ADF&G TECHNICAL DATA REPORT NO. 56
(Limited Distribution)

STATE OF ALASKA
Jay S. Hammond, Governor

1979 BRISTOL BAY SOCKEYE SALMON TEST FISHING PROJECTS

Edited by:
Henry J. Yuen

1980

ALASKA DEPARTMENT OF FISH AND GAME
Subport Building, Juneau, Alaska 99801

Ronald O. Skoog
Commissioner

ADF&G TECHNICAL DATA REPORTS

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

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

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

1979 BRISTOL BAY SOCKEYE SALMON TEST FISHING PROJECTS

A summary of sockeye salmon *(Oncorhynchus nerka)* test fishing in Bristol Bay, including the Kvichak, Egegik, Ugashik, and Igushik inside and the Port Moller offshore projects

Edited by:

Henry J. Yuen

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

1980

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF TABLES (Continued)

LIST OF APPENDIX TABLES

FOREWORD

By

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

The common objective in test fishing for Bristol Bay sockeye salmon *(Oncorhynchus nerka)* is to estimate abundance, i.e., of total inshore return as in the offshore test fishing project, or of escapement past the commercial fishery as in the inside test fishing projects. While most of these estimates are based on historical catch per unit of effort data, there are some estimates based primarily on mean weights, mean lengths, and lag times. These methods as well as other objectives specific to a particular project will be discussed in the individual reports.

Offshore test fishing dates back as far as 1939. Inside test fishing began later in 1960. Recent documentation of these test fisheries began with Seibel (1965)[1]. Documentation from 1960 to 1973, when the project was financed in part with funds from the Anadromous Fish Act (P.L. 89-304) through the National Marine Fisheries Service is available in the form of annual technical reports, annual progress reports, and a completion report, Anadromous Fish Projects AFC-6 and 31, to the National Marine Fisheries Service.

Documentation from 1970 to 1978 are available in the form of inter-departmental reports entitled "Bristol Bay Data Report Series" as follows:

Year	Report No.	Offshore	Inside
1967	15	x	x
1968	22	x	x
1969	35	x	x
1970	36	x	x
1971	38	x	x
1972	42	x	x
1975	60	x	x
1976	61	x	x
1975-76	62		x
1977	63	x	
1977	64		x
1976-78	67		x
1978	69	x	
1978	70		x

[1] Seibel, Melvin C. 1965. Test fishing in Bristol Bay, 1960-64. ADF&G Informational Leaflet No. 67. 39 pp.

This report represents a continuation in the documentation of sockeye salmon test fishing in Bristol Bay, and is the first in a series of Technical Data Reports in which all Bristol Bay test fishing reports are combined in a single report.

1979 PORT MOLLER OFFSHORE TEST FISHING

By

Charles P. Meacham
Alaska Department of Fish and Game
Division of Commercial Fisheries
Anchorage, Alaska

INTRODUCTION

The offshore test fish project dates back to studies conducted in 1939-1940. Although location, timing, and gear type have improved over those in the early studies, the goal remains the same, to assist in the management of the Bristol Bay commercial salmon fishery--a fishery estimated to have been worth 120 million dollars to commercial fishermen in 1979.

The specific objectives of the 1979 Port Moller offshore gillnet test fishery were to:

1) Estimate the magnitude of the sockeye *(Oncorhynchus nerka)* and chum salmon *(O. keta)* runs to Bristol Bay from catch-per-unit-effort (CPUE) statistics before these fish entered the commercial fishery;

2) Forecast the timing and entry pattern of these runs to the fishing grounds (early, late, bimodal, etc.);

3) Obtain age, weight, and length data to update the long range forecast of age composition and total run size; and

4) Obtain a second estimate of the total abundance of sockeye salmon from the size of the returning fish caught in the test fishery.

The early Port Moller test fishery results had substantial errors in the estimates of inshore run size. Differences between estimated and actual inshore returns can be attributed to differences in the year-to-year inshore return per test fish index point. Between 1968 and 1979 the average sockeye salmon return per index point was 26,311 with a standard deviation of 16,261. The range was wide, from 7,200 in 1973 to 56,000 in 1972.

In 1978 a sockeye salmon gillnet catchability model using average weights of fish caught in the test fishery was developed to determine an inshore return per test fish index point used in expanding the test fishery indices into estimates of inshore return (Meacham 1978). In 1979 two catchability models based on sockeye salmon mean length were developed, one to determine inshore return per test fish index and the other to estimate total run magnitude from the size of fish caught in the test fishery, independent of CPUE data.

The results of the 1978 test fishing successfully alerted the fishery managers to the early timing and age composition of the inshore run. The return per index point was successfully determined from the sockeye salmon accumulated mean length and this model successfully forecast the inshore run size (within 85% of that portion of the run forecast). The model based on sockeye salmon accumulative mean weight and sum of daily forecast based on mean weights significantly underforecast the total run as did the total abundance estimation procedure based solely on size of the sockeye salmon.

MATERIALS AND METHODS

Due to an unusual offshore and fluctuating distribution of sockeye salmon in 1979 (Appendix Table 1), gillnet test fishing was conducted further northwest than normal. The test fishing stations were 8 km apart along a line extending from Port Moller to Cape Newenham. Station 1 was about 45 km offshore from Port Moller on the 20 fm contour and station 12 was about 137 km offshore (Figure 1). Generally on the outgoing trip the odd-numbered stations were fished for approximately 1 hour each with about 1 hour of running time between stations. The vessel then anchored overnight and on the following day fished the even-numbered stations on the return trip. Test fishing was earlier than usual, beginning on 6 June and terminating on 29 June 1979.

The 20 m vessel COMMANDO was chartered for the 1979 season. The gillnet was deployed and retrieved over a stern roller with a hydraulic drum. The gillnet was 200 fm long with 137 mm (5-3/8 in) stretch mesh, 60 meshes deep. An attempt was made to set the net perpendicular to the anticipated path of fish migration to decrease variability in catch due to net orientation.

Consistent with other gillnet test fish projects, an index point was defined as the number of fish caught per 100 fm of gillnet per hour of fishing time. Index values were computed as follows:

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

where C = catch
F = fathoms of net
T = minutes fished

Missing data was interpolated from the mean of index values from the stations on each side on the missing station and/or from the index values of the preceeding and following days.

Scale samples for age class analysis, length, weight, and sex data were collected. Additionally, water surface temperatures, wind direction and velocity, and tide stage (Appendix Table 2), and air temperature, water depth, and Loran coordinates were recorded for each station fished.

