	345	8	2	E
	5	E7	91	6.08	7	138	0	0	E
	6	E6	91	3.92	83	2,541	0	0	E
	7	F6	91	5.58	0	0	0	0	E
	8	G7	91	4.93	75	1,826	0	0	E
July 2	9	F6	91	3.88	78	2,412	0	0	F
	10	E6	91	3.30	137	4,982	0	0	F
	11	B7	91	5.12	31	727	0	0	F
	12	A7	91	14.70	46	376	0	0	H
	13	A7	91	4.57	1	26	0	0	E
	14	A7	45	2.50	27	2,592	0	0	E
	15	Kanak	91	4.50	0	0	0	0	E
	16	Grassy	91	10.10	7	83	0	0	E
	17	Grassy	91	7.92	11	167	0	0	E
					Trip No. 4				
July 2	1	Skinns	91	5.25	10	229	3	0	F
	2	Nush	36	1.00	138	41,400	0	0	F
	3	Grassy	18	1.50	75	30,000	0	2	F
	4	Picnic	18	1.50	49	19,600	0	1	F

[1] Grassy=Grassy Island; Kanak=Kanakanak Beach; Nush=Nushagak Point, Picnic=Picnic Point; number and letter codes=grid locations on Nushagak District test fishing map.

[2] Gill net stretched mesh size was 134 mm (5-3/8 in).

[3] Index expressed as number of sockeye salmon that would have been caught if a gill net 182 m (600 ft) long were fished for one hour.

1983 KVICHAK, EGEGIK, AND UGASHIK ESCAPEMENT TEST FISHING

By

Henry J. Yuen
Alaska Department of Fish and Game
Division of Commercial Fisheries
Anchorage, Alaska

INTRODUCTION

The Bristol Bay sockeye salmon escapement test fishing program began in 1960 to provide an early estimate of escapement past the commercial fisheries. Such estimates are needed because sockeye salmon migration time to tower counting sites in clear water areas ranges from one to nine days. Therefore, visual counts are often not available in time for making within-season fishery management decisions, especially when 80% of the salmon run can be harvested within a two-week period. During 1983, on the east side of Bristol Bay, within-season forecasts of sockeye salmon escapement using river test fishing data were made for the Kvichak, Egegik, and Ugashik Rivers. This report summarizes this data and presents results of analyses.

METHODS

One test fishing site was located in the lower section of each river, as close as possible to the fishing district boundary but above areas where salmon milled about or flushed up and down with the tides (Figure 1). Both river banks at each site were fished at the start of each flood tide on the Kvichak River, 1-1/2 hours before each high slack on the Egegik River, and 1-1/2 hours prior to each low slack on the Ugashik River. Therefore, a maximum of four sets per day were made within each river. A gill net with 137 mm (5-3/8 in) stretched mesh, 28 meshes deep, and 46 or 92 m (25 or 50 fm) long was used. Fishing time was usually 30 minutes or less to minimize catches while still obtaining good estimates of sockeye salmon escapement.

Catches were expressed as the number of fish caught per fathom of net used per hour of fishing time. Tese standardized indices were calculated individually for each set. The daily test fish index was the mean of all the individual test fish indices from that day. All salmon caught were aged (using scale samples), weighed (round weight, kg), and measured (mid-eye to tail fork length, mm).

Forecasts of cumulative escapement were made by multiplying cumulative daily index points by an escapement per index point (EPI) value calculated from either (A) lag time analysis or (B) catchability models based upon size of sockeye salmon caught.

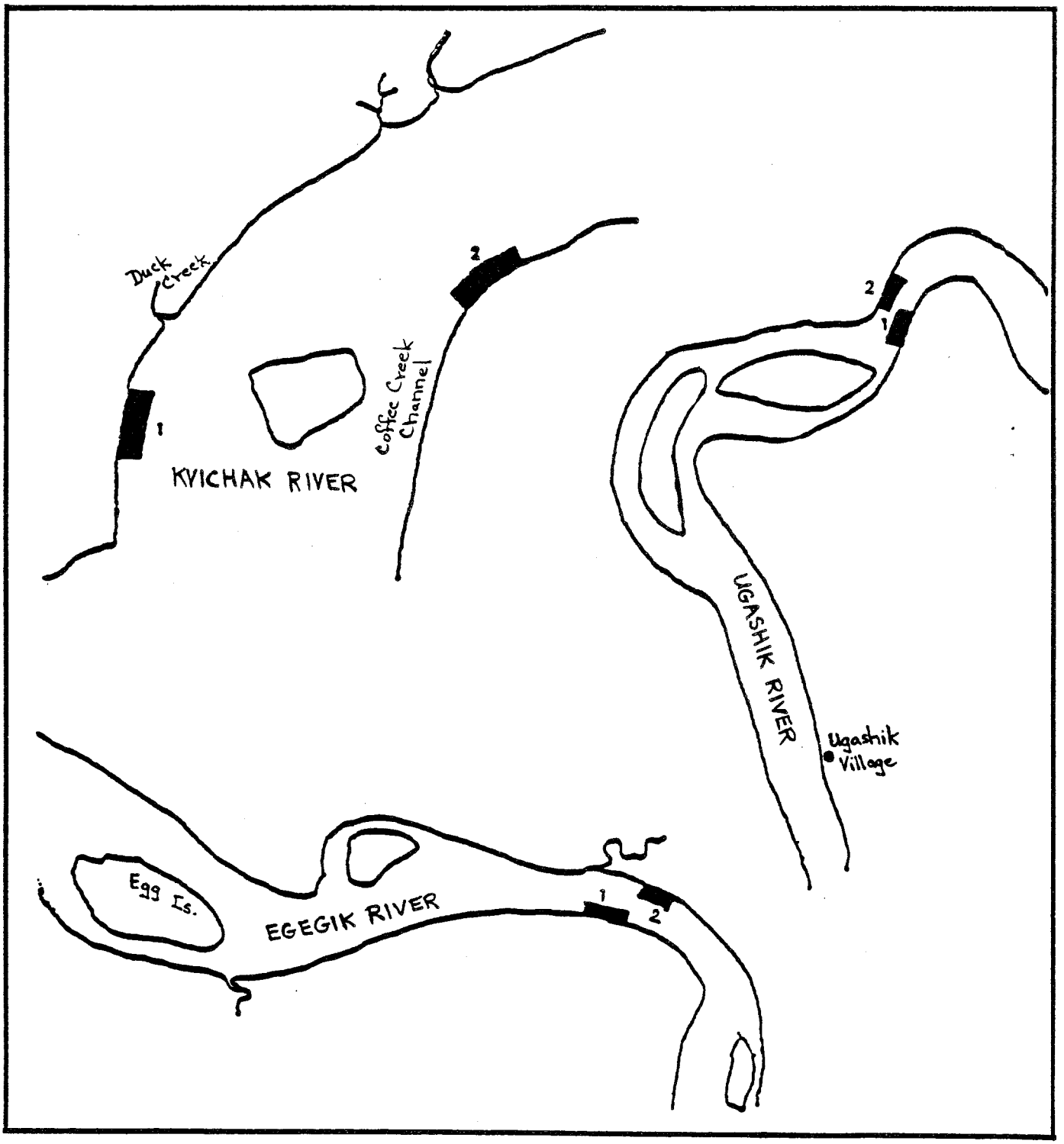


Figure 1. Locations of escapement test fishing sites on the Kvichak, Egegik, and Ugashik Rivers, 1983.

EPI values based on lag time analysis were computed using two methods: (1) cumulative escapement divided by cumulative indices for the most recent date:

$$EPI = \frac{\sum_{i=1}^{t+\Delta l} E_{i+\Delta l}}{\sum_{i=1}^{t+\Delta l} I_i},$$

or (2) least squares fit (Mundy and Mathisen 1981):

$$EPI = \frac{\sum_{i=1}^{t+\Delta l} E_{i+\Delta l}\, I_i}{\sum_{i=1}^{t+\ l} I_i{}^2},$$

Δl = lag time (days), I = daily indices, and E = daily tower counts.

In both methods, a lag time was selected by comparing cumulative test fish and escapement curves. The time shift that resulted in the smallest squared sum of errors between the two curves was selected as the best lag time estimate. To obtain a least squares estimate, the most accurate "forecast" of current cumulative escapement, using cumulative indices from several proceeding days, was also used to choose a lag time. In both methods, lag times equal to zero or considered to be excessive were ignored.

EPI values based on catchability models were computed using equations describing the relationship between running mean length (X, mm) and final EPI estimates (Y, sockeye salmon escapement per index point) for past seasons (Tables 1, 2, and 3). A power curve equation was used for all three rivers:

$$Y = a\, X^b$$

and a linear regression for the Kvichak River only:

$$Y = a + bX, \text{ where}$$

a, b = constants.

Table 1. Historic data on mean weight, mean length, and return per index values, Kvichak River sockeye salmon test fishery.

Year	Mean Weight (kg)[1]	Mean Length (mm)[2]	Return/Index
1969	2.31	509.1	441
1970	2.18	498.6	614
1971	2.54	536.1	149
1972	2.77	540.9	79
1973	3.04	533.1	43
1974	-	-	-
1975	2.39	507.0	222
1976	2.63	508.6	160
1977	3.08	533.1	97
1978	2.39[3]	498.8	147
1979	2.50[3]	519.3[3]	227
1980	2.20[3]	514.6[3]	161
1981	2.54[3]	528.8[3]	84
1982	2.56[3]	532.3[3]	69
1983	2.28[3]	513.5[3]	216

[1] From commercial processors reports.

[2] From tower samples.

[3] From inside test fish samples.

$Y = a X^b$ Y = Return/Index
X = Mean Length (mm)

$a = 4.0124 \times 10^{85}$

$b = -30.7176$

$r^2 = 0.8252$

Note: only 1979-1983 included in power progression

Table 2. Historic data on mean weight, mean length, and return per index values, Egegik River sockeye salmon test fishery.

Year	Mean Weight (kg)[1]	Mean Length (mm)[2]	Return/Index
1969	2.49	531.5	239
1970	2.18	494.1	202
1971	2.68	559.4	221
1972	2.72	529.5	184
1973	3.22	586.1	75
1974	-	-	-
1975	2.58	551.6	74
1976	2.68	545.1	54
1977	2.87	565.7	103
1978	3.04[3]	566.1[3]	59
1979	2.69[3]	546.5[3]	43[4]
1980	2.19[3]	524.6[3]	85[4]
1981	2.65[3]	544.0[3]	38[4]
1982	2.97[3]	568.7[3]	33[4]
1983	2.56[3]	536.6[3]	45[4]

[1] From commercial processors reports.

[2] From tower samples.

[3] From inside test fish samples.

[4] Return/index values are not comparable with those of prior years due to relocation of test fish project upriver.

$Y = a X^b$ Y = Return/Index

X = Mean Length (mm)

$a = 3.1678 \times 10^{30}$

$b = -10.5407$

$r^2 = 0.7383$

Note: only 1979-1983 used in power progression

Table 3. Historic data on mean weight, mean length, and return per index values, Ugashik River sockeye salmon test fishery.

Year	Mean Weight (kg)[1]	Mean Length (mm)[2]	Return/Index
1961	-	574.8	26
1962	-	537.7	15
1963	2.81	543.8	38
1964	2.40	510.0	23
1965	2.40	495.9	51
1966	2.95	555.0	51
1967	2.86	555.3	26
1968	2.68	526.2	11
1978	2.90[3]	543.0	3
1979	2.61[3]	538.0[3]	39
1980	2.30[3]	520.5[3]	30
1981	2.92[3]	560.2[3]	18
1982	3.12[3]	571.76[3]	24
1983	2.42[3]	521.71[3]	54

[1] From commercial processors reports.

[2] From tower samples.

[3] From inside test fish samples.

$Y = a X^b$ Y = Return/Index

X = Mean Length (mm)

$a = 9.4190 \times 10^{21}$

b = -7.4932

$r^2 = .5516$

Note: only 1979-1983 used in power regression

RESULTS AND DISCUSSION

Kvichak River

Test fishing began 21 June and ended 12 July. A total of 949 sockeye salmon were caught resulting in 13,233.63 accumulated daily index points. Mean sockeye length was 513.52 mm and mean weight was 2.28 kg (Table 4). Data by set and station are presented in Appendix Table 1. Age and sex composition data are presented in Appendix Table 2.