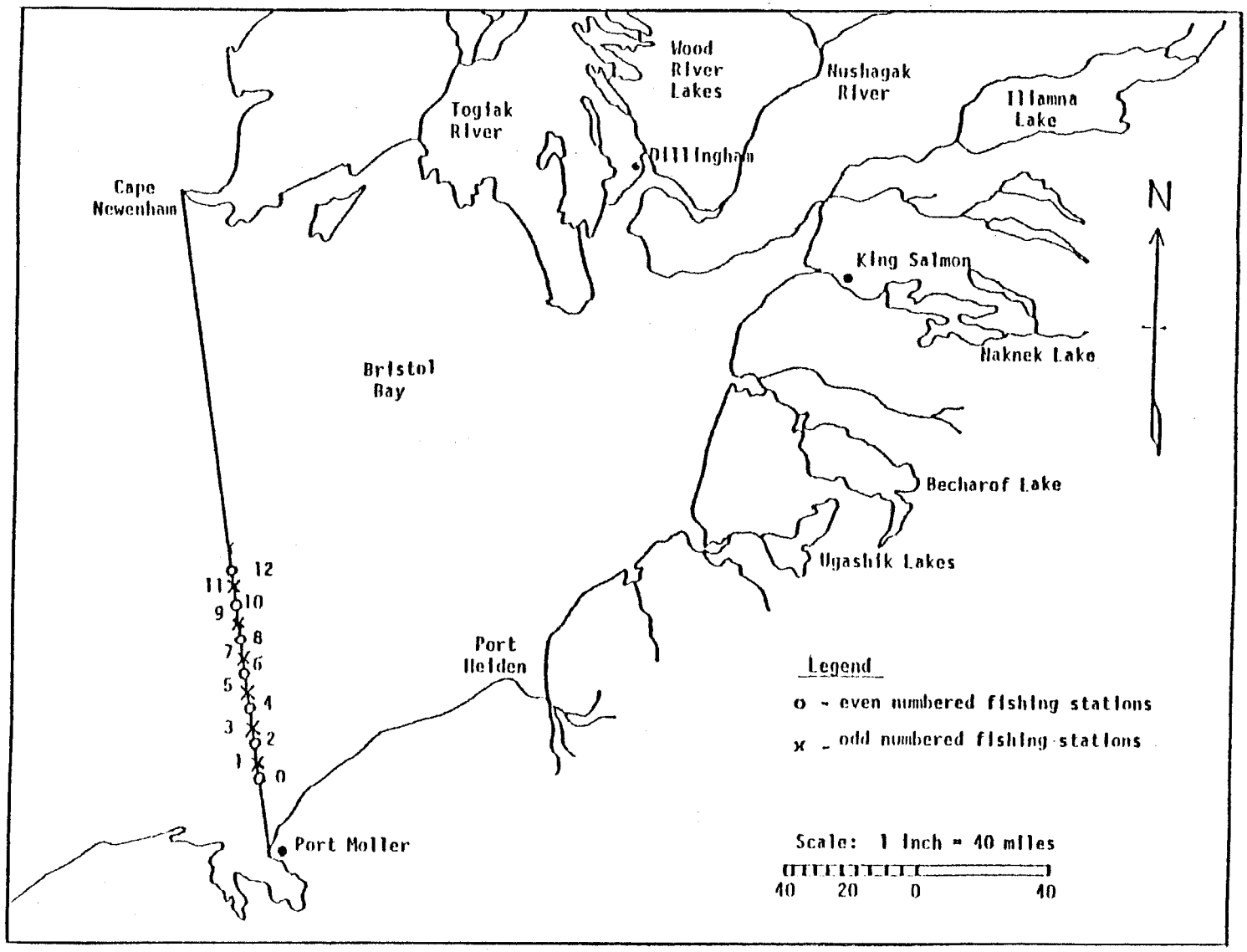

Figure 1. Transect and stations fished during the Port Moller offshore gillnet test fishery.

Historic Port Moller test fish sockeye salmon mean length and weight (Table 1) were correlated with inshore return per test fish index values (Figure 2) and with sockeye salmon run size (Figure 3). All relationships were statistically significant at the 95% confidence level. Thus, passage and total inshore run size could be estimated using the following relationships:

1) Index multiplied by return per index based on sockeye salmon length or weight, which equaled passage, the sum of which equaled total inshore return;

2) Cumulative indices multiplied by return per index based on sockeye salmon running mean length or weight, which equaled cumulative passage and inshore return; and

3) Sockeye salmon average length, or weight, to estimate total inshore run size.

The principal method used was that developed for the 1978 season whereby station index values were multiplied by a return per index value calculated from the mean weight of sockeye salmon caught at that station:

$$\text{daily passage by station, } N_{ij} = [K_{ij}][I_{ij}]$$

where I = sockeye salmon index
K = inshore return per index or catchability
i = day
j = station

Return per index or catchability varied between day and stations as a function of mean weight of the fish caught:

$$\text{catchability, } K_{ij} = [272.69][[1/c][\sum_{n=1}^{c} W_{ijn}]]^{-2.81}$$

where c = sockeye catch
W = sockeye weight

To obtain estimates of daily passage, the individual station passage estimates were summed at the end of a sampling day. Similarly, an estimate of cumulative passage after 24 days of sampling was obtained by summing the individual daily passage estimates.

Because the return per index to mean weight relationship was derived from annual mean weight and total index values, the cumulative passage was also estimated from the cumulative index and the running sockeye salmon mean weight. The sockeye salmon mean weight to date was also weighted by the daily station indices, providing a weight unbiased by fathoms of net fished or length of time fished:

Table 1. Relationship between average fork length and weight of sockeye salmon captured offshore of Port Moller and inshore run size and return per index, Bristol Bay, 1971-1978.

Date	Inshore run (millions)	Return per index (thousands)	Length (mm)	Weight (kg)
1971	15.82	24.2	549.9	2.65
1972	5.37	-	566.8	2.94
1973	2.42	7.2	584.9	3.31
1974	10.94	-	-	-
1975	24.20	18.8	547.9	2.38
1976	11.47	16.7	552.1	2.78
1977	9.47	12.2	567.8	3.18
1978	19.65	-	545.4	2.76

Power Curve $y = ax^b$

Inshore run versus:

Length	$r^2 = .91$	$a = 1.757 \times 10^{83}$	$b = -29.93$
Weight	$r^2 = .72$	$a = 5,845.23$	$b = - 6.09$

Return per index versus:

Length	$r^2 = .93$	$a = 3.10117 \times 10^{45}$	$b = -16.13$
Weight	$r^2 = .67$	$a = 272.69$	$b = - 2.81$

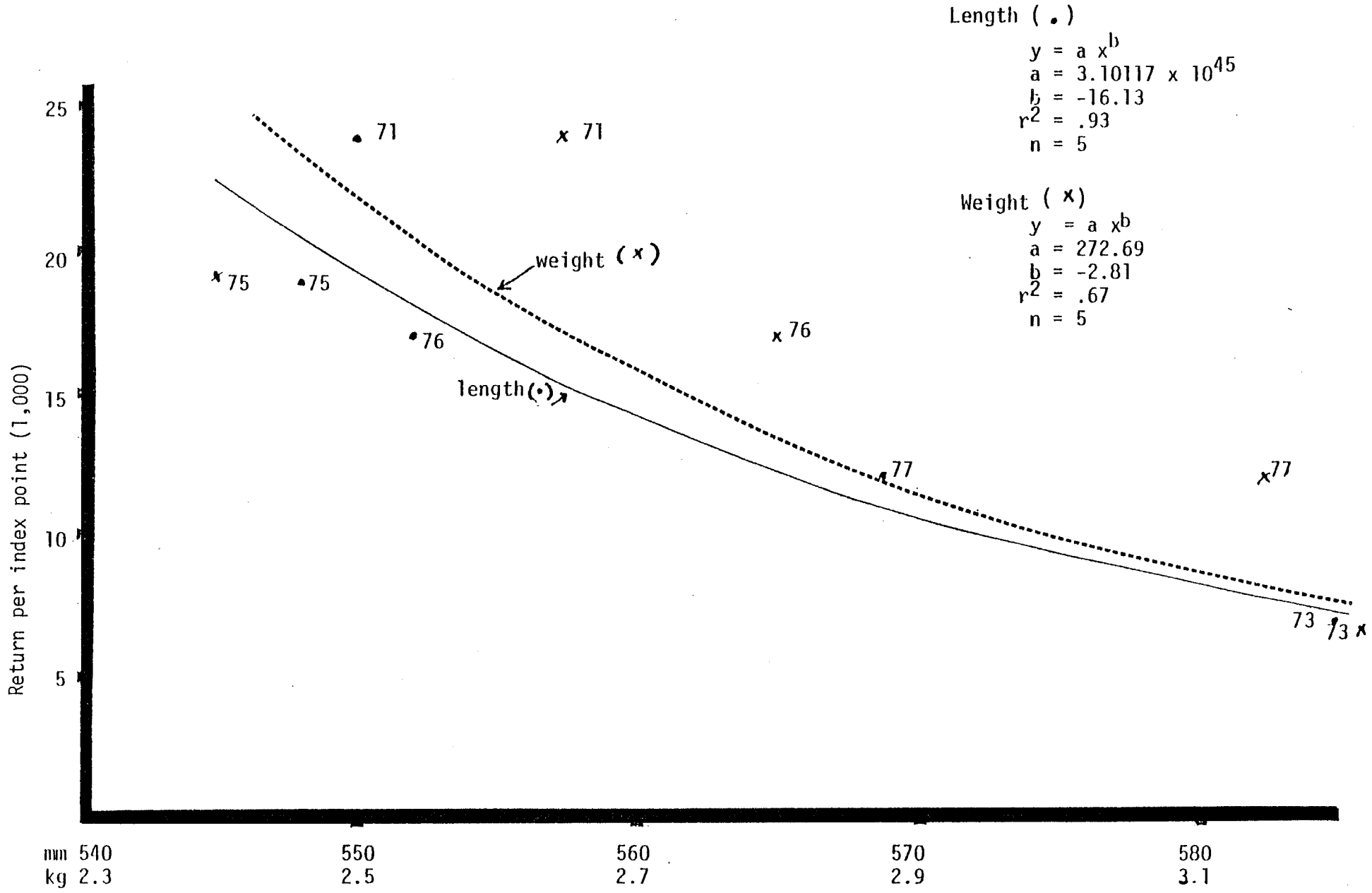

Figure 2. Relationship between fork length or round weight of sockeye salmon captured offshore of Port Moller and inshore sockeye salmon return per Port Moller test fishing index point.

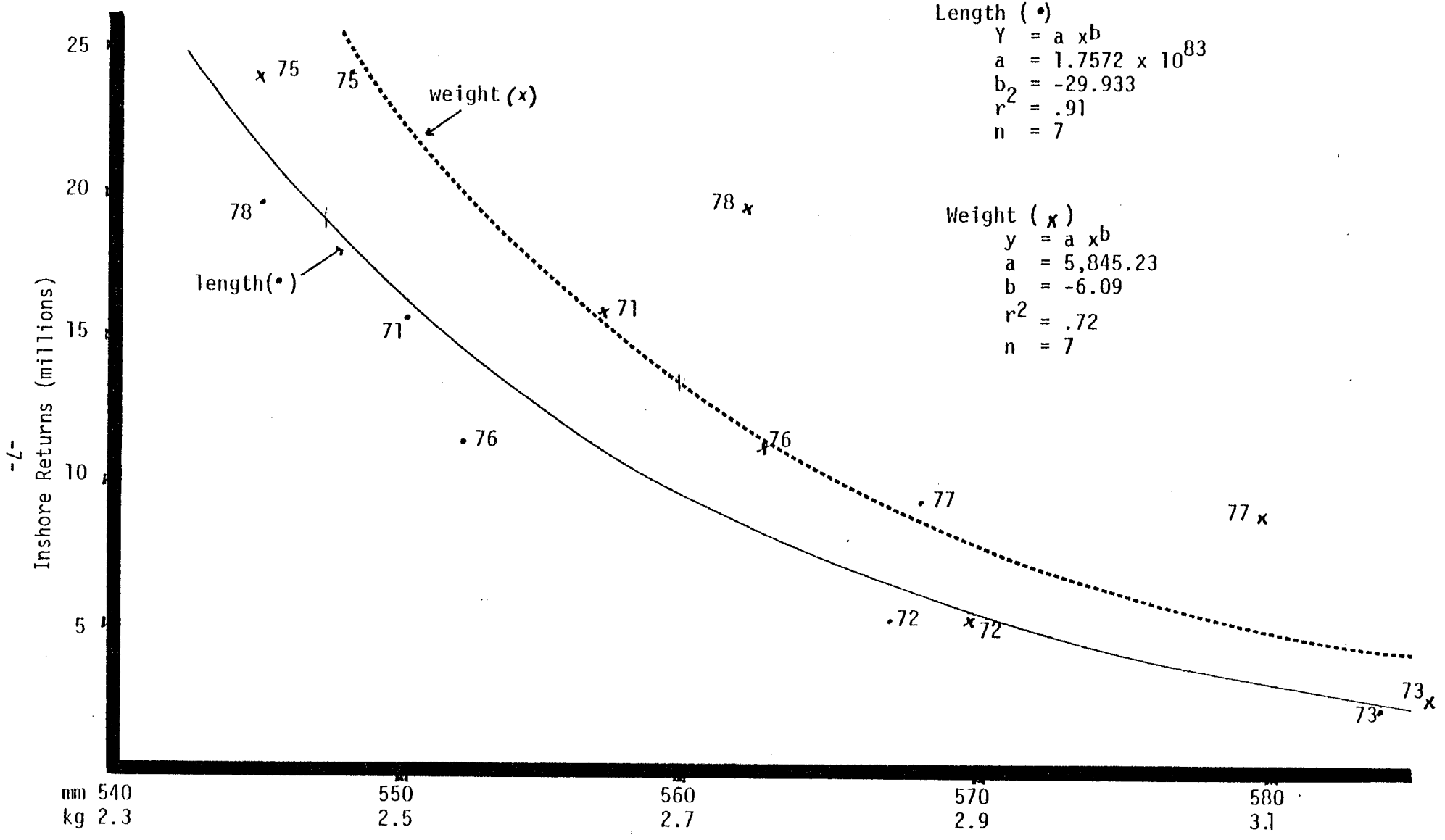

Figure 3. Relationship between fork length and round weight of sockeye salmon captured offshore of Port Moller and inshore sockeye salmon run size, Bristol Bay, 1971-1978.

cumulative passage =

$$\sum_{n=1}^{t} N_n = [[272.69][\sum_{n=1}^{t} [\bar{W}_n I_n]/\sum_{n=1}^{t} I_n]^{-2.81}][\sum_{n=1}^{t} I_t]$$

$\bar{W}$ = sockeye mean weight
t = fishing sets

Estimates of cumulative passage were also made from the relationship between sockeye salmon mean length (L) and return per index (weighted by daily station indices):

cumulative passage =

$$\sum_{n=1}^{t} N_n = [[3.10017 \times 10^{45}][\sum_{n=1}^{t} [\bar{L}_n I_n]/\sum_{n=1}^{t} I_n]^{-16.13}][\sum_{n=1}^{t} I_n]$$

The relationship between sockeye salmon mean weight ($\bar{W}$) and inshore return (N) in millions was:

$$N_t = [5{,}845.23][\bar{W}_t]^{-6.09}$$

The relationship between sockeye salmon mean length ($\bar{L}$) and inshore return in millions was:

$$N_t = [1.7572 \times 10^{83}][\bar{L}_t]^{-29.93}$$

RESULTS

A total of 1,422 sockeye salmon and 50 chum salmon was captured as a result of 85 test fishing sets made between 6 June and 29 June 1979. The inshore return of sockeye salmon and chum salmon was 40.3 and 0.9 million, respectively. A toal of 1,034.4 sockeye salmon index points and 31.6 chum salmon index points were calculated, including interpolated values. The sockeye salmon mean weight and length was 2.70 kg and 547 mm, respectively (Table 2).

The forecast of sockeye salmon returns from the sum of the individual station passage rates based on daily mean weights was 19.3 million while the forecast based on cumulative mean weights and index values was 17.8 million. Both were below actual inshore returns for the comparable period of inshore run (using 7 day travel time between the test fish site and inshore systems) by 36% and 41%, respectively. The forecast of sockeye salmon returns based on the running mean length and index values was 25.8 million--only 15% in error (Table 3, Figure 4).

Table 2. Daily summary of sockeye salmon catch, length, weight, and index[1] and chum salmon catch and index[1] from the Port Moller test fishery, 1979.

Date	Stations fished	Sockeye				Chum	
		Catch	Length (mm)	Weight (kg)	Index	Catch	Index
6/ 6	6	2	555	2.78	1.030	0	0.0
6/ 7	5	2	555	2.95	0.960	0	0.0
6/ 8	0	0			1.390	0	0.45
6/ 9	4	4	501	2.20	1.800	2	1.125
6/10	1	1	558	3.41	2.010	0	0.45
6/11	5	5	560	3.34	2.220	1	0.47
6/12	6	60	552	2.85	30.980	5	2.18
6/13	5	48	547	2.83	24.100	2	0.81
6/14	5	90	550	2.78	42.730	4	1.58
6/15	5	45	562	2.88	19.220	7	3.03
6/16	4	130	548	2.68	85.410	2	0.84
6/17	0	0			85.400	0	1.238
6/18	2	20	532	2.62	85.400	1	0.748
6/19	3	66	553	2.83	37.380	2	1.211
6/20	3	86	550	2.72	56.660	0	0.220
6/21	6	152	550	2.75	65.180	4	1.660
6/22	5	311	546	2.66	124.900	6	2.400
6/23	4	120	545	2.66	85.140	1	0.730
6/24	0	0			74.000	0	1.876
6/25	3	97	542	2.61	58.340	2	1.014
6/26	0	0			46.325	0	2.197
6/27	4	59	545	2.65	34.310	1	0.808
6/28	6	95	547	2.60	52.580	10	5.880
6/29	4	29	535	2.48	16.980	0	0.703
Total	85	1,422	547	2.70	1034.435	50	31.620

[1] Includes interpolated indices.

Table 3. Comparison between actual Bristol Bay inshore sockeye salmon returns and three forecast returns based on data from the Port Moller gillnet test fishery, 1979.

(In thousands of fish)

Date	Inshore return	Forecast returns[1] Method 1 (weight, sum)	Method 2 (weight, accum.)	Method 3 (length, accum.)
6/18	71	198	130	237
6/19	223	646	571	841
6/20	392	1,010	928	1,425
6/21	592	1,696	1,590	2,342
6/22	1,179	1,971	1,860	2,588
6/23	2,375	3,551	3,321	4,533
6/24	3,872	5,145	4,808	6,633
6/25	5,441	6,861	6,371	9,701
6/26	7,103	7,423	6,920	10,402
6/27	9,005	8,414	7,854	11,602
6/28	11,757	9,497	8,894	12,975
6/29	14,414	11,921	11,111	16,179
6/30	17,196	13,521	12,589	18,276
7/ 1	19,170	14,963	13,920	20,105
7/ 2	21,178	16,152	15,004	21,774
7/ 3	23,443	17,069	15,850	23,083
7/ 4	26,293	17,727	16,462	23,978
7/ 5	28,266	18,847	17,438	25,205
7/ 6	30,041	19,265	17,789	25,777
7/ 7	31,468			
7/ 8	32,567			
7/ 9	33,418			
7/10	34,348			
7/11	35,419			
7/12	36,391			
7/13	37,040			
7/14	37,462			
7/15	37,909			
7/16	38,164			
7/17	38,348			
7/18	38,452			
7/19	38,529			
7/20	38,579			
7/21	38,625[2]			

[1] Based on a 7 day travel time between Port Moller and inshore systems.