Lag time estimated on 12 July, the last day of test fishing, by the first method was 2 days, i.e., the lag time with the smallest sum of errors squared (Figure 2). A lag time of 2 days with this method produced an EPI estimate of 216 and an escapement forecast of 2,861,576 for 12 July. The actual tower count on 14 July was 2,853,198, 0.3% less than the final forecast.

Lag time estimated on the last day of test fishing by the least squares method was also 2 days, i.e., the lag time with the smallest sum of errors squared and the most accurate forecast of the current accumulated escapement (Figure 3). A lag time of 2 days with this method, however, produced an EPI estimate of 159 and an escapement forecast of 2,109,977 for 14 July. The difference between the final forecast and the escapement 2 days later was 26.1% less accurate than the first method.

The catchability model utilizing fish size produced EPI values of 223 and 209 and escapement forecasts of 2,954,963 and 2,773,893 for the power curve and linear regression model, respectively (Figures 2 and 3). Those forecast were within +3.6 and -2.8% of the actual escapement two days later.

Egegik River

Test fishing began 15 June and continued through 10 July. A total of 1,568 sockeye salmon were caught resulting in 16,276.12 daily index points. Mean length was 536.609 mm and mean weight was 2.56 kg (Table 5). Data by set and station are presented in Appendix Table 3. Age and sex composition data are presented in Appendix Table 4.

Lag time estimated on 10 July, the last day of test fishing, by the first method was 1 day, i.e., the lag time with the smallest sum of errors squared (Figure 4). A lag time of 1 day with this method produced an EPI estimate of 45 and an escapement forecast of 726,366 for 11 July, only 1.1% over the actual 11 July tower count of 718,368.

Lag time estimated on the last day of test fishing by the least squares method was 2 days, i.e., the lag time with the smallest sum of errors squared which lead to the most accurate forecast of the current accumulated escapement (Figure 5). A lag time of 2 days with this method produced an EPI estimate of 51 and escapement forecast of 834,563 for 11 July. This forecast was not as accurate as the forecast from the first method. It was 16.2% over the actual escapement 2 days later.

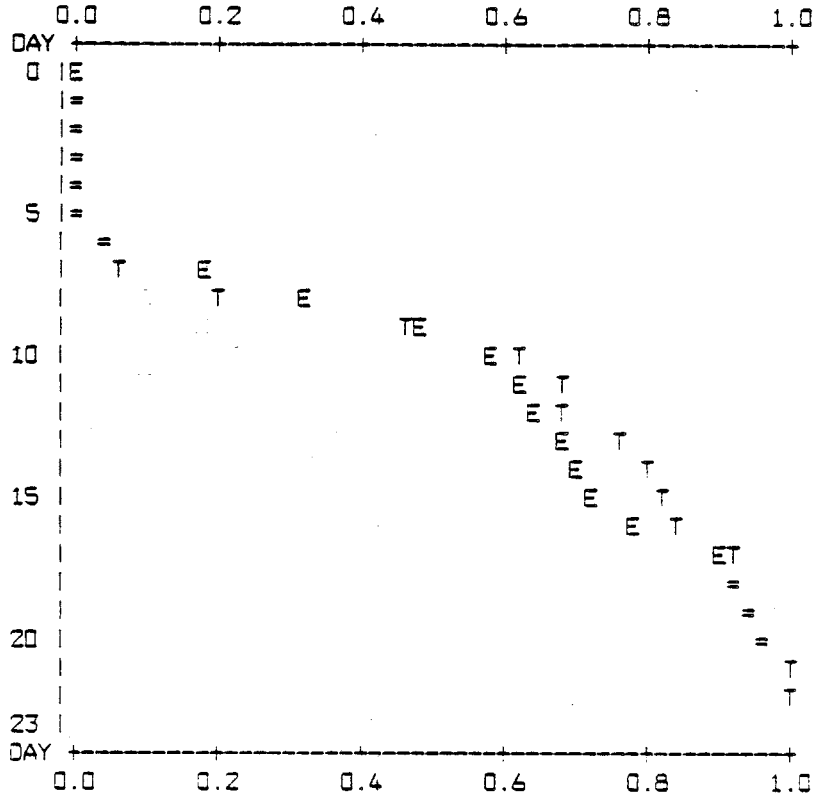
Table 4. Sockeye salmon escapement test fish summary data, Kvichak River, 1983.

DATE	FISHING TIME	CATCH	INDEX	ACCUMULATIVE INDEX	MEAN WEIGHT	MEAN LENGTH	RUNNING MEAN LENGTH
6 21	96.80	1	2.03	2.03	2.22	522.00	522.00
6 22	90.76	0	0.00	2.03	0.00	0.00	522.00
6 23	102.29	0	0.00	2.03	0.00	0.00	522.00
6 24	38.48	0	0.00	2.03	0.00	0.00	522.00
6 25	91.28	1	1.04	3.07	2.18	505.00	516.27
6 26	69.34	71	472.34	475.40	2.40	517.78	517.77
6 27	49.42	84	441.40	916.80	2.23	516.31	517.07
6 28	42.89	115	1636.57	2553.38	2.33	518.38	517.91
6 29	19.62	127	3602.80	6156.18	2.41	516.42	517.04
6 30	13.09	75	2061.90	8218.08	2.34	513.45	516.14
7 1	34.50	52	735.88	8953.96	1.93	502.73	515.03
7 2	55.35	19	115.08	9069.03	1.98	503.75	514.89
7 3	35.44	98	1010.96	10079.99	2.07	505.97	514.00
7 4	75.12	60	420.18	10500.17	1.97	501.74	513.51
7 5	68.72	37	273.96	10774.13	1.99	509.37	513.40
7 6	72.93	50	297.10	11071.23	2.51	517.11	513.50
7 7	23.05	52	1052.95	12124.18	2.29	519.09	513.99
7 8	58.34	13	54.94	12179.12	2.07	499.63	513.92
7 9	67.67	37	246.21	12425.33	2.18	509.88	513.84
7 10	37.59	19	197.42	12622.75	2.22	516.21	513.86
7 11	50.94	19	488.03	13110.78	2.06	504.62	513.51
7 12	73.10	19	122.84	13233.63	2.67	513.70	513.52
TOTAL		949	13233.63				
MEAN					2.28	513.52	

KVICHAK

7/12 ACCUMULATED ESCAPEMENT = 2,729,484
7/12 ACCUMULATED INDEX= 13233.66113 (4 SETS ON LAST DAY)
MEAN LENGTH = 513.59 FISH/INDEX = 223 FORECAST = 2,954,963 (POWER CURVE)
FISH/INDEX = 209 FORECAST = 2,773,893 (LINEAR REGRESSION)
MEAN WEIGHT =2.28 KG (5.01 LBS)

LAGTIME	FISH PER INDEX	FORECAST AHEAD	SUMS OF SQUARES	FORECAST 7/12
1	208.186	2,755,058	800471.19	2729484.00
2	216.235	2,861,576	735101.06	2729484.00
3	219.670	2,907,042	1282358.50	2729484.00
4	224.111	2,965,809	1951392.87	2729484.00
5	225.127	2,979,249	2588193.00	2729484.00



INDEX	FORECAST	ACTUAL
0.00	0.00	390.00
2.03	439.80	444.00
2.03	439.80	492.00
2.03	439.80	498.00
2.03	439.80	504.00
3.07	663.64	3132.00
475.40	102798.86	142134.00
916.80	198245.00	520458.00
2553.38	552128.75	937770.00
6156.18	1331179.50	1360122.00
8218.08	1777034.25	1676928.00
8953.96	1936155.87	1773012.00
9069.03	1961039.62	1859706.00
10079.99	2179643.25	1959282.00
10500.17	2270500.00	2006172.00
10774.13	2329740.25	2048376.00
11071.26	2393990.75	2204220.00
12124.22	2621675.75	2553390.00
12179.16	2633556.50	2648610.00
12425.36	2686794.50	2680494.00
12622.79	2729484.00	2729484.00
13110.82	2835013.25	0.00
13233.66	2861576.25	0.00
0.00	0.00	0.00

TIME LAG = 2

CURVE	DATA POINT PLOT SYMBOL	NUMBER OF POINTS
TEST FISH	T	22
ESCAPEMENT	E	23

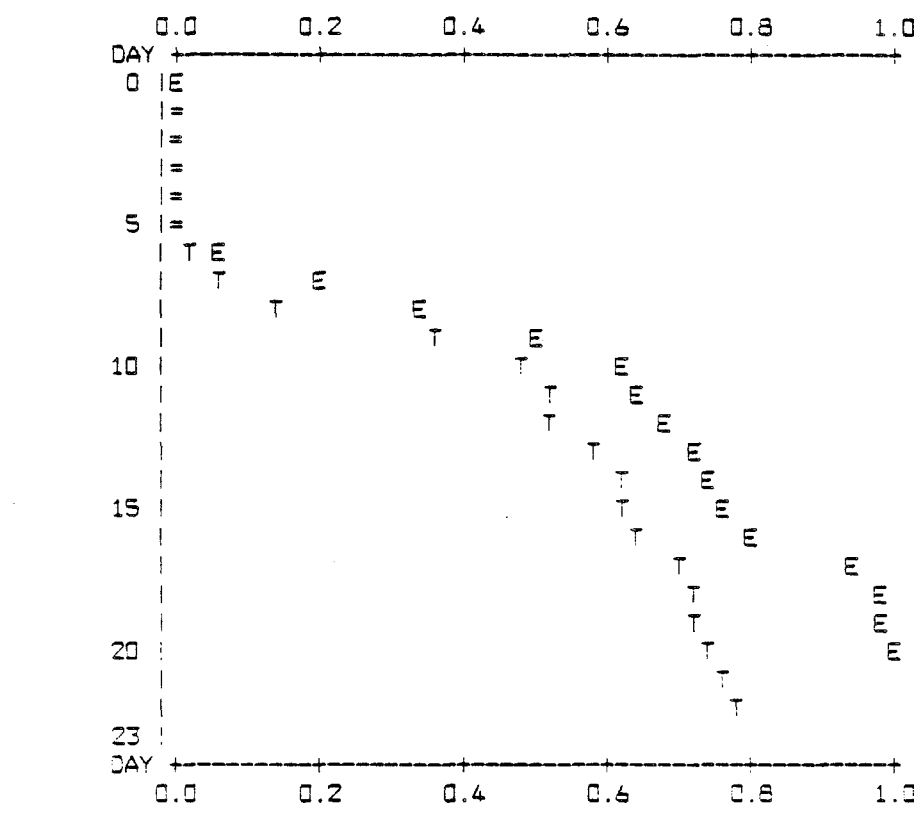
THE PLOT SYMBOL = USED WHEN 2 DATA POINTS ARE IN SAME PLOT POSITION

Figure 2. Computer printout of estimate of escapement/index point and forecast of escapement from running mean length, lag time estimate by the accumulated escapement divided by accumulated index method, and plot of cumulative index and escapement curves on last day of test fishing, Kvichak River, 1983.