[2] Incomplete estimate of inshore returns. Additional sockeye salmon entered the Bay prior to and after dates shown. Excludes Togiak system catch and escapement counts.

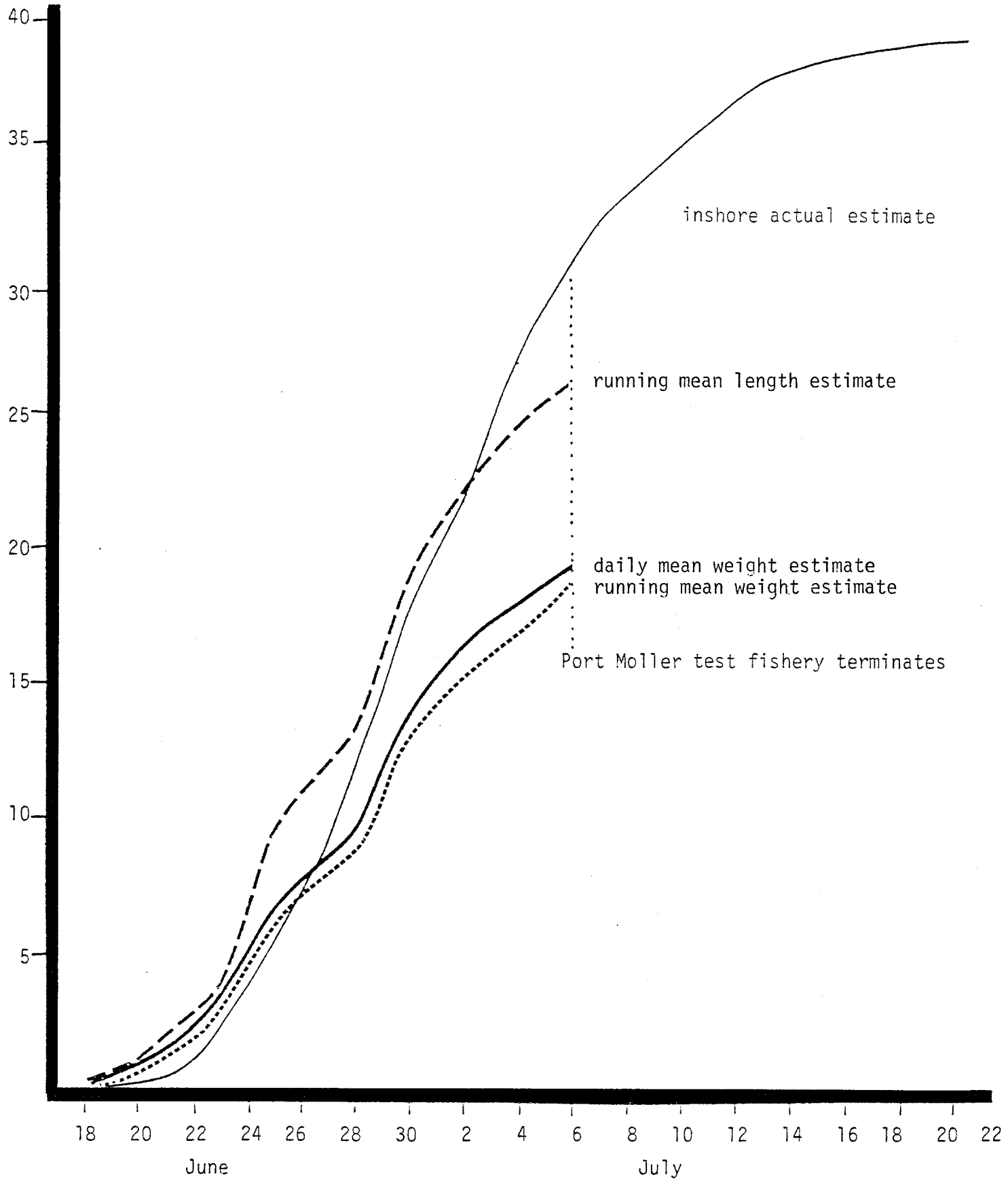

Figure 4. Comparison of estimates of Bristol Bay inshore sockeye salmon returns based on three treatments of Port Moller test fish data with an estimate of actual returns, by day, 1979.

The forecast of sockeye salmon total run size based on mean weight and length was 13.8 and 19.8 million, respectively, both below actual inshore returns by 60% and 50%, respectively.

The forecast of the total chum salmon run size based on the standard return of 8,730 chum per chum index point was 276,041, well below the actual return.

The percent age class composition of the sockeye run was forecast satisfactorily by the Port Moller test fishery as indicated in Table 4.

Peak catches in the test fishery occurred 22 June, indicating an early run which was forecast to peak in the bay on 29 June, using a 7 day lag time between the test fishery and the bay. The actual peak of the run was sometime between 28 June and 30 June as forecast, approximately 4 to 5 days earlier than normal.

Table 4. Comparison of age class composition, actual return, and Port Moller test fishing, 1979.

Age Class	Actual	Port Moller
4_2	28.0	22.6
5_3	53.2	52.0
5_2	13.2	16.2
6_3	5.6	8.9

LITERATURE CITED

Meacham, Charles P. 1978. Offshore test fishing in Bristol Bay, 1978. Alaska Department of Fish and Game, Bristol Bay Data Report No. 69. 33 pp.

Appendix Table 1. Sockeye salmon catch index by date and station, Port Moller, 1979.

	STATION												
DATE	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL
6/ 6	0.000		0.530		0.000		0.000		0.500		0.000		1.030
6/ 7		0.000		0.000		0.000		0.960		0.000			0.960
6/ 8													
6/ 9		0.000		1.400		0.400		0.000					1.800
6/10	0.430												0.430
6/11		0.000		0.480		0.850		0.890		0.000			2.220
6/12	0.000		0.000		5.170		2.300		10.870		8.240		26.580
6/13				0.000		4.100		3.000		8.500		4.400	20.000
6/14			3.480		0.000		6.250		13.700		13.000		36.430
6/15				2.240		7.800		6.570		0.000		2.610	19.220
6/16					2.040		13.600		15.620		22.950		54.210
6/17													
6/18					0.880		8.050						8.930
6/19						9.790		17.800					27.590
6/20							22.600		11.300		5.730		39.630
6/21		0.000		10.300		19.480		13.000		21.900		0.500	65.180
6/22			24.600		18.600		35.400		33.400		12.900		124.900
6/23				2.400		22.540		11.700		36.500			73.140
6/24													
6/25				17.140		12.100		17.100					46.340
6/26													
6/27				10.720		5.400		3.890		9.300			29.310
6/28	5.240		1.780		5.630		0.560		26.800		12.570		52.580
6/29		0.000		1.330		2.750		12.900					16.980
TOTAL	5.670	0.000	30.390	46.010	32.320	85.210	88.760	87.810	112.190	76.200	75.390	7.510	647.460
%	1.	0.	5.	7.	5.	13.	14.	14.	17.	12.	12.	1.	100.

Appendix Table 2. Sockeye and chum salmon catch and index data and environmental measurements collected during the Port Moller offshore test fish project, 1979.

YR	MO	DY	SET NO.	STA NO.	GEAR LENGTH (FMS)	MEAN FISHING TIME (MIN)	SOCKEYE CATCH	SOCKEYE INDEX	SOCKEYE MEAN WT	SOCKEYE MEAN LN	CHUM CATCH	CHUM INDEX	WATER TEMP	WIND VELO	WIND DIRE	I D E	SET	HAUL
07PORT MOLR.79	6	6	1	1	200	66.0	0	0.	0.	0	0	0.	9	0		3	325	325
07PORT MOLR.79	6	6	2	3	200	56.5	1	0.530	3.35	590	0	0.	9	0		3	325	325
07PORT MOLR.79	6	6	3	5	200	60.0	0	0.	0.	0	0	0.	9	0		3	330	330
07PORT MOLR.79	6	6	4	7	200	63.5	0	0.	0.	0	0	0.	8	12	NE	4	325	325
07PORT MOLR.79	6	6	5	9	200	60.0	1	0.500	2.20	520	0	0.	8	20	NE	4	305	250
07PORT MOLR.79	6	6	6	11	200	67.0	0	0.	0.	0	0	0.	8	20	NE	3	325	325
07PORT MOLR.79	6	7	7	10	200	62.5	0	0.	0.	0	0	0.	8	15	NE	4	325	250
07PORT MOLR.79	6	7	8	8	200	62.5	2	0.960	2.95	555	0	0.	8	10	NE	3	145	100
07PORT MOLR.79	6	7	9	6	200	61.0	0	0.	0.	0	0	0.	8	15	NE		145	190
07PORT MOLR.79	6	7	10	4	200	67.0	0	0.	0.	0	0	0.	9	15	NE	4	140	100
07PORT MOLR.79	6	7	11	2	200	74.0	0	0.	0.	0	0	0.	9	20	NE		145	195
07PORT MOLR.79	6	9	12	2	200	65.0	0	0.	0.	0	0	0.	8	10	SW	4	325	355
07PORT MOLR.79	6	9	13	4	200	64.0	3	1.400	1.94	482	0	0.	8	12	SW		310	
07PORT MOLR.79	6	9	14	6	200	71.5	1	0.400	2.98	560	0	0.	9	20	SW	3	325	295
07PORT MOLR.79	6	9	15	8	200	67.0	0	0.	0.	0	0	0.	8	20	SW	3	325	40
07PORT MOLR.79	6	10	16	1	200	70.0	1	0.430	3.30	580	0	0.	8	26	SW	4	330	270
07PORT MOLR.79	6	11	17	2	200	63.5	0	0.	0.	0	0	0.	8	9	SW	4	325	45
07PORT MOLR.79	6	11	18	4	200	62.5	1	0.480	3.20	590	0	0.	8	18	SW	3	325	325
07PORT MOLR.79	6	11	19	6	200	70.5	2	0.850	3.65	557	0	0.	8	10	SW	3	330	50
07PORT MOLR.79	6	11	20	8	200	67.5	2	0.890	3.10	547	0	0.	8	20	SW	4	325	50
07PORT MOLR.79	6	11	21	10	200	57.0	0	0.	0.	0	0	0.	8	20	W	4	325	50
07PORT MOLR.79	6	12	22	11	200	65.5	18	8.240	2.84	547	0	0.	8	8	SW	4	145	145
07PORT MOLR.79	6	12	23	9	200	74.5	27	10.870	2.76	547	0	0.	8	7	SW	4	140	140
07PORT MOLR.79	6	12	24	7	200	66.0	5	2.300	3.00	569	0	0.	8	6	W	4	145	145
07PORT MOLR.79	6	12	25	5	200	50.0	10	5.170	3.06	566	0	0.	8	5	SW	3	145	145
07PORT MOLR.79	6	12	26	3	200	60.5	0	0.	0.	0	0	0.	8	3	SW	3	145	145
07PORT MOLR.79	6	12	27	1	200	64.0	0	0.	0.	0	0	0.	8	0		4	145	145
07PORT MOLR.79	6	13	28	4	200	70.5	0	0.	0.	0	0	0.	8	12	SW		140	140
07PORT MOLR.79	6	13	29	6	200	65.5	9	4.100	2.88	549	0	0.	9	15	NW	1	345	345
07PORT MOLR.79	6	13	30	8	200	69.0	7	3.000	2.61	527	0	0.	8	14	NW	3	335	60
07PORT MOLR.79	6	13	31	10	200	74.0	21	8.500	2.81	547	1	0.400	8	18	W	4	330	330
07PORT MOLR.79	6	13	32	12	200	73.5	11	4.400	2.99	557	1	0.410	8	18	W	4	340	340
07PORT MOLR.79	6	14	33	11	200	76.0	33	13.000	2.81	549	4	1.580	8	5	SW	2	120	120
07PORT MOLR.79	6	14	34	9	200	74.5	34	13.700	2.79	554	0	0.	9	8	SE	4	145	145
07PORT MOLR.79	6	14	35	7	200	72.0	15	6.250	2.68	549	0	0.	8	2	NW	4	150	150
07PORT MOLR.79	6	14	36	5	200	67.5	0	0.	0.	0	0	0.	8	10	SE	3	150	150
07PORT MOLR.79	6	14	37	3	200	69.0	8	3.480	2.74	541	0	0.	9	21	S	3	150	150
07PORT MOLR.79	6	15	38	4	200	67.0	5	2.240	2.79	556	0	0.	9	2	SW	2	330	330
07PORT MOLR.79	6	15	39	6	200	73.0	19	7.800	2.80	564	1	0.410	8	15	SW	3	330	330
07PORT MOLR.79	6	15	40	8	200	68.5	15	6.570	2.85	557	2	0.880	9	17	SW	4	330	330
07PORT MOLR.79	6	15	41	10	200	59.5	0	0.	0.	0	0	0.	9	15	W	3	340	330
07PORT MOLR.79	6	15	42	12	200	69.0	6	2.610	3.26	574	4	1.740	9	8	SW	3	310	310
07PORT MOLR.79	6	16	43	11	200	74.5	57	22.950	2.73	549	0	0.	8	14	SW	3	145	145
07PORT MOLR.79	6	16	44	9	200	73.0	38	15.620	2.55	543	1	0.410	9	14	SE	3	110	110
07PORT MOLR.79	6	16	45	7	200	70.5	32	13.600	2.76	554	1	0.430	8	15	S	4	140	140
07PORT MOLR.79	6	16	46	5	200	44.0	3	2.040	2.62	543	0	0.	9	20	S	4	150	150
07PORT MOLR.79	6	16	47	3	200	68.5	2	0.880	2.87	563	1	0.440	9	25	SW	1	325	

Appendix Table 2. (Continued)

YR	MO	DY	SET NO.	STA NO.	GEAR LENGTH (FMS)	MEAN FISHING TIME (MIN)	SOCKEYE CATCH	SOCKEYE INDEX	SOCKEYE MEAN WT	SOCKEYE MEAN LN	CHUM CATCH	CHUM INDEX	WATER TEMP	WIND VELO	WIND DIRE	TIDE	SET	HAUL
07FORT	HOLR.79	6	18	48	7	200	67.0	18	8.050	2.59	529	0	0.	9	23	SW	4	325	325
07FORT	HOLR.79	6	19	49	6	200	70.5	23	9.790	2.86	560	0	0.	8	25	SW	3	290	
07FORT	HOLR.79	6	19	50	8	200	72.5	43	17.800	2.81	549	2	0.830	9	20	SW	3	285	285
07FORT	HOLR.79	6	20	51	7	200	66.5	50	22.600	2.67	549	0	0.	9	4	NW	3	300	300
07FORT	HOLR.79	6	20	52	9	200	66.5	25	11.300	2.70	548	0	0.	9	5	NW	3	300	300
07FORT	HOLR.79	6	20	53	11	200	57.5	11	5.730	2.98	559	0	0.	8	6	NW	4	310	310
07FORT	HOLR.79	6	21	54	12	200	60.0	1	0.500	2.56	542	0	0.	8	3	SE	1	125	125
07FORT	HOLR.79	6	21	55	10	200	70.0	51	21.900	2.78	553	3	1.290	9	6	SW	3	140	140
07FORT	HOLR.79	6	21	56	8	200	64.5	28	13.000	2.78	547	1	0.460	8	10	SE	3	140	
07FORT	HOLR.79	6	21	57	6	200	77.0	50	19.480	2.70	548	0	0.	9	7	SE	3	140	140
07FORT	HOLR.79	6	21	58	4	200	64.0	22	10.300	2.78	554	0	0.	9	10	E	3		
07FORT	HOLR.79	6	21	59	2	200	59.5	0	0.	0.	0	0	0.	0	6	NE	4	140	140
07FORT	HOLR.79	6	22	60	3	200	78.0	64	24.600	2.68	549	2	0.770	0	0			310	310
07FORT	HOLR.79	6	22	61	5	200	69.5	43	18.600	2.47	536	0	0.	0	0		3	310	310
07FORT	HOLR.79	6	22	62	7	200	74.5	88	35.400	2.69	545	0	0.	0	0		3	310	310
07FORT	HOLR.79	6	22	63	9	200	83.5	93	33.400	2.75	552	3	1.070	0	0		4	310	310
07FORT	HOLR.79	6	22	64	11	160	67.0	23	12.900	2.51	531	1	0.560	0	10	SE	4	300	
07FORT	HOLR.79	6	23	65	10	160	73.0	71	36.500	2.65	541	0	0.	0	10	SE	2	130	130
07FORT	HOLR.79	6	23	66	8	125	65.0	15	11.700	2.66	544	1	0.730	0	8	SE	3	130	130
07FORT	HOLR.79	6	23	67	6	150	55.0	31	22.540	2.70	553	0	0.	0	10	SE	3	130	130
07FORT	HOLR.79	6	23	68	4	150	50.0	3	2.400	2.96	572	0	0.	0	15	S	3	130	130
07FORT	HOLR.79	6	25	69	4	200	73.5	42	17.140	2.58	544	2	0.810	0	10	W	4	310	310
07FORT	HOLR.79	6	25	70	6	200	57.0	23	12.100	2.65	543	0	0.	0	20	W	4	310	
07FORT	HOLR.79	6	25	71	8	200	56.0	32	17.100	2.61	536	0	0.	0	20	SW	3	325	325
07FORT	HOLR.79	6	27	72	4	200	58.5	21	10.720	2.69	549	1	0.510	0	20	W	4	330	330
07FORT	HOLR.79	6	27	73	6	200	55.5	10	5.400	2.58	532	0	0.	0	20	NW	4	330	315
07FORT	HOLR.79	6	27	74	8	200	54.0	7	3.890	2.68	543	0	0.	0	10	NW	3	310	310
07FORT	HOLR.79	6	27	75	10	200	67.5	21	9.300	2.64	540	0	0.	0	15	NW	3	325	325
07FORT	HOLR.79	6	28	76	11	200	52.5	22	12.570	2.82	561	4	2.280	0	7	NW	3	140	140
07FORT	HOLR.79	6	28	77	9	200	57.0	51	26.800	2.46	535	1	0.530	0	8	NW	4	140	140
07FORT	HOLR.79	6	28	78	7	200	54.0	1	0.560	2.49	567	0	0.	0	10	N	4	130	130
07FORT	HOLR.79	6	28	79	5	200	40.0	9	5.630	2.79	559	3	1.080	0	8	NE	4	140	140
07FORT	HOLR.79	6	28	80	3	200	50.5	3	1.780	3.28	601	2	1.190	0	10	NE	4	140	140
07FORT	HOLR.79	6	28	81	1	200	51.5	9	5.210	2.49	540	0	0.	0	12	NE	4	115	115
07FORT	HOLR.79	6	29	82	2	200	50.5	0	0.	0.	0	0	0.	0	5	NE	3	325	325
07FORT	HOLR.79	6	29	83	4	200	67.5	3	1.330	2.10	515	0	0.	0	15	SE	3	325	325
07FORT	HOLR.79	6	29	84	6	200	54.5	5	2.750	2.52	534	0	0.	0	21	E		300	
07FORT	HOLR.79	6	29	85	8	200	49.0	21	12.900	2.52	538	0	0.	0	25	E	2	325	270