KVICHAK

7/12 ACCUMULATED ESCAPEMENT = 2,729,484
7/12 ACCUMULATED INDEX= 13233.66113 (4 SETS ON LAST DAY)
MEAN LENGTH = 513.59 FISH/INDEX = 223 FORECAST = 2,954,963 (POWER CURVE)
FISH/INDEX = 209 FORECAST = 2,773,893 (LINEAR REGRESSION)
MEAN WEIGHT =2.28 KG (5.01 LBS)

LAGTIME	FISH PER INDEX	FORECAST AHEAD	SUMS OF SQUARES	FORECAST 7/12
1	155.823	2,062,103	7584366.50	2042961.25
2	159.440	2,109,977	1973064.75	2012579.75
3	119.344	1,579,355	2382272.00	1482890.00
4	75.969	1,005,353	4018578.00	925243.87
5	61.894	819,089	5520889.50	750420.69



DAY	INDEX	FORECAST	ACTUAL
0	0.00	0.00	390.00
	2.03	324.29	444.00
	2.03	324.29	492.00
	2.03	324.29	498.00
	2.03	324.29	504.00
5	3.07	489.34	3132.00
	475.40	75798.54	142134.00
	916.80	146175.58	520458.00
	2553.38	407111.09	937770.00
	6156.18	981542.69	1360122.00
10	8218.08	1310292.75	1676928.00
	8953.96	1427620.87	1773012.00
	9069.03	1445968.75	1859706.00
	10079.99	1607155.87	1959282.00
	10500.17	1674148.87	2006172.00
15	10774.13	1717829.62	2048376.00
	11071.26	1765204.50	2204220.00
	12124.22	1933087.62	2553390.00
	12179.16	1941847.75	2648610.00
	12425.36	1981102.75	2680494.00
20	12622.79	2012579.75	2729484.00
	13110.82	2090391.50	0.00
	13233.66	2109977.75	0.00
23	0.00	0.00	0.00

TIME LAG = 2

CURVE	DATA POINT PLOT SYMBOL	NUMBER OF POINTS
TEST FISH	T	22
ESCAPEMENT	E	23

THE PLOT SYMBOL = USED WHEN 2 DATA POINTS ARE IN SAME PLOT POSITION

Figure 3. Computer printout of estimate of escapement/index point and forecast of escapement from running mean length, lag time estimate by the least squares method, and plot of cumulative index and escapement curves on last day of test fishing, Kvichak River, 1983.

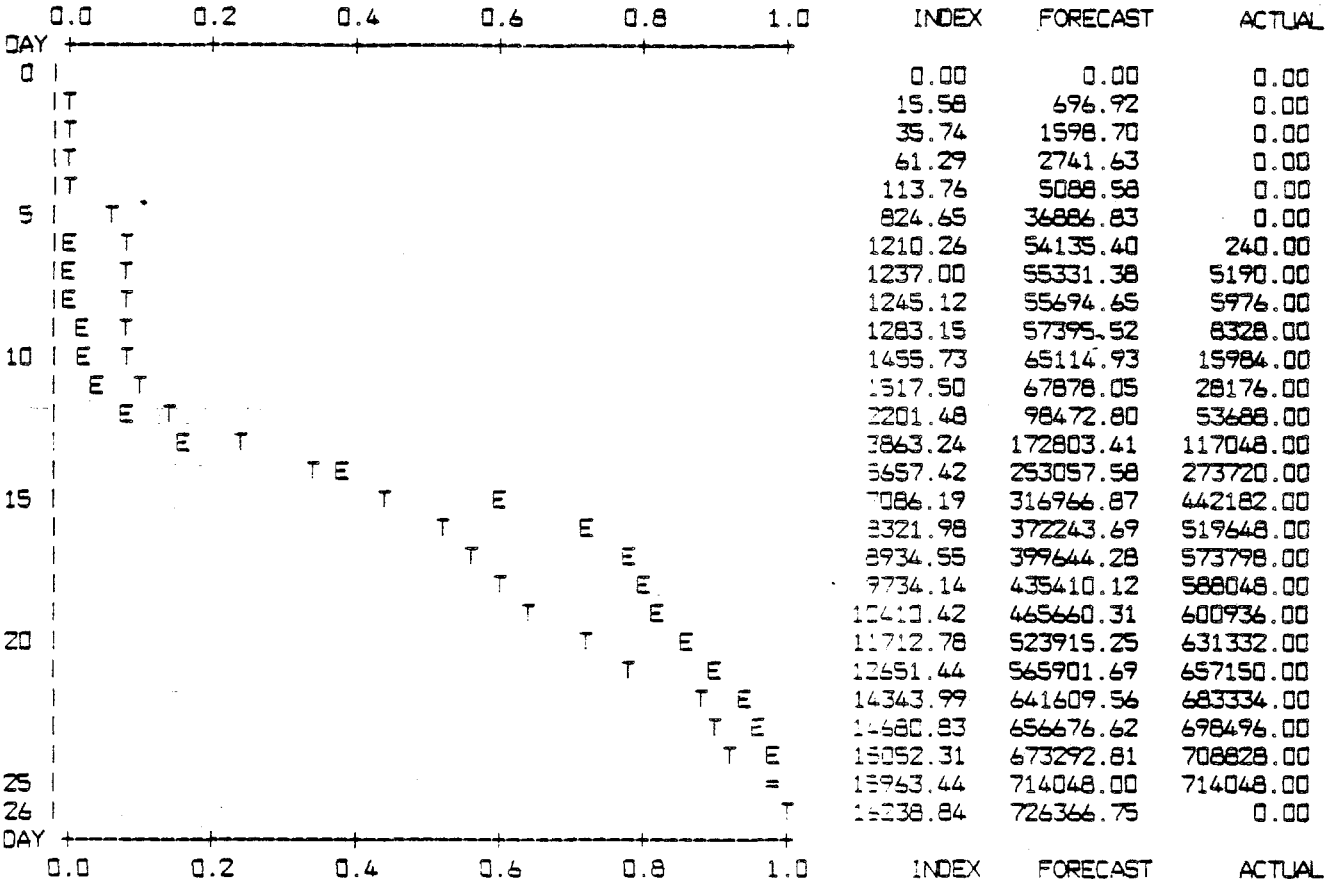
Table 5. Sockeye salmon escapement test fish summary data, Egegik River, 1983.

DATE	FISHING TIME	CATCH	INDEX	ACCUMULATIVE INDEX	MEAN WEIGHT	MEAN LENGTH	RUNNING MEAN LENGTH
6 15	58.20	4	15.58	15.58	2.20	532.74	532.74
6 16	94.50	9	20.16	35.74	2.43	536.92	535.76
6 17	108.80	10	25.55	61.29	2.30	532.12	534.02
6 18	124.30	27	52.47	113.76	2.79	550.90	542.38
6 19	74.60	65	708.95	822.72	2.47	551.67	550.46
6 20	65.60	62	385.61	1208.33	2.66	544.98	548.70
6 21	107.80	12	26.74	1235.07	2.37	544.52	548.61
6 22	59.20	2	8.12	1243.19	2.54	540.56	548.58
6 23	116.20	19	38.02	1281.21	2.35	528.86	547.99
6 24	91.50	54	172.58	1453.79	2.57	546.65	547.83
6 25	114.60	30	61.77	1515.56	2.46	545.07	547.72
6 26	72.90	69	683.98	2199.55	2.67	538.39	544.80
6 27	24.24	119	1661.75	3861.30	2.53	546.74	545.64
6 28	21.40	88	1831.68	5692.98	2.71	541.28	544.23
6 29	42.90	92	1428.77	7121.76	2.61	532.96	541.97
6 30	54.70	127	1235.78	8357.54	2.65	533.70	540.74
7 1	37.20	82	612.58	8970.12	2.50	527.67	539.85
7 2	51.90	81	799.59	9769.71	2.59	534.98	539.45
7 3	54.50	95	676.28	10445.99	2.60	527.51	538.68
7 4	49.40	91	1302.36	11748.35	2.56	539.61	538.78
7 5	33.60	71	938.66	12687.01	2.50	532.12	538.29
7 6	61.00	111	1694.25	14381.26	2.44	527.01	536.96
7 7	56.70	71	336.84	14718.11	2.56	536.04	536.94
7 8	19.70	25	371.48	15089.58	2.32	516.91	536.69
7 9	35.10	97	911.13	16000.71	2.45	534.43	536.56
7 10	61.50	55	275.40	16276.12	2.47	538.88	536.60
TOTAL		1568	16276.12				
MEAN					2.56	536.60	

EGEGIK

7/10 ACCUMULATED ESCAPEMENT = 714,048
7/10 ACCUMULATED INDEX= 16238.84277 (4 SETS ON LAST DAY)
MEAN LENGTH = 536.57 FISH/INDEX = 81 FORECAST = 1,324,426 (POWER CURVE)
MEAN WEIGHT =2.56 KG (5.63 LBS)

LAGTIME	FISH PER INDEX	FORECAST AHEAD	SUMS OF SQUARES	FORECAST 7/10
1	44.730	726,366	392149.47	714048.00
2	47.438	770,334	448131.72	714048.00
3	48.638	789,826	587925.37	714048.00
4	49.780	808,374	743827.19	714048.00
5	56.440	916,520	805955.87	714048.00



TIME LAG = 1

CURVE	DATA POINT PLOT SYMBOL	NUMBER OF POINTS
TEST FISH	T	26
ESCAPEMENT	E	20

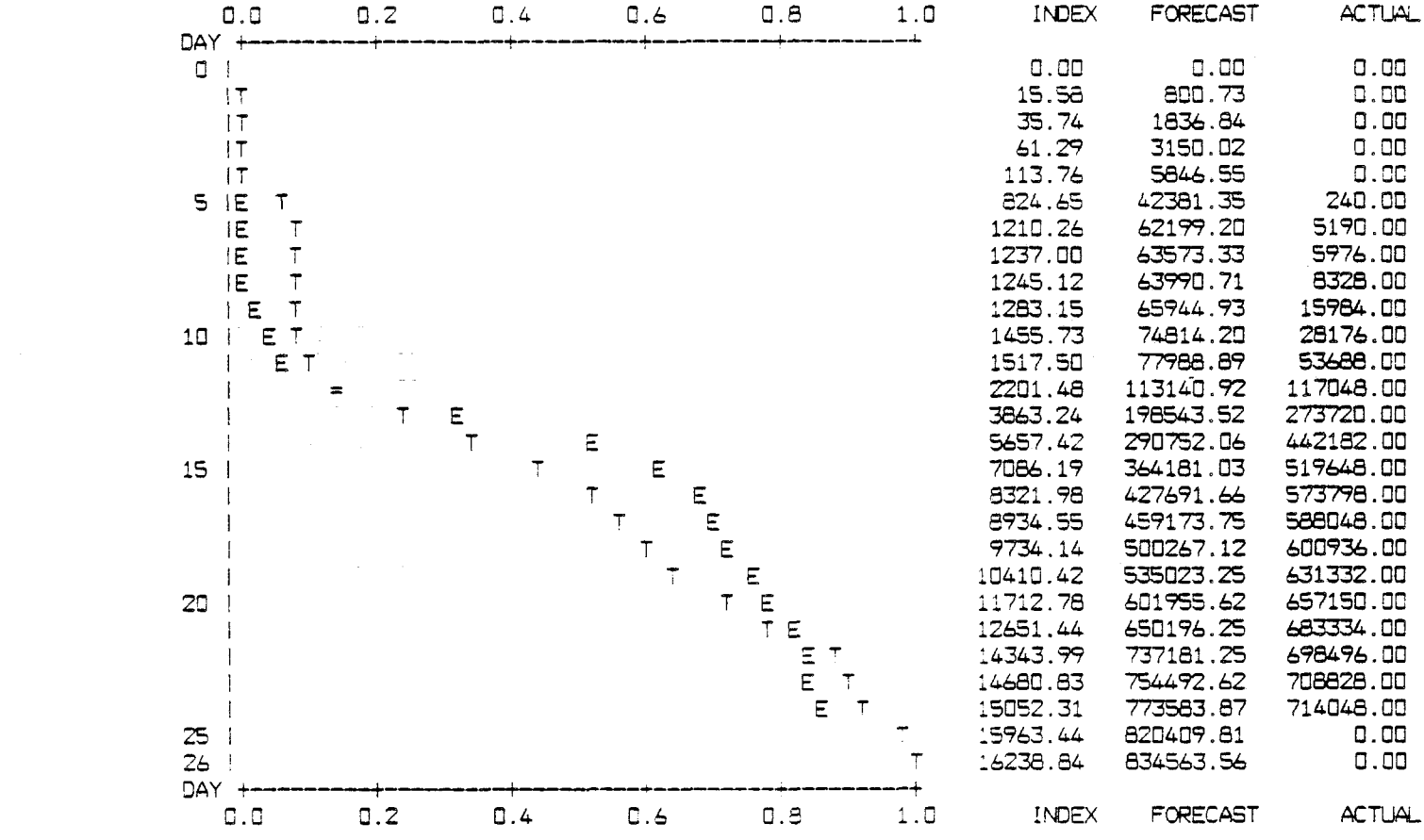
THE PLOT SYMBOL = USED WHEN 2 DATA POINTS ARE IN SAME PLOT POSITION

Figure 4. Computer printout of estimate of escapement/index point and forecast of escapement from running mean length, lag time estimate by the accumulated escapement divided by accumulated index method, and plot of cumulative index and escapement curves on last day of test fishing, Egegik River, 1983.