1979 KVICHAK, EGEGIK, AND UGASHIK INSIDE TEST FISHING

by

Charles P. Meacham
Alaska Department of Fish and Game
Division of Commercial Fisheries
Anchorage, Alaska

INTRODUCTION

The inside test fishing program which began in 1960 was designed to provide an early indication of spawning escapement for management decisions because the escapement can not be enumerated at a counting tower upriver in clear water until 3 to 15 days after passing through the commercial fishing districts. Since about 80% of the sockeye salmon *(Oncorhynchus nerka)* run occurs within a 2 week period, an early estimate of escapement is necessary for timely management decisions.

One difficulty in estimating escapements with test fish projects is the extreme annual variability in tower counts per test fish index values which ranged from 55 to 1,234 for the Kvichak project, 55 to 360 for the Egegik project, and 6 to 49 for the Ugashik project (Yuen 1979). Some of the variance in tower count per index values can be accounted for by considering the relative catchability of the fish as measured by their average weight and average length. This relationship was used to forecast the Kvichak and Egegik escapements along with an entry pattern model which compares cumulative tower counts with cumulative test fish indices. For the Ugashik system, escapement was forecast by the latter method only.

MATERIALS AND METHODS

Test fishing was conducted in the river mouths, usually immediately above the commercial fishing district boundaries (Figure 1). The Egegik River test fish site was relocated up river from its former location to minimize interceptions of fish destined for other river systems. Fishing gear was 25 to 50 fm of 5-3/8 in stretch mesh gillnet and fishing time was 30 minutes or less. Fishing began at the start of the flood tide on the Kvichak River 1½ hours before high slack water on the Egekik River, and at 1½ hours prior to low slack water at the Ugashik River. Sockeye salmon catch, index, mean weight, mean length, mean fishing time, gillnet strength, and date for each set for all rivers are presented in Appendix Table 1.

Daily escapement estimates were made from the test fisheries located at Kvichak and Egegik Rivers using: (1) a relationship between tower count per test fish index point and mean weight of the fish, (2) the same relationship based on mean length, and (3) comparing cumulative tower counts with cumulative test fish indices. The relationship between fish size and

Figure 1. Locations of inside test fishing sites, Kvichak, Egegik, Ugashik Rivers, 1979.

catchability was determined with a power regression curve:

$$Y = ax^b$$

where y = tower count per index point
x = mean weight or length of the fish
a, b are constants

Data on which regression models were based are found in Appendix Table 2. Mean weights used to calculate these relationships were the average round weight of the commercial catch by district from commercial processors annual reports (Nelson 1979). The mean length data were taken from fish sampled by beach seine at the respective tower sites. Weights and lengths used in-season for forecasting were from the fish caught by the test fishing project. The daily test fishing index (I) was calculated as follows:

$$I = 6000C/FT$$

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

Cumulative escapement estimates were made by multiplying the cumulative test fish indices by the expected tower count per index point calculated from the cumulative mean weight and length of fish caught.

Cumulative test fish index curves were matched with cumulative escapement curves to determine lag time. Cumulative test fish index curves and escapement curves, $y = 1/[1 + \exp(-(A+BT))]$, were first estimated by computer. The time lag between the two curves was then varied until the sum of squared differences between the two curves was minimized. This quantity is the lag time between the test fish site and the tower. After lag time was determined actual cumulative escapement was compared with the associated cumulative test fish indices and another tower count per index value was calculated. For the Ugashik project, this latter method was the only one used.

Limited tagging of sockeye with colored surveyors tape occurred at each test fish site to determine: (1) lag time between the test fish site and tower, and (2) the degree of flushing down river and straying between river systems. Number and type of tag, date, and tagging locations are presented in Table 1.

RESULTS

Kvichak River

Test fishing began on 17 June and ended 29 June. The project was terminated much earlier than normal as a result of escapement requirements being satisfied and for fiscal reasons. At the end of the project, 21,780 daily index

Table 1. Inside test fish tagging schedule, Bristol Bay, 1979.

Tagging location	Date	Number	Tag type
Kvichak	June 25	59	Yellow w/black stripes
Egegik	June 26	71	White w/red polka dots
	July 1	245	Solid white
Ugashik	June 29	104	Red w/white stripes
	July 4	322	Solid yellow and solid red

Table 2. Test fish daily and accumulative index values, mean weight, and mean length data summarized by day for Kvichak, Egegik, and Ugashik Rivers, 1979.

1979 UGASHIK INSIDE TEST FISHING

DATE	DAILY	ACCUM	ACCUM %	MEAN WT	MEAN LN
621	84.71	84.71	0.002	2.83	542.7
622	49.87	134.58	0.004	2.70	542.9
623	10.14	144.72	0.004	2.46	540.3
624	37.18	181.90	0.005	2.58	541.9
625	163.45	345.35	0.009	2.64	552.8
626	900.47	1245.84	0.034	2.29	529.4
627	996.52	2242.37	0.061	2.68	529.3
628	846.62	3088.98	0.084	2.82	544.4
629	1155.00	4243.98	0.115	2.60	529.6
630	2288.57	6532.55	0.177	2.70	543.7
7 1	1700.82	8233.42	0.224	2.58	532.5
7 2	4704.00	12937.42	0.351	2.29	540.0
7 3	2410.85	15348.27	0.417	2.44	532.2
7 4	3520.00	18868.27	0.512	2.59	534.0
7 5	3000.00	21868.27	0.594	2.58	537.3
7 6	2964.71	24832.98	0.674	2.55	541.4
7 7	3243.47	28076.45	0.761	2.65	538.9
7 8	2748.00	30824.45	0.836	2.43	528.5
7 9	1896.00	32720.45	0.887	2.65	537.7
710	1520.00	34240.45	0.928	2.54	541.6
711	1126.96	35367.40	0.959	2.50	530.8
712	712.26	36079.66	0.978	2.48	528.4
713	905.16	36984.82	1.000	2.65	542.3

1979 KVICHAK INSIDE TEST FISHING

DATE	DAILY	ACCUM	ACCUM %	MEAN WT	MEAN LN
617	0.	0.	0.	0.	0.
618	10.76	10.76	0.000	2.48	520.0
619	29.83	40.59	0.002	2.29	512.6
620	0.	40.59	0.002	0.	0.
621	0.	40.59	0.002	0.	0.
622	1.55	42.14	0.002	2.10	500.0
623	7.65	49.79	0.002	2.33	513.1
624	3734.00	3783.79	0.174	2.45	515.0
625	7929.60	11713.39	0.538	2.44	519.4
626	1230.72	12944.11	0.594	2.60	526.1
627	3617.14	16561.25	0.760	2.45	518.2
628	4800.00	21361.25	0.981	2.60	521.3
629	418.72	21779.97	1.000	2.38	521.7

1979 EGEGIK INSIDE TEST FISHING

DATE	DAILY	ACCUM	ACCUM %	MEAN WT	MEAN LN
616	24.24	24.24	0.001	2.54	544.2
617	123.01	147.26	0.009	2.86	560.6
618	93.91	241.17	0.014	2.74	547.1
619	18.88	260.04	0.015	2.53	546.2
620	21.68	281.72	0.017	2.66	555.0
621	19.79	301.52	0.018	2.18	540.0
622	0.	301.52	0.018	0.	0.
623	19.69	321.21	0.019	2.46	542.0
624	96.67	417.88	0.025	2.71	546.6
625	222.72	640.60	0.038	2.64	544.8
626	1440.00	2080.60	0.122	2.51	537.4
627	1245.41	3326.01	0.195	2.55	541.4
628	3750.00	7076.01	0.415	2.66	546.2
629	2770.00	9846.01	0.579	2.71	547.7
630	151.35	10017.36	0.588	2.54	545.9
7 1	1560.00	11577.36	0.680	2.71	550.2
7 2	890.46	12475.82	0.733	2.98	554.5
7 3	308.97	12784.79	0.751	2.64	547.2
7 4	972.00	13756.78	0.808	2.66	548.4
7 5	597.03	14353.81	0.843	2.58	547.0
7 6	186.41	14540.21	0.854	2.55	540.2
7 7	1723.08	16263.29	0.955	2.81	553.9
7 8	501.29	16844.58	0.989	2.69	547.2
7 9	107.26	16951.83	0.995	2.80	549.6
710	80.00	17031.81	1.000	2.49	539.3

points were accumulated (Table 2). Sockeye mean weight and length were 2.50 kg and 519.28 mm leading to an estimated 309 and 334 salmon passing per index from weight and length regression relationships. The estimated escapements were therefore 6,742,567 and 7,556,761, respectively. Actual tower counts, 3 days after termination of the test fish project, were 5,915,544 fish. This was a 14.0% and 27.8% overestimation of escapement by the test fish project. Lag time between the test fishing site and counting tower was estimated by curve matching to be 3 days and by tagging to be 3½ days. The estimated escapement based strictly on a 3 day lag time was 6,391,162 which was an 8% overestimation. The three forecast methods are compared with actual daily tower counts in Table 3.

Egegik River

Test fishing began 16 June and ended 10 July. At the end of the season 17,032 daily index points were accumulated (Table 2). Mean weight and length of the sockeye caught were 2.69 kg and 546.54 mm which lead to an estimate of 144 and 143 salmon passing per index point. The associated escapement estimates were 2,455,410 and 2,439,357. Compared to the final tower count of 1,032,042 this was 140% and 136% overestimation, respectively. This high error was anticipated due to a relocation of the test fish project further upriver where salmon were more concentrated. The more appropriate forecast procedure based on a curve fit calculated lag time of 3 days was 1,025,347 or 1% less than the actual escapement. The three forecast procedures were compared with actual daily tower counts in Table 4. No lag time calculations were possible using tagging data as tower crew members were unable to distinguish between solid white tags and white with red polka dot tags. Of the 316 tags deployed, 1.3% were returned from Egegik District and 1.6% were sited at other rivers, suggesting minimal straying and flushing from the new upriver test fish site.

Ugashik River

Test fishing began 21 June and ended 13 July. At the end of the season, 36,885 daily index points were accumulated (Table 2). Sockeye mean weight and mean length were 2.61 kg and 538 mm, respectively. The number of fish passing per index value based on mean weight and length was not successfully calculated before the fishing season and therefore no forecast of escapement using this technique was possible. Lag time between the test fishing site and the counting tower was estimated to be 7 days based on curve matching and was 6.7 days based on tagging data. The actual escapement was 1,602,264 while the estimated escapement was 1,597,726, representing an underestimation error of less than 1%. The actual and estimated escapement values by day are compared in Table 5.

Table 3. Comparison of actual escapement and escapement as forecast by mean weight and length models and by lag time model for sockeye salmon, Kvichak River, 1979.

Date	Forecast Acumulative Escapement by weight 1/	by length 2/	by lag time 3/	Actual Acumulative Escapement 4/
6/18	3,558	3,604	-	1,194
6/19	21,626	18,090	-	1,806
6/20	21,626	18,090	-	2,202
6/21	21,626	18,090	4,504	2,424
6/22	23,256	19,023	1,874	358,854
6/23	27,477	22,705	2,701	1,045,722
6/24	1,382,674	1,648,191	225,964	1,895,892
6/25	4,426,461	4,355,565	99,748,382	2,783,274
6/26	4,574,495	4,618,624	271,860,626	3,798,348
6/27	5,852,805	5,946,877	8,298,119	4,773,516
6/28	6,399,745	7,431,079	5,075,747	5,330,532
6/29	6,742,567	7,556,761	6,391,162	5,915,544
	Project terminated early			5/

1/ Forecast = [Accumulative index] [5.7206×10^{5}] [Accumulative mean weight] $^{-8.20896}$

2/ Forecast = [Accumulative index] [1.0154×10^{77}] [Accumulative mean length] $^{-27.4237}$

3/ Forecast = [Accumulative index] [Accumulative excapement/accumulative index 3 days prior]

4/ Actual escapements lagged back 3 days to correspond with test fishery forecast escapements.

5/ The final escapement at termination of the tower counting project on July 23 was 11,218,434 sockeye.

Table 4. Comparison of actual escapement and escapement as forecast by mean weight and length models and by lag time model for sockeye salmon, Egegik River, 1979.

Date	Forecast accumulative escapement			Actual accumulative escapement
	by weight[1]	by length[2]	by lag time[3]	[4]
6/16	4,346	4,165	-	1,272
6/17	17,983	18,328	-	2,346
6/18	30,679	31,593	-	12,174
6/19	34,000	34,173	13,645	17,430
6/20	36,332	37,022	4,488	24,162
6/21	41,096	46,458	15,220	32,946
6/22	41,096	46,458	20,210	35,046
6/23	45,021	49,550	27,548	58,356
6/24	58,571	64,263	45,660	124,158
6/25	92,353	98,124	74,457	189,714
6/26	362,116	326,391	377,994	358,872
6/27	545,733	514,434	988,204	441,168
6/28	1,111,477	1,067,276	2,095,563	511,716
6/29	1,505,718	1,455,360	1,701,737	612,270
6/30	1,528,816	1,477,415	1,328,720	712,098
7/ 1	1,741,774	1,691,087	837,240	776,352
7/ 2	1,876,944	1,804,305	774,230	798,744
7/ 3	1,869,418	1,855,215	908,824	854,922
7/ 4	2,011,544	1,994,805	922,499	880,782
7/ 5	2,098,843	2,080,162	918,979	902,280
7/ 6	2,126,099	2,109,022	972,307	949,194
7/ 7	2,311,765	2,347,611	1,041,262	979,080
7/ 8	2,428,415	2,414,199	1,058,849	998,142
7/ 9	2,409,638	2,426,737	1,106,626	1,013,256
7/10	2,455,410	2,439,257	1,025,347	1,019,526[5]
	Project terminated			

[1] Forecast = [Accumulative index][6207.4][Accumulative mean weight]$^{-3.8023}$

[2] Forecast = [Accumulative index][9.4372 x 10^{23}][Accumulative mean length]$^{-7.970}$

[3] Forecast = [Accumulative index][Accumulative escapement/accumulative index 3 days prior]

[4] Actual escapements lagged 3 days to correspond with test fishery forecast escapements.

[5] The final escapement at termination of the tower counting project on 27 July was 1,032,042.

Table 5. Comparison of actual escapement and escapement as forecast by lag time model for sockeye salmon, Ugashik River, 1979.

Date	Forecast[1] accumulative escapement	Actual[2] accumulative escapement
7/01	127,948	243,918
7/02	564,803	371,694
7/03	657,421	544,644
7/04	440,446	712,500
7/05	434,111	829,374
7/06	724,940	1,076,976
7/07	818,841	1,279,392
7/08	913,219	1,370,064
7/09	940,081	1,413,240
7/10	1,212,681	1,447,764
7/11	1,333,432	1,468,356
7/12	1,366,509	1,527,402
7/13	1,597,726	1,602,264[3]

[1] Forecast = [Accumulative index][Accumulative escapement/Accumulative index 7 days prior].

[2] Actual escapements lagged back 7 days to correspond with test fishery forecast escapements.

[3] The final escapement at termination of the tower counting project on 26 July was 1,700,904.

LITERATURE CITED

Nelson, Michael 1979. Annual Management Report. 1976. Bristol Bay Bay area. Alaska Department of Fish and Game inter-departmental report pp 115-116.

Yuen, Henry. 1979. Inside Test Fishing Kvichak, Egegik and Ugashik River, 1978. Alaska Department of Fish and Game, Bristol Bay Data Report No. 70. 43pp.