EGEGIK

7/10 ACCUMULATED ESCAPEMENT = 714,048
7/10 ACCUMULATED INDEX= 16238.84277 (4 SETS ON LAST DAY)
MEAN LENGTH = 536.57 FISH/INDEX = 81 FORECAST = 1,324,426 (POWER CURVE)
MEAN WEIGHT =2.56 KG (5.63 LBS)

LAGTIME	FISH PER INDEX	FORECAST AHEAD	SUMS OF SQUARES	FORECAST 7/10
1	50.436	819,019	2095706.12	805129.81
2	51.393	834,563	386311.37	773583.87
3	42.344	687,614	533017.31	621642.69
4	28.158	457,259	906505.94	403903.66
5	22.701	368,634	1384710.25	287197.75



TIME LAG = 2

CURVE	DATA POINT PLOT SYMBOL	NUMBER OF POINTS
TEST FISH	T	26
ESCAPEMENT	E	20

THE PLOT SYMBOL = USED WHEN 2 DATA POINTS ARE IN SAME PLOT POSITION

Figure 5. Computer printout of estimate of escapement/index point and forecast of escapement from running mean length, lag time estimate by the least squares method, and plot of cumulative index and escapement curves on last day of test fishing, Egegik River, 1983.

The catchability model utilizing fish size produced an EPI estimate of 34 and an escapement forecast of 1,324,426 (Figures 4 and 5). This method over forecast the final escapement count by 82.3%.

Ugashik River

Test fishing began 20 June and ended 16 July. A total of 908 sockeye salmon were caught resulting in 15,485.45 daily index points. Mean sockeye length was 521.60 mm and mean weight was 2.42 kg (Table 6). Data by set and station are presented in Appendix Table 5. Age and sex composition of the fish caught are presented in Appendix Table 6.

On the last day of test fishing, 16 July, lag time between the test fishery and the counting tower estimated by the first method was 1 day, i.e., the lag time with the smallest sum of errors squared (Figure 6). The EPI estimate of 54 led to an escapement forecast of 849,004 on 17 July, which was 2.1% greater than the 17 July accumulated escapement of 831,744.

If the sum of errors squared were the only consideration, then the best lag time estimated by the least squares method would be 2 days (Figure 7). The corresponding EPI value of 37, however, led to a current escapement forecast of 535,671 which was 35.4% below the actual count of 828,946 on 16 July.

The catchability model using fish size produced an EPI value of 35 and an escapement forecast of 555,524. This forecast was 33.0% less than the actual accumulated escapement count for 16 July.

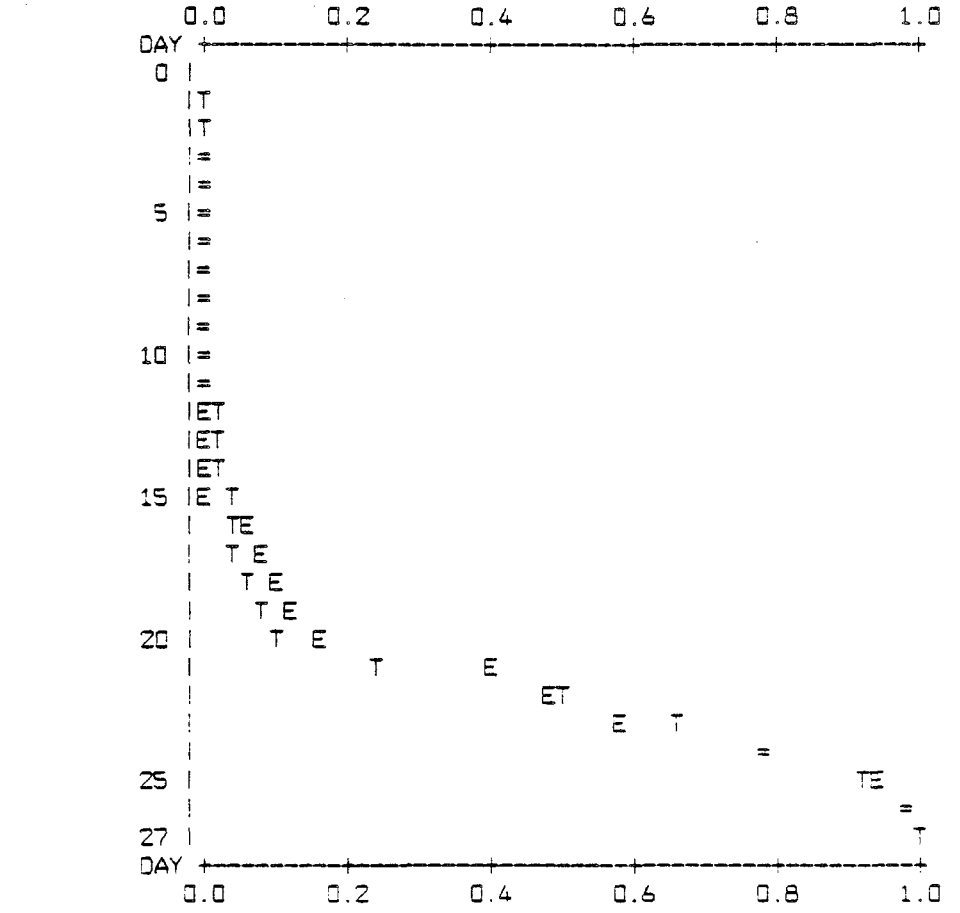
Table 6. Sockeye salmon escapement test fish summary data, Ugashik River, 1983.

DATE	FISHING TIME	CATCH	INDEX	ACCUMULATIVE INDEX	MEAN WEIGHT	MEAN LENGTH	RUNNING MEAN LENGTH
6 20	13.50	0	0.00	0.00	0.00	0.00	0.00
6 21	44.54	4	21.75	21.75	2.25	523.39	523.39
6 22	53.60	3	13.44	35.18	2.99	549.52	533.37
6 23	24.30	1	8.57	43.76	2.13	504.00	530.18
6 24	36.10	1	6.67	50.42	2.70	493.00	526.00
6 25	46.90	6	30.00	80.42	2.28	523.50	524.99
6 26	43.80	4	25.83	106.26	2.30	530.00	526.28
6 27	44.16	2	10.78	117.03	2.90	553.00	527.79
6 28	37.25	2	13.13	130.17	2.49	541.55	529.30
6 29	21.15	1	9.92	140.09	2.32	538.00	529.65
6 30	46.66	2	9.52	149.61	2.60	564.00	532.09
7 1	38.60	3	20.11	169.72	2.38	538.13	532.61
7 2	48.81	8	41.50	211.22	2.96	554.43	537.43
7 3	40.17	25	156.84	368.06	2.33	533.43	535.61
7 4	45.64	35	187.21	555.27	2.27	523.73	531.43
7 5	39.43	14	85.32	640.59	2.21	514.72	529.12
7 6	44.70	27	145.50	786.08	2.45	533.33	529.92
7 7	49.32	28	138.98	925.07	2.47	531.41	530.15
7 8	38.91	61	365.51	1290.57	2.41	532.90	530.94
7 9	32.88	58	372.92	1663.49	2.61	545.28	533.48
7 10	20.53	155	2251.65	3915.14	2.56	523.84	527.76
7 11	14.21	134	3511.25	7426.40	2.47	516.00	526.44
7 12	4.13	46	2721.60	10147.99	2.52	509.37	522.32
7 13	14.82	95	1770.98	11918.97	2.34	520.20	521.81
7 14	8.79	81	2200.01	14118.99	2.16	516.70	520.64
7 15	17.34	72	990.90	15109.88	2.41	526.38	521.18
7 16	27.57	40	375.57	15485.45	2.25	533.53	521.60
TOTAL		908	15485.45				
MEAN					2.42	521.60	

UGASHIK

7/16 ACCUMULATED ESCAPEMENT = 828,946
7/16 ACCUMULATED INDEX= 15896.49609 (4 SETS ON LAST DAY)
MEAN LENGTH = 521.65 FISH/INDEX = 35 FORECAST = 559,382 (POWER CURVE)
MEAN WEIGHT =2.39 KG (5.27 LBS)

LAGTIME	FISH PER INDEX	FORECAST AHEAD	SUMS OF SQUARES	FORECAST 7/16
1	53.408	849,004	172762.08	828946.00
2	57.051	906,903	342970.44	828946.00
3	67.230	1,068,719	489490.41	828946.00
4	78.506	1,247,967	679930.06	828946.00
5	105.767	1,681,330	822576.81	828946.00
6	212.852	3,383,608	731928.19	828946.00
7	504.589	8,021,200	311656.37	828946.00
8	652.768	10,376,722	304215.87	828945.94
9	916.583	14,570,465	255711.48	828946.00



INDEX	FORECAST	ACTUAL
0.00	0.00	0.00
0.00	0.00	0.00
21.76	1161.98	0.00
35.20	1879.72	12.00
43.77	2337.51	66.00
50.43	2693.56	156.00
80.43	4295.81	240.00
106.27	5675.57	306.00
117.04	6251.16	318.00
130.18	6952.62	420.00
140.10	7482.29	696.00
149.62	7990.94	714.00
169.73	9064.89	1656.00
211.23	11281.55	3834.00
368.07	19658.04	3972.00
560.50	29935.21	4002.00
645.81	34491.78	53356.00
791.31	42262.58	62608.00
904.39	48301.73	84238.00
1269.89	67822.84	96580.00
1642.81	87739.84	127534.00
3894.46	207996.48	340438.00
7837.45	418584.44	413278.00
10559.04	563940.19	484294.00
12330.02	658525.25	657358.00
14530.04	776024.00	789988.00
15520.93	828946.00	828946.00
15896.50	849004.31	0.00

TIME LAG = 1

CURVE	DATA POINT PLOT SYMBOL	NUMBER OF POINTS
TEST FISH	T	27
ESCAPEMENT	E	24

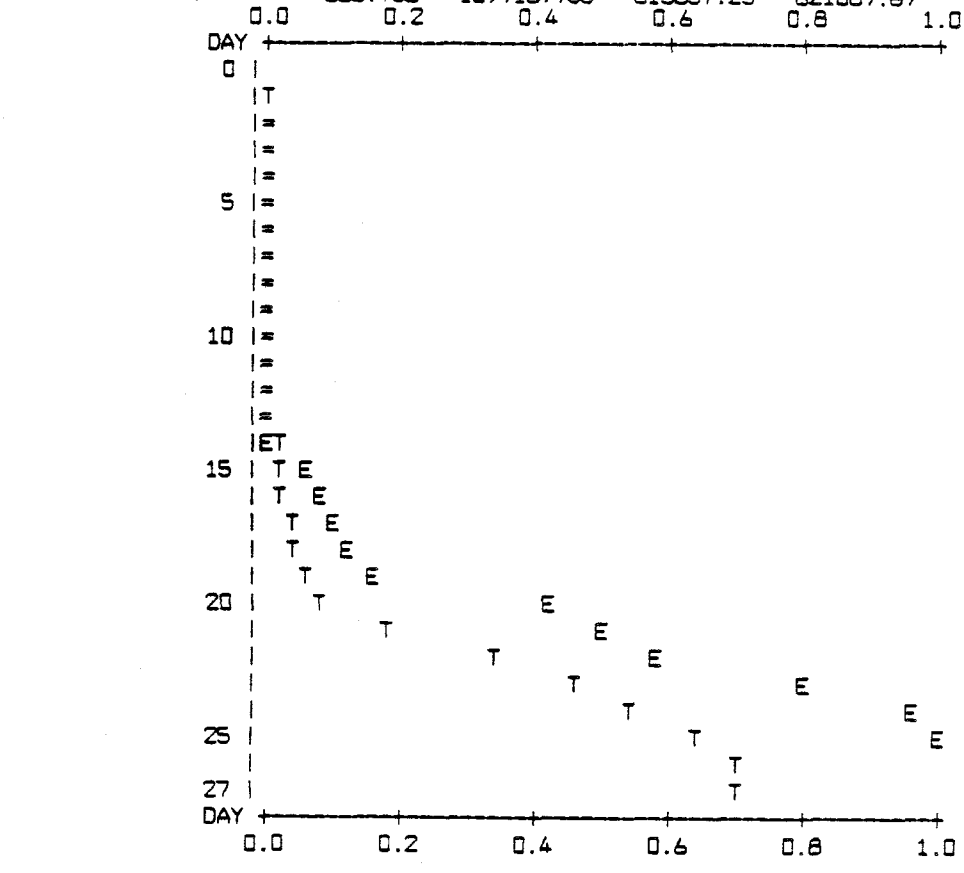
THE PLOT SYMBOL = USED WHEN 2 DATA POINTS ARE IN SAME PLOT POSITION

Figure 6. Computer printout of estimate of escapement/index point and forecast of escapement from running mean length, lag time estimate by the accumulated escapement divided by accumulated index method, and plot of cumulative index and escapement curves on last day of test fishing, Ugashik River, 1983.

UGASHIK

7/16 ACCUMULATED ESCAPEMENT = 828,946
7/16 ACCUMULATED INDEX= 15896.49609 (4 SETS ON LAST DAY)
MEAN LENGTH = 521.65 FISH/INDEX = 35 FORECAST = 559,382 (POWER CURVE)
MEAN WEIGHT =2.39 KG (5.27 LBS)

LAGTIME	FISH PER INDEX	FORECAST AHEAD	SUMS OF SQUARES	FORECAST 7/16
1	43.385	689,664	1517924.62	673370.37
2	36.866	586,047	557247.31	535671.31
3	44.195	702,538	885253.81	544919.62
4	39.047	620,710	985778.56	412299.16
5	28.184	448,026	1219030.37	220890.48
6	45.268	719,605	1398446.50	176295.12
7	385.209	6,123,474	1401739.25	632826.75
8	457.515	7,272,889	759689.94	580995.81
9	686.752	10,916,955	815837.25	621089.69



INDEX	FORECAST	ACTUAL
0.00	0.00	0.00
0.00	0.00	0.00
21.76	802.08	12.00
35.20	1297.53	66.00
43.77	1613.53	156.00
50.43	1859.31	240.00
80.43	2965.30	306.00
106.27	3917.72	318.00
117.04	4315.03	420.00
130.18	4799.23	696.00
140.10	5164.85	714.00
149.62	5515.96	1656.00
169.73	6257.28	3834.00
211.23	7787.39	3972.00
368.07	13569.49	4002.00
560.50	20663.58	53356.00
645.81	23808.87	62608.00
791.31	29172.87	84238.00
904.39	33341.56	96580.00
1269.89	46816.53	127534.00
1642.81	60564.77	340438.00
3894.46	143575.14	413278.00
7837.45	288939.09	484294.00
10559.04	389274.81	657358.00
12330.02	454564.66	789988.00
14530.04	535671.31	828946.00
15520.93	572202.19	0.00
15896.50	586047.94	0.00

INDEX FORECAST ACTUAL

TIME LAG = 2

CURVE	DATA POINT PLOT SYMBOL	NUMBER OF POINTS
TEST FISH	T	27
ESCAPEMENT	E	24

THE PLOT SYMBOL = USED WHEN 2 DATA POINTS ARE IN SAME PLOT POSITION

Figure 7. Computer printout of estimate of escapement/index point and forecast of escapement from running mean length, lag time estimate by the least squares method, and plot of cumulative index and escapement curves on last day of test fishing, Ugashik River, 1983.

APPENDIX

Appendix Table 1. Kvichak River test fish sockeye salmon catch, fishing time, index, mean weight, and length by set, 1983.

month	day	set no.	station no.	length of net (fathoms)	fishing time (min)	catch	index	mean weight (kg)	mean length (mm)
June	21	1	1	25	22.70	0			
	21	2	2	25	16.53	0			
	21	3	1	25	29.50	1	8.14	2.22	522
	21	4	2	25	28.07	0			
	22	5	1	25	29.25	0			
	22	6	2	25	22.78	0			
	22	7	1	25	27.90	0			
	22	8	2	25	10.83	0			
	23	9	1	25	28.83	0			
	23	10	2	25	28.77	0			
	23	11	1	50	25.62	0			
	23	12	2	50	19.07	0			
	24	13	1	50	27.05	0			
	24	14	2	50	11.43	0			
	25	15	1	50	28.98	1	4.14	2.18	505
	25	16	2	50	17.57	0			
	25	17	1	50	29.55	0			
	25	18	2	50	15.18	0			
	26	19	1	50	28.05	0			
	26	20	2	50	10.23	0			
	26	21	1	50	26.71	3	13.48	1.78	487
	26	22	2	50	4.35	68	1875.86	2.40	518
	27	23	1	50	19.21	42	262.36	2.34	518
	27	24	2	25	12.55	3	57.37	2.37	515
	27	25	1	25	5.30	30	1358.49	2.21	516
	27	26	2	50	12.36	9	87.38	2.14	517
	28	27	1	50	2.41	71	3535.27	2.37	517
	28	28	2	25	23.33	0			
	28	29	1	25	3.20	39	2925.00	2.27	520
	28	30	2	25	13.95	5	86.02	2.37	520
	29	31	1	25	1.15	41	8556.52	2.44	516
	29	32	2	25	11.32	12	254.42	2.28	511
	29	33	1	25	4.82	38	1892.12	2.32	512
	29	34	2	25	2.33	36	3708.15	2.40	520
	30	35	1	25	1.30	12	2215.38	2.31	515
	30	36	2	25	3.28	25	1829.27	2.26	511
	30	37	1	25	1.16	17	3517.24	2.49	515
	30	38	2	25	7.35	21	685.71	1.84	507
July	1	39	1	25	9.00	13	346.67	2.05	498
	1	40	2	25	2.92	26	2136.99	1.86	499
	1	41	1	25	16.45	2	29.18	2.55	548
	1	42	2	25	6.13	11	430.67	2.16	522
	2	43	1	25	14.40	0			
	2	44	2	25	8.98	8	213.81	1.97	500
	2	45	1	25	21.26	0			
	2	46	2	25	10.71	11	246.50	1.98	507
	3	47	1	25	13.23	14	253.97	2.36	520

-Continued-

Appendix Table 1. Kvichak River test fish sockeye salmon catch, fishing time, index, mean weight, and length by set, 1983 (continued).

month	day	set no.	station no.	length of net (fathoms)	fishing time (min)	catch	index	mean weight (kg)	mean length (mm)
3	48	2	25	3.40	34	2400.00	2.00	501
3	49	2	25	10.96	16	350.36	1.99	506
3	50	2	25	7.85	34	1039.49	2.20	514
4	51	1	25	30.95	3	23.26	1.68	494
4	52	2	25	7.83	25	766.28	2.18	506
4	53	1	25	27.91	1	8.60	2.50	526
4	54	2	25	8.43	31	882.56	1.79	498
5	55	1	25	28.45	1	8.44	1.62	486
5	56	2	25	11.05	9	195.48	2.10	507
5	57	1	25	24.07	10	99.71	2.09	511
5	58	2	25	5.15	17	792.23	1.96	510
6	59	1	25	17.86	3	40.31	2.02	508
6	60	2	25	20.75	2	23.13	2.54	536
6	61	1	25	29.55	27	219.29	2.30	509
6	62	2	25	4.77	18	905.66	2.58	519
7	63	1	25	3.75	11	704.00	2.84	540
7	64	2	25	1.90	24	3031.58	2.20	517
7	65	1	25	10.77	10	222.84	2.19	510
7	66	2	25	6.63	7	253.39	1.87	494
8	67	1	25	13.43	7	125.09	2.11	504
8	68	2	25	18.13	2	26.48	2.27	508
8	69	1	25	18.70	3	38.50	1.79	474
8	70	2	25	8.08	1	29.70	2.10	507
9	71	1	25	30.93	0			
9	72	2	25	8.98	27	721.60	2.17	509
9	73	1	25	22.01	5	54.52	2.64	521
9	74	2	25	5.75	5	208.70	2.09	510
10	75	1	25	28.53	6	50.47	1.76	504
10	76	2	25	9.06	13	344.37	2.29	518
11	77	1	25	13.38	1	17.94	2.28	513
11	78	2	25	7.86	4	122.14	2.06	483
11	79	1	25	27.97	1	8.58		
11	80	2	25	1.73	13	1803.47	2.06	506
12	81	1	25	23.10	1	10.39	1.78	482
12	82	2	25	20.45	8	93.89	1.88	483
12	83	1	25	23.35	0			
12	84	2	25	6.20	10	387.10	2.88	522

Appendix Table 2. Kvichak River test fish catch of sockeye salmon by age and sex, with length (mm) and weight (kg), 1983.

	AGE GROUP				
	42	52	53	63	TOTAL
MALES					
PERCENT	29.40	1.70	1.70	0.00	32.80
AV LENGTH	518.92	531.77	522.46	0.00	519.77
STD ERROR	1.87	6.56	6.85	0.00	1.75
SAMP SIZE	218	13	13	0	244
AV WEIGHT	2.44	2.52	2.75	0.00	2.46
STD ERROR	.04	.05	.14	0.00	.04
SAMP SIZE	93	7	4	0	104
FEMALES					
PERCENT	59.00	5.60	2.40	.20	67.20
AV LENGTH	506.30	529.05	514.28	544.00	508.59
STD ERROR	1.01	4.96	5.70	36.00	1.01
SAMP SIZE	437	42	18	2	499
AV WEIGHT	2.07	2.49	2.30	2.64	2.11
STD ERROR	.02	.16	.14	.56	.02
SAMP SIZE	205	17	9	2	233
SEXES COMBINED					
PERCENT	88.40	7.30	4.10	.20	100.00
AV LENGTH	510.50	529.68	517.67	544.00	512.26
STD ERROR	.92	4.09	4.38	36.00	.89
SAMP SIZE	655	55	31	2	743
AV WEIGHT	2.19	2.50	2.49	2.64	2.23
STD ERROR	.02	.12	.11	.56	.02
SAMP SIZE	298	24	13	2	337

Appendix Table 3. Egegik River test fish sockeye salmon catch, fishing time, index, mean weight, and length by set, 1983.

month	day	set no.	station no.	length of net (fathoms)	fishing time (min)	catch	index	mean weight (kg)	mean length (mm)
June	15	1	1	25	24.50	1	9.80	1.80	530
	15	2	2	25	33.70	3	21.36	2.38	534
	16	3	1	25	21.00	0			
	16	4	2	25	15.50	1	15.48	2.28	530
	16	5	1	25	25.50	3	28.24	2.25	521
	16	6	2	25	32.50	5	36.92	2.62	552
	17	7	1	25	27.10	0			
	17	8	2	25	20.30	6	70.94	2.27	535
	17	9	1	25	30.60	2	15.69	2.69	550
	17	10	2	25	30.80	2	15.58	2.02	501
	18	11	1	25	31.40	0			
	18	12	2	25	30.10	2	15.95	3.25	587
	18	13	1	25	32.00	3	22.50	2.81	555
	18	14	2	25	30.80	22	171.43	2.75	547
	19	15	1	25	33.30	5	36.04	2.27	526
	19	16	2	25	6.70	37	1325.37	2.25	541
	19	17	1	25	31.00	1	7.74	2.34	542
	19	18	2	25	3.60	22	1466.67	2.68	562
	20	19	1	25	15.60	15	230.77	2.44	531
	20	20	2	25	4.10	16	936.59	2.68	547
	20	21	1	25	30.50	14	110.16	2.52	557
	20	22	2	25	15.40	17	264.94	2.82	545
	21	23	1	25	20.60	3	34.95	2.51	554
	21	24	2	25	30.30	8	63.37	2.29	541
	21	25	1	25	27.80	1	8.63	2.38	532
	21	26	2	25	29.10	0			
	22	27	1	25	30.80	1	7.79	2.20	539
	22	28	2	25	28.40	1	8.45	2.85	542
	23	29	1	25	30.80	2	15.58	2.94	571
	23	30	2	25	29.90	10	80.27	2.20	518
	23	31	1	25	31.00	6	46.45	2.47	536
	23	32	2	25	24.50	1	9.80	2.00	517
	24	33	1	25	29.70	2	16.16	2.88	557
	24	34	2	25	32.70	19	139.45	2.56	553
	24	35	1	25	15.30	23	360.78	2.56	545
	24	36	2	25	13.80	10	173.91	2.56	544
	25	37	1	25	31.90	0			
	25	38	2	25	21.10	4	45.50	2.31	529
	25	39	1	25	30.60	3	23.53	2.71	554
	25	40	2	25	31.00	23	178.06	2.47	548
	26	41	1	25	31.90	11	82.76	2.91	543
	26	42	2	25	5.40	31	1377.78	2.31	542
	26	43	1	25	31.00	3	23.23	2.65	544
	26	44	2	25	4.60	24	1252.17	3.04	534
	27	45	1	25	6.70	41	1468.66	2.56	547
	27	46	2	25	1.50	22	3520.00	2.54	547
	27	47	1	25	12.50	44	844.80	2.45	544

-Continued-

Appendix Table 3. Egegik River test fish sockeye salmon catch, fishing time, index, mean weight, and length by set, 1983 (continued).

month	day	set no.	station no.	length of net (fathoms)	fishing time (min)	catch	index	mean weight (kg)	mean length (mm)
	27	48	2	25	3.54	12	813.56	2.54	548
	28	49	1	25	1.70	17	2400.00	2.57	547
	28	50	2	25	1.60	21	3150.00	2.85	537
	28	51	1	25	13.10	21	384.73	2.66	538
	28	52	2	25	5.00	29	1392.00	2.65	542
	29	53	1	25	7.60	38	1200.00	3.01	533
	29	54	2	25	1.30	22	4061.54	2.48	533
	29	55	1	25	13.50	13	231.11	2.55	532
	29	56	2	25	20.50	19	222.44	2.79	533
	30	57	1	25	32.80	50	365.85	2.39	526
	30	58	2	25	2.60	32	2953.85	2.71	528
	30	59	1	25	16.80	33	471.43	2.34	538
	30	60	2	25	2.50	12	1152.00	2.70	549
July	1	61	1	25	5.60	19	814.29	2.51	522
	1	62	2	25	7.20	16	533.33	2.43	526
	1	63	1	25	16.40	20	292.68	2.39	529
	1	64	2	25	8.00	27	810.00	2.58	534
	2	65	1	25	9.30	20	516.13	2.26	522
	2	66	2	25	3.00	22	1760.00	2.67	535
	2	67	1	25	29.80	2	16.11	2.66	554
	2	68	2	25	9.80	37	906.12	2.61	542
	3	69	1	25	14.20	32	540.85	2.45	531
	3	70	2	25	4.30	20	1116.28	2.57	518
	3	71	1	25	3	21	168.00	2.61	535
	3	72	2	25	6.00	22	880.00	2.72	536
	4	73	1	25	32.30	23	170.90	2.16	517
	4	74	2	25	10.30	16	372.82	2.36	515
	4	75	1	25	5.50	35	1527.27	2.37	535
	4	76	2	25	1.30	17	3138.46	2.69	546
	5	77	1	25	2.70	29	2577.78	2.54	537
	5	78	2	25	15.90	12	181.13	2.48	528
	5	79	1	25	6.30	16	609.52	2.36	521
	5	80	2	25	8.70	14	386.21	2.47	519
	6	81	1	25	23.90	18	180.75	2.21	525
	6	82	2	25	30.20	37	294.04	2.39	529
	6	83	1	25	5.40	23	1022.22	2.44	532
	6	84	2	25	1.50	33	5280.00	2.45	526
	7	85	1	25	12.80	8	150.00	2.19	519
	7	86	2	25	17.90	2	26.82	2.13	512
	7	87	1	25	17.50	38	521.14	2.90	536
	7	88	2	25	8.50	23	649.41	2.38	541
	8	89	1	25	6.40	15	562.50	2.13	514
	8	90	2	25	13.30	10	180.45	2.91	526
	9	91	1	25	15.80	34	516.46	2.34	527
	9	92	2	25	2.10	16	1828.57	2.50	540
	9	93	1	25	7.80	19	584.62	2.28	518
	9	94	2	25	9.40	28	714.89	2.54	539
	10	95	1	25	23.80	10	100.84	2.29	524
	10	96	2	25	8.80	15	409.09	2.44	542
	10	97	1	25	19.80	14	169.70	2.28	520
	10	98	2	25	9.10	16	421.98	2.61	547

Appendix Table 4. Egegik River test fish catch of sockeye salmon by age and sex, with length (mm) and weight (kg), 1983.

	AGE GROUP					
	42	52	53	63	64	TOTAL
MALES						
PERCENT	2.70	1.90	32.00	4.00	.10	40.70
AV LENGTH	515.31	594.80	540.15	602.38	543.50	547.18
STD ERROR	4.74	4.60	1.15	3.82	1.50	1.05
SAMP SIZE	36	25	416	53	2	532
AV WEIGHT	2.31	3.82	2.71	3.71	0.00	2.83
STD ERROR	.11	.24	.03	.10	0.00	.03
SAMP SIZE	13	8	153	21	0	195
FEMALES						
PERCENT	4.20	2.30	48.00	4.40	.40	59.30
AV LENGTH	509.29	573.81	521.80	583.45	513.50	527.45
STD ERROR	2.90	3.37	.74	3.51	7.66	.70
SAMP SIZE	56	31	625	58	6	776
AV WEIGHT	2.06	3.04	2.20	3.08	1.80	2.29
STD ERROR	.07	.11	.02	.08	0.00	.02
SAMP SIZE	16	12	248	28	1	305
SEXES COMBINED						
PERCENT	6.90	4.20	80.00	8.40	.50	100.00
AV LENGTH	511.65	583.31	529.14	592.46	519.50	535.48
STD ERROR	2.56	2.78	.64	2.59	5.76	.59
SAMP SIZE	92	56	1,041	111	8	1,308
AV WEIGHT	2.16	3.39	2.40	3.38	1.80	2.51
STD ERROR	.06	.12	.02	.06	0.00	.02
SAMP SIZE	29	20	401	49	1	500

Appendix Table 5. Ugashik River test fish sockeye salmon catch, fishing time, index, mean weight, and length by set, 1983.

month	day	set no.	station no.	length of net (fathoms)	fishing time (min)	catch	index	mean weight (kg)	mean length (mm)
June	20	1	1	25	6.50	0			
	20	2	2	25	7.00	0			
	21	3	1	25	10.62	1	22.60	2.30	540
	21	4	2	25	12.13	0			
	21	5	1	25	13.34	2	35.98	1.70	488
	21	6	2	25	8.45	1	28.40	2.90	555
	22	7	1	25	11.00	0			
	22	8	2	25	13.00	1	18.46	3.86	583
	22	9	1	25	13.60	2	35.29	2.54	532
	22	10	2	25	16.00	0			
	23	11	2	25	10.30	0			
	23	12	1	25	14.00	1	17.14	2.13	504
	24	13	2	25	10.70	0			
	24	14	1	25	12.00	1	20.00	2.70	493
	24	15	2	25	13.40	0			
	25	16	1	25	12.00	3	60.00	2.12	509
	25	17	2	25	10.00	0			
	25	18	1	25	12.00	3	60.00	2.44	538
	25	19	2	25	12.90	0			
	26	20	2	25	8.18	0			
	26	21	1	25	9.29	4	103.34	2.30	530
	26	22	1	25	14.25	0			
	26	23	2	25	12.08	0			
	27	24	1	25	10.00	1	24.00	2.90	553
	27	25	2	25	9.50	0			
	27	26	1	25	12.56	1	19.11		
	27	27	2	25	12.10	0			
	28	28	1	25	9.50	1	25.26	3.10	581
	28	29	2	25	8.15	0			
	28	30	1	25	8.80	1	27.27	1.92	505
	28	31	2	25	10.80	0			
	29	32	1	25	12.10	1	19.83	2.32	538
	29	33	2	25	9.05	0			
	30	34	1	25	11.48	0			
	30	35	2	25	10.68	0			
	30	36	1	25	12.60	2	38.10	2.60	564
	30	37	2	25	11.90	0			
July	1	38	1	25	11.20	0			
	1	39	2	25	7.90	1	30.38		
	1	40	1	25	11.00	1	21.82	2.98	581
	1	41	2	25	8.50	1	28.24	1.92	505
	2	42	1	25	12.90	2	37.21	2.63	526
	2	43	2	25	13.10	0			
	2	44	1	25	10.81	4	88.81	3.30	576
	2	45	2	25	12.00	2	40.00	2.51	533
	3	46	1	25	9.34	4	102.78	2.17	505
	3	47	2	25	13.50	5	88.89	2.52	550
	3	48	1	25	8.35	4	114.97	2.33	550

-Continued-

Appendix Table 5. Ugashik River test fish sockeye salmon catch, fishing time, index, mean weight, and length by set, 1983 (continued).

month	day	set no.	station no.	length of net (fathoms)	fishing time (min)	catch	index	mean weight (kg)	mean length (mm)
3	49	2	25	8.98	12	320.71	2.33	532
4	50	1	25	12.70	5	94.49	2.60	556
4	51	2	25	11.50	11	229.57	1.84	510
4	52	1	25	10.62	8	180.79	2.38	528
4	53	2	25	10.82	11	243.99	2.47	521
5	54	1	25	11.00	5	109.09	2.25	509
5	55	2	25	7.45	3	96.64	2.51	539
5	56	1	25	10.95	4	87.67	1.93	502
5	57	2	25	10.03	2	47.86	2.04	502
6	58	1	25	13.10	9	164.89	2.93	545
6	59	2	25	11.42	9	189.14	2.48	528
6	60	1	25	8.72	6	165.14	2.00	526
6	61	2	25	11.46	3	62.83	2.30	538
7	62	1	25	13.38	6	107.62	2.35	555
7	63	2	25	12.05	6	119.50	2.25	519
7	64	1	25	11.10	10	216.22	2.44	521
7	65	2	25	12.79	6	112.59	2.88	542
8	66	1	25	10.10	36	855.45	2.64	543
8	67	2	25	10.30	15	349.51	2.06	521
8	68	1	25	8.67	4	110.73	1.88	487
8	69	2	25	9.84	6	146.34	2.29	537
9	70	1	25	11.01	26	566.76	2.82	542
9	71	2	25	8.49	12	339.22	2.52	546
9	72	1	25	2.59	2	185.33		554
9	73	2	25	10.79	18	400.37	2.40	
10	74	1	25	2.95	59	4800.00	2.70	520
10	75	2	25	6.08	31	1223.68	2.33	539
10	76	1	25	4.67	43	2209.85	2.40	522
10	77	2	25	6.83	22	773.06	2.52	529
11	78	1	25	1.98	50	6060.61		
11	79	2	25	7.13	25	841.51		
11	80	1	25	3.77	30	1909.81	2.47	516
11	81	2	25	1.33	29	5233.08		
12	82	1	25	2.30	22	2295.65	2.45	514
12	83	2	25	1.83	24	3147.54	2.57	506
13	84	1	25	3.50	9	617.14	3.05	522
13	85	2	25	3.50	29	1988.57	2.62	520
13	86	1	25	2.16	30	3333.33	2.01	518
13	87	2	25	5.66	27	1144.88	2.41	526
14	88	1	25	2.25	18	1920.00	2.36	522
14	89	2	25	2.55	22	2070.59	1.89	527
14	90	1	25	2.26	27	2867.26	2.10	515
14	91	2	25	1.73	14	1942.20	2.32	503
15	92	1	25	3.93	11	671.76	2.89	524
15	93	2	25	5.77	25	1039.86	2.52	528
15	94	1	25	4.59	22	1150.33	2.33	519
15	95	2	25	3.05	14	1101.64	2.11	534
16	96	1	25	4.00	6	360.00	2.07	545
16	97	2	25	10.29	10	233.24	2.79	514
16	98	1	25	5.46	13	571.43	2.03	534
16	99	2	25	7.82	11	337.60	2.42	534

Appendix Table 6. Ugashik River test fish catch of sockeye salmon by age and sex, with length (mm) and weight (kg), 1983.

	AGE GROUP							
	31	41	42	43	52	53	63	TOTAL
MALES								
PERCENT	.10	.20	42.10	.20	3.70	4.50	1.30	52.10
AV LENGTH	523.00	446.50	530.89	400.50	585.90	541.84	606.64	536.79
STD ERROR	0.00	4.50	1.70	3.50	6.19	5.82	5.73	1.53
SAMP SIZE	1	2	343	2	31	37	11	427
AV WEIGHT	2.30	1.48	2.57	.95	3.31	2.75	3.33	2.65
STD ERROR	0.00	0.00	.04	.07	.21	.14	.21	.04
SAMP SIZE	1	1	130	2	11	14	5	164
FEMALES								
PERCENT	.20	0.00	37.80	.10	2.80	6.30	.70	47.90
AV LENGTH	510.00	0.00	515.70	495.00	556.96	522.73	569.67	519.76
STD ERROR	2.00	0.00	1.14	0.00	6.18	2.51	11.61	1.04
SAMP SIZE	2	0	308	1	23	52	6	392
AV WEIGHT	2.04	0.00	2.12	0.00	2.57	2.14	0.00	2.15
STD ERROR	0.00	0.00	.04	0.00	.15	.08	0.00	.04
SAMP SIZE	1	0	88	0	12	19	0	120
SEXES COMBINED								
PERCENT	.30	.20	79.90	.30	6.50	10.80	2.00	100.00
AV LENGTH	514.33	446.50	523.70	432.00	573.43	530.69	593.70	528.63
STD ERROR	1.33	4.50	1.05	2.33	4.42	2.83	5.53	.94
SAMP SIZE	3	2	651	3	54	89	17	819
AV WEIGHT	2.13	1.48	2.36	.95	2.99	2.39	3.33	2.41
STD ERROR	0.00	0.00	.03	.07	.13	.08	.21	.03
SAMP SIZE	2	1	218	2	23	33	5	284

1983 IGUSHIK RIVER ESCAPEMENT TEST FISHING

By

Wesley A. Bucher
and
Mark Frederickson

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

INTRODUCTION

The Igushik River test fishing project was initiated in 1976 (McBride 1978) and has been conducted annually since that time (McBride and Clark 1979; Minard 1981; Bucher 1983). The objective of the project is to obtain estimates of sockeye salmon escapement into the lower portion of the Igushik River immediately after the fish have passed through the commercial fishery (Figure 1). These estimates are incorporated into management decisions since final enumeration of Igushik River spawning escapement occurs five to ten days later at the outlet of Amanka Lake.

METHODS AND MATERIALS

Test Fishing

The fishing site on the Igushik River was in the same general location as that used during 1980-1982. This site was selected because tagging studies showed minimal flushing of sockeye salmon back out of the river from that location (McBride 1980). This season the first nine sets were made about 100 m upstream from the original site. While this may at first appeared to be an insignificant change, physical characteristics of the river bank at the two sites were quite different. The upstream site had a fairly sharp cutbank, while the original site had a gradual sloping bank. It was thought that sockeye salmon distribution would be more concentrated at the cutbank site than at the original site, since river velocity should have been greater in the vicinity of the cutbank site. This hypothesis was tested by making six successive sets at both sites, and calculating the percent difference in test fish indices.

A 45.5 m (25 fm) gill net with 13.7 cm (5-3/8 in) stretched mesh was fished during each high tide at both sites which were on the left bank facing upstream. Actual fishing methods were consistent with past years. The gill net was set 15 minutes before the time of each high tide, as indicated in the local tide tables, 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 abundance. The standard test fish index

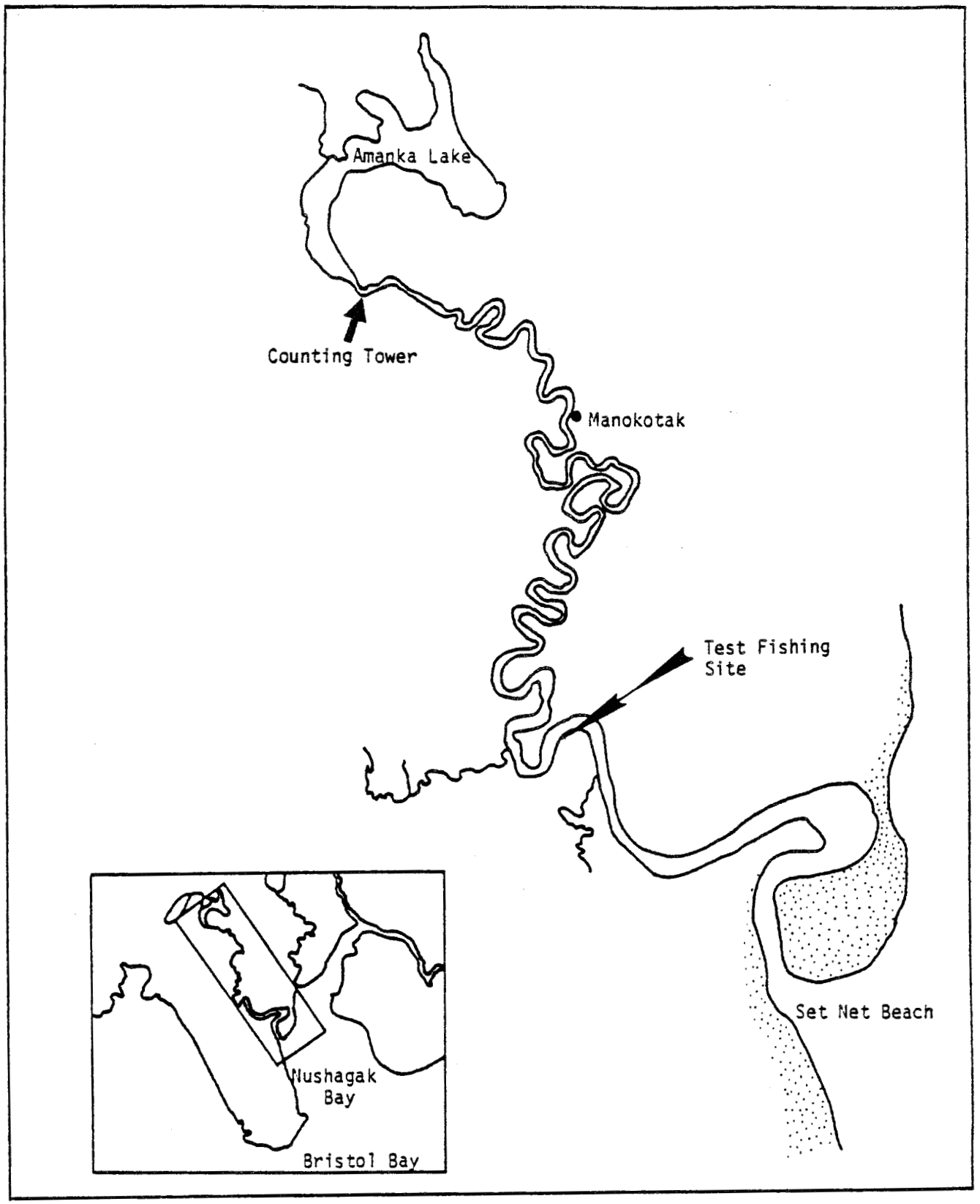


Figure 1. Location of the Igushik River counting tower, the village of Manokotak, and the Igushik inside test fishing site.

catch per 100 fathom-hours) was calculated for each set. Length and weight measurements were obtained from at least 10 fish caught in each set.

Escapement Estimates

Test fish indices were calculated for each high tide and averaged each day to yield a daily test fish index value. During the season estimates of cumulative escapement past the test fishing site were calculated by two different methods. While both estimated cumulative escapement by multiplying cumulative test fish index points by the number of spawners per index point (EPI), different techniques were used to estimate EPI. The first method used mean weight of sockeye salmon caught in the test fishery to estimate EPI. The second correlated cumulative test fish indices with cumulative tower counts at Amanka Lake during subsequent 24-hour periods to estimate EPI (Paulus 1968).

RESULTS AND DISCUSSION

Test fishing was conducted from 18 June until 13 July (Table 1). Catches at upstream site were consistently higher than catches made at the original site (Table 2). Therefore, to be consistent with data from prior years, index points for the first nine sets made upstream were proportionally adjusted downward, and test fishing for the remainder of the season was conducted at the original location.

Correlation analysis of cumulative test fish index points and cumulative tower escapement estimates after the season showed that a four-day lag time produced the best fit between tower counts and test fish indices (Table 3 and Figure 2). Lag time has ranged from two to seven days since the project was started (Table 4).

Post-season escapement estimates based on test fishing index points remained within 40% of the actual escapement after 20 June (Table 5). However, during the season, both methods used produced escapement estimates which were much greater than actual total tower counts. Reasons for overestimates have not yet been determined.

The EPI for the 1983 season, calculated by dividing the cumulative tower count at day n+4 (four days lag time) by the cumulative test fish indices (161,754 spawners / 15,321.7 indices), was 11.4. This was the lowest EPI value ever observed since initiation of the project in 1976 (Table 6). Sockeye salmon mean weight for the season, 2.7 kg (6.1 lb), was also the lowest ever recorded. The relationship between mean weight and EPI was not consistent with past data, which show a strong negative correlation of mean weight and EPI (Figure 3). Since the 1983 data point was considered to be an outlier, a new regression equation was not recalculated for use during the 1984 season.

Test fish data were unreliable for predicting escapement to the Igushik River during the 1983 season. Tagging studies done in the past indicated that few sockeye caught at the test fish site moved back downriver when the tide began to ebb. However, sockeye salmon may have traveled downriver past the test

Table 1. Sockeye salmon escapement into Igushik River system as indexed at the test fish site and enumerated at the tower at Amanka Lake, 1983.

Date	Test Fish Indices		Tower Counts	
	Index [1]	Accum.	Daily	Accum.
6/18	9.1	9.1	0	0
19	37.4	46.5	0	0
20	229.1	275.6	0	0
21	240.9	516.5	0	0
22	341.9	858.4	0	0
23	1,067.3	1,925.7	18	18
24	1,115.3	3,041.0	834	852
25	718.2	3,759.2	3,312	4,164
26	477.8	4,237.0	6,024	10,188
27	580.0	4,817.0	5,682	15,870
28	1,050.5	5,867.5	7,926	23,796
29	624.0	6,491.5	5,160	28,956
30	773.8	7,265.3	8,226	37,182
7/ 1	424.3	7,689.6	6,642	43,824
2	605.4	8,295.0	6,120	49,944
3	454.4	8,749.4	6,792	56,736
4	358.4	9,107.8	8,040	64,776
5	824.2	9,932.0	10,632	75,408
6	961.3	10,893.3	11,916	87,324
7	800.0 [2]	11,693.3	11,616	98,940
8	1,050.0	12,743.3	12,510	111,450
9	947.2	13,690.5	9,288	120,738
10	562.6	14,253.1	10,824	131,562
11	553.3	14,806.4	6,252	137,814
12	162.6	14,969.0	3,738	141,552
13	352.7	15,321.7	2,514	144,066
14			1,452	145,518
15			4,944	150,462
16			7,680	158,142
17			3,612	161,754
18			4,302	166,056
19			2,460	168,516
20			2,346	170,862
21			2,982	173,844
22			1,746	175,590
23			1,878	177,468
24			1,314	178,782
25			1,176	179,958
26			480	180,438

[1] The daily index is the average of both high tides for each day.

[2] Data is for one tide only.

Table 2. Comparison of test fish indices at two different fishing sites 100 m apart on the Igushik River, 1983.

Date	Daily Indices		Adjustment Factor [1]	Tide (Ft.)
	Upriver Site	Original Site		
6/23	2,571.4	1,614.5	.63	20.3
6/23	523.6	520.0	.99	16.0
6/24	6,600.0	1,920.0	.29	20.7
6/24	523.6	310.6	.59	14.9
6/25	2,880.0	1,260.0	.44	20.8
6/25	252.0	176.3	.70	14.0
Mean			.59	

[1] Adjustment Factor - original site indices/upriver site indices.

Table 3. Correlation of accumulative test fish indices with accumulative escapement at Igushik River with various lag times, 1983.

Lag Time	Correlation Coefficient
2 Day Lag	.9871
3 Day Lag	.9895
4 Day Lag	.9897 [1]
5 Day Lag	.9886
6 Day Lag	.9865
7 Day Lag	.9841

[1] Four-day lag time demonstrated highest correlation coefficient and was used in this analysis.

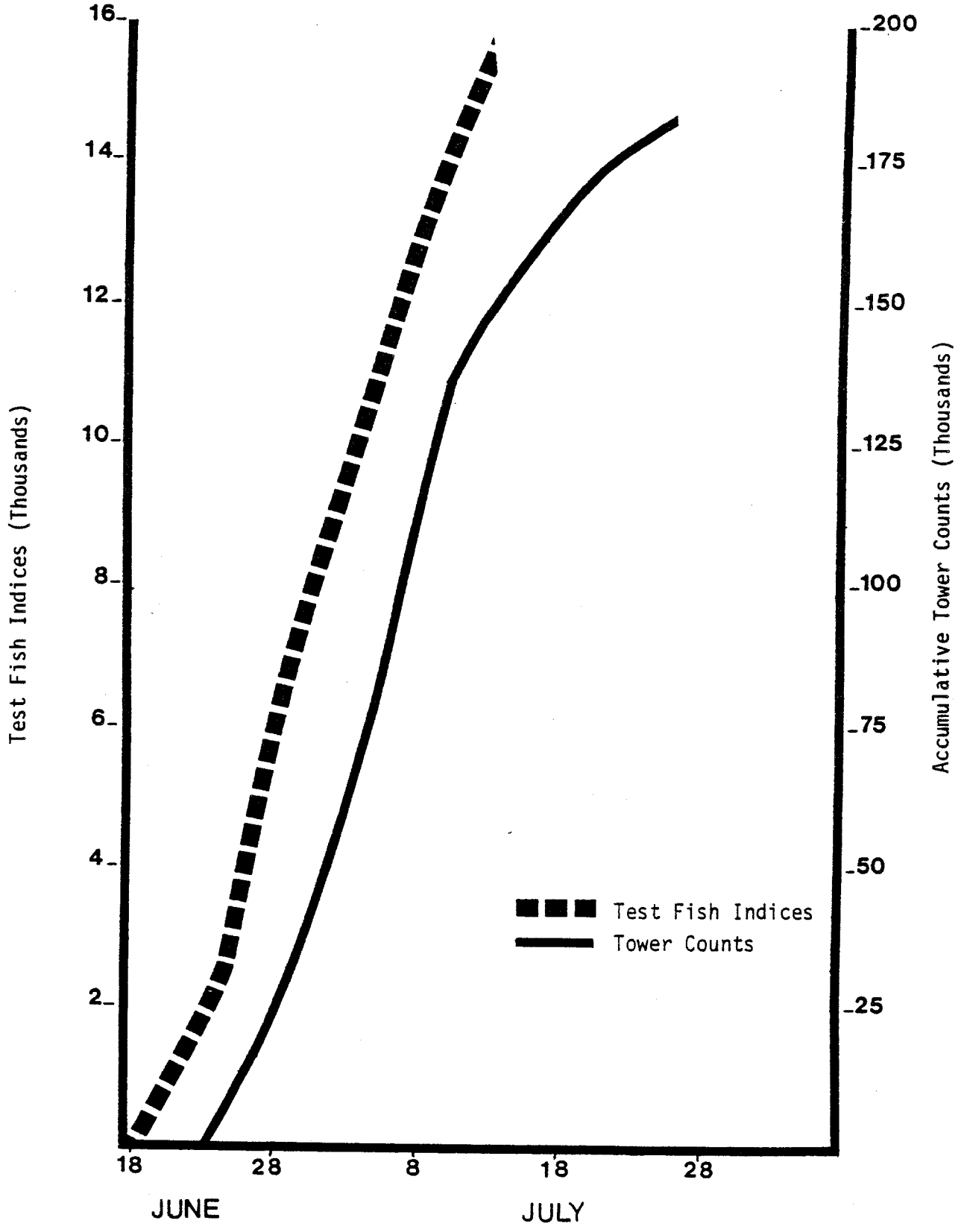


Figure 2. Igushik River accumulative test fishing indices and tower counts, 1983.

Table 4. Correlation of accumulative test fish indices with accumulative escapement used to calculate lag time between the test fish site and the tower, 1976-1983.

Year	Correlation Coefficient	Lag Time
1976 [1]	.99305	7 Days [2]
1977 [1]	.97734	7 Days [2]
1978 [1]	.99761	7 Days
1979	.99843	2 Days
1980	.99842	4 Days
1981	.99928	4 Days
1982	.99333	5 Days
1983	.98970	4 Days

[1] Correlation is between estimated escapement at the test fish site and the actual escapement enumerated at the tower; subsequent years correlate accumulative test fish indices with actual escapement.

[2] Fishing site was approximately 10 km downstream from the present site. Tagging studies indicate travel time of one day between the two fishing sites (McBride 1978).

Table 5. Sockeye salmon escapement into the Igushik River system as estimated by the Igushik River inside test fishing project, 1983.

Date	Accum. Test Fish Index	Estimated Escapement [1]	Actual Escapement [2]	Accuracy [3]
6/18	9.1	104	0	-
19	46.5	530	18	29.5
20	275.6	3,142	852	3.7
21	516.5	5,888	4,164	1.4
22	858.4	9,785	10,188	1.0
6/23	1,925.7	21,952	15,870	1.4
24	3,041.0	34,667	23,796	1.5
25	3,759.2	42,855	28,956	1.5
26	4,237.0	48,302	37,182	1.3
27	4,817.0	54,914	43,824	1.3
6/28	5,867.5	66,889	49,944	1.3
29	6,491.5	74,003	56,736	1.3
30	7,265.3	82,824	64,776	1.3
7/ 1	7,689.6	87,661	75,408	1.2
2	8,295.0	94,563	87,324	1.1
7/ 3	8,749.4	99,743	98,940	1.0
4	9,107.8	103,828	111,450	0.9
5	9,932.0	113,225	120,738	0.9
6	10,893.3	124,184	131,562	0.9
7	11,693.3	133,304	137,814	1.0
7/ 8	12,743.3	145,274	141,552	1.0
9	13,690.5	156,072	144,066	1.1
10	14,253.1	162,485	145,518	1.1
11	14,806.4	168,793	150,462	1.1
12	14,969.0	170,647	158,142	1.1
7/13	15,321.7	174,667	161,754	1.1

[1] Estimated escapement = (Accum. test fish index) x (No. spawners/index point).

[2] Actual escapement = Accumulative tower count on day n + 4 (4 day lag time).

[3] Accuracy = Estimated escapement/actual escapement.

Table 6. Individual mean weight and spawners per index point of sockeye salmon caught at Igushik River test fishing site, 1976-1983.

Year	Mean Weight (Kg)	Spawners Per Index Point
1976	3.0[1]	46.8
1977	3.6[1]	13.1
1978	3.0	40.4
1979	3.4	17.4
1980	3.1	50.3
1981	3.3	14.0
1982	3.5	32.6
1983	2.7	11.4

[1] Weight data from Igushik section commercial catch.

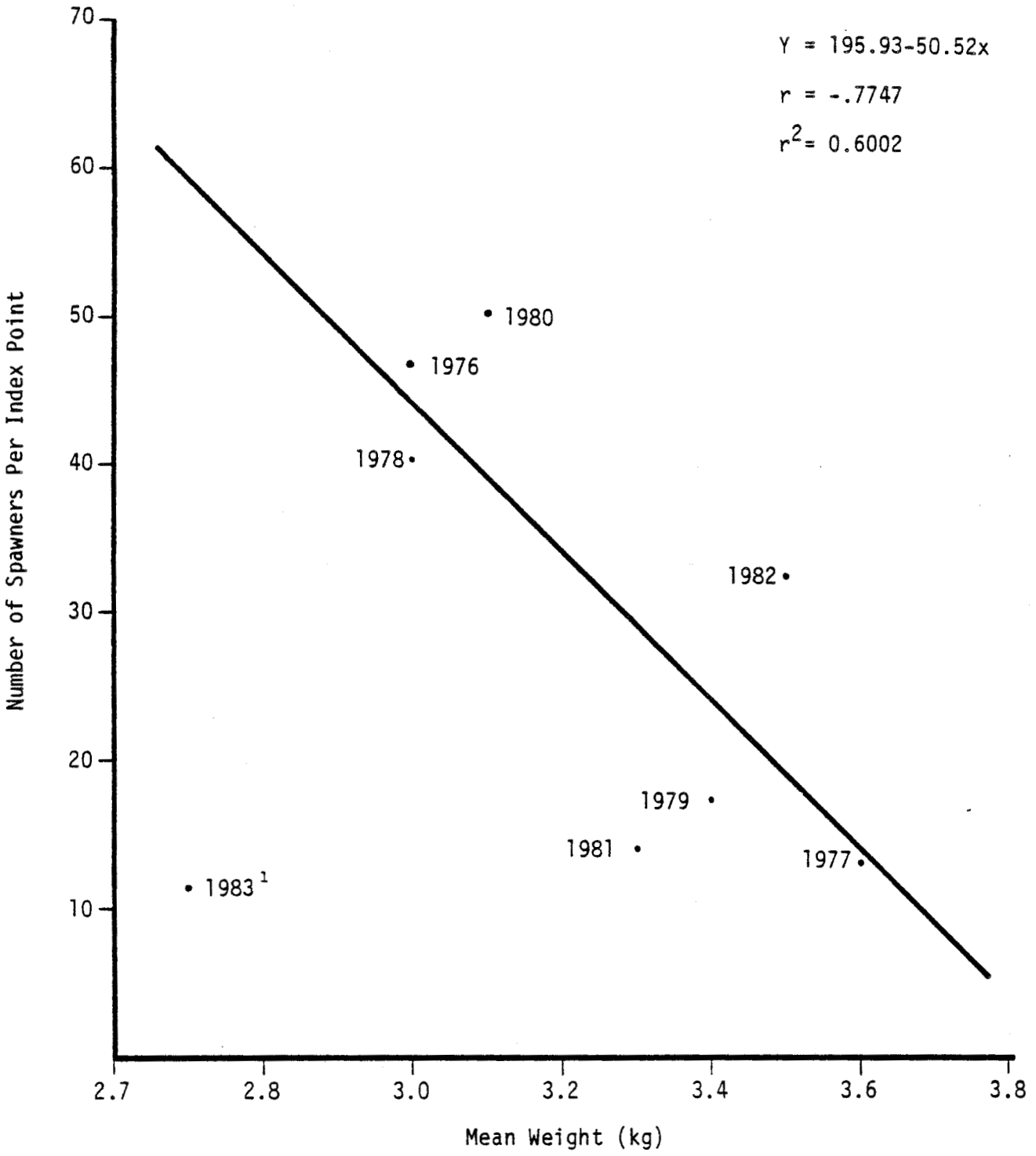


Figure 3. Relationship between mean weight (kg) and number of spawners per test fishing index point for Igushik River sockeye salmon, 1976-1983.

[1] This data point not included in calculation of the regression line.

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