APPENDIX TABLE 1. Sockeye salmon catch, index, mean weight, mean length, fishing time, gillnet length and date by river system, 1979.

AREA IDENT.	YR	MO	DY	SET NO.	STATION IDENT.	GEAR LENGTH (FMS)	MEAN FISHING TIME (MIN)	SOCKEYE CATCH	TEST FISHING INDEX (DAILY)	MEAN WT	MEAN LN
KVICHAK	79	6	17	1	1	50	18.00	0	0.	0.	0.
KVICHAK	79	6	17	2	2	50	21.50	0	0.	0.	0.
KVICHAK	79	6	17	3	1	50	10.50	0	0.	0.	0.
KVICHAK	79	6	17	4	1	50	19.00	0	0.	0.	0.
KVICHAK	79	6	17	5	2	50	23.00	0	0.	0.	0.
KVICHAK	79	6	18	6	2	50	19.00	3	18.95	2.45	513.0
KVICHAK	79	6	18	7	2	50	20.50	7	40.98	2.49	523.0
KVICHAK	79	6	18	8	1	50	41.00	0	0.	0.	0.
KVICHAK	79	6	18	9	2	50	31.00	0	0.	0.	0.
KVICHAK	79	6	19	10	1	50	22.00	4	21.82	2.18	492.0
KVICHAK	79	6	19	11	2	50	28.00	11	47.14	2.32	515.0
KVICHAK	79	6	19	12	1	50	19.00	2	12.63	2.31	522.0
KVICHAK	79	6	19	13	2	50	19.50	5	30.77	2.31	520.0
KVICHAK	79	6	20	14	1	50	16.00	0	0.	0.	0.
KVICHAK	79	6	21	16	1	50	15.50	0	0.	0.	0.
KVICHAK	79	6	21	17	2	50	14.00	0	0.	0.	0.
KVICHAK	79	6	22	18	1	50	17.50	0	0.	0.	0.
KVICHAK	79	6	22	19	2	50	18.50	1	6.49	2.10	508.0
KVICHAK	79	6	22	20	1	50	17.50	0	0.	0.	0.
KVICHAK	79	6	22	21	2	50	24.00	0	0.	0.	0.
KVICHAK	79	6	23	22	1	50	17.50	0	0.	0.	0.
KVICHAK	79	6	23	23	2	50	21.00	0	0.	0.	0.
KVICHAK	79	6	23	24	1	50	16.00	4	30.00	2.70	534.0
KVICHAK	79	6	23	25	2	50	23.50	2	10.21	1.88	474.0
KVICHAK	79	6	23	26	1	50	29.00	1	4.14	2.35	532.0
KVICHAK	79	6	23	27	2	50	18.50	1	6.49	1.72	489.0
KVICHAK	79	6	24	28	1	25	5.00	78	3734.00	2.45	515.0
KVICHAK	79	6	25	29	1	25	3.00	119	9520.00	2.43	520.0
KVICHAK	79	6	25	30	2	25	4.00	199	11940.0	2.43	520.0
KVICHAK	79	6	25	31	1	25	3.00	48	3840.00	2.56	519.0
KVICHAK	79	6	25	32	2	25	2.50	47	4512.00	2.41	516.0
KVICHAK	79	6	26	33	1	25	3.00	21	1680.00	2.83	526.0
KVICHAK	79	6	26	34	2	25	4.00	20	1200.00	2.62	518.0
KVICHAK	79	6	26	35	1	25	7.00	37	1268.50	2.26	529.4
KVICHAK	79	6	26	36	2	25	5.50	22	959.90	2.93	527.8
KVICHAK	79	6	27	37	1	25	2.50	40	3840.00	2.55	526.4
KVICHAK	79	6	27	38	2	25	3.50	73	5005.71	2.21	511.3
KVICHAK	79	6	27	39	1	25	5.00	36	1728.00	2.68	523.8
KVICHAK	79	6	27	40	2	25	3.00	62	4960.00	2.55	517.7
KVICHAK	79	6	28	41	1	25	2.50	36	3456.00	2.29	511.5
KVICHAK	79	6	28	42	2	25	3.00	24	1920.00	2.78	526.3
KVICHAK	79	6	28	43	1	25	2.00	54	6480.00	2.73	527.7
KVICHAK	79	6	28	44	2	25	2.50	86	8256.00	2.78	519.9
KVICHAK	79	6	29	45	1	25	4.50	10	533.33	2.14	524.9
KVICHAK	79	6	29	46	2	25	19.00	31	391.58	2.46	520.7

APPENDIX TABLE 1. (Continued)

AREA IDENT.	YR	MO	DY	SET NO.	STATION IDENT.	GEAR LENGTH (FMS)	MEAN FISHING TIME (MIN)	SOCKEYE CATCH	TEST FISHING INDEX (DAILY)	MEAN WT	MEAN LN
EGEGIK	79	6	16	1	1	25	25.75	1	9.32	3.56	613.0
EGEGIK	79	6	16	2	2	25	23.75	4	40.42	2.28	514.5
EGEGIK	79	6	17	3	1	25	27.25	4	35.23	3.14	581.8
EGEGIK	79	6	17	4	2	25	30.75	15	117.07	2.81	559.5
EGEGIK	79	6	17	5	1	25	21.25	9	101.65	2.90	562.0
EGEGIK	79	6	17	6	2	25	20.25	23	272.59	2.82	557.0
EGEGIK	79	6	18	7	1	25	13.75	2	34.91	2.38	433.0
EGEGIK	79	6	18	8	2	25	12.25	12	235.10	2.67	557.0
EGEGIK	79	6	18	9	1	25	22.75	5	52.75	2.77	539.0
EGEGIK	79	6	18	10	2	25	20.25	8	94.81	2.93	566.0
EGEGIK	79	6	19	11	1	25	18.75	1	12.80	3.05	568.0
EGEGIK	79	6	19	12	2	25	20.25	3	35.56	2.58	545.0
EGEGIK	79	6	19	13	1	25	26.25	1	9.14	2.20	532.0
EGEGIK	79	6	19	14	2	25	23.75	2	20.21	2.35	546.0
EGEGIK	79	6	20	15	1	25	19.75	4	48.61	2.74	545.0
EGEGIK	79	6	20	16	2	25	17.25	2	27.83	3.30	581.0
EGEGIK	79	6	20	17	1	25	20.25	0	0.	0.	0.
EGEGIK	79	6	20	18	2	25	20.25	1	11.85	2.45	543.0
EGEGIK	79	6	21	19	1	25	25.25	0	0.	0.	0.
EGEGIK	79	6	21	20	2	25	23.25	4	41.29	2.18	540.0
EGEGIK	79	6	22	21	1	25	22.25	0	0.	0.	0.
EGEGIK	79	6	22	22	2	25	22.25	0	0.	0.	0.
EGEGIK	79	6	22	23	1	25	24.75	0	0.	0.	0.
EGEGIK	79	6	22	24	2	25	23.25	0	0.	0.	0.
EGEGIK	79	6	23	25	1	25	22.25	0	0.	0.	0.
EGEGIK	79	6	23	26	2	25	28.25	7	59.47	2.41	528.0
EGEGIK	79	6	23	27	1	25	23.75	1	10.11	2.80	560.0
EGEGIK	79	6	23	28	2	25	23.25	0	0.	0.	0.
EGEGIK	79	6	24	29	1	25	9.25	0	0.	0.	0.
EGEGIK	79	6	24	30	2	25	20.25	5	59.26	2.98	564.0
EGEGIK	79	6	24	31	1	25	20.25	0	0.	0.	0.
EGEGIK	79	6	24	32	2	25	22.25	24	258.88	2.65	543.0
EGEGIK	79	6	25	33	1	25	12.75	6	112.94	2.50	539.0
EGEGIK	79	6	25	34	2	25	11.75	10	204.26	2.56	533.0
EGEGIK	79	6	25	35	1	25	17.25	6	83.48	2.31	521.0
EGEGIK	79	6	25	36	2	25	20.75	36	416.39	2.74	553.0
EGEGIK	79	6	26	37	1	25	6.25	15	576.00	2.58	548.0
EGEGIK	79	6	26	38	2	25	4.25	49	2767.06	2.56	538.0
EGEGIK	79	6	26	39	1	25	4.75	15	757.89	2.44	533.0
EGEGIK	79	6	26	40	2	25	2.75	29	2530.91	2.44	533.0
EGEGIK	79	6	27	41	2	25	4.25	19	1072.94	2.64	544.0
EGEGIK	79	6	27	42	1	25	3.25	22	1624.62	2.65	542.0
EGEGIK	79	6	27	43	2	25	1.75	7	960.00	2.68	553.0
EGEGIK	79	6	28	44	1	25	2.75	23	2007.27	2.65	531.0
EGEGIK	79	6	28	45	2	25	2.25	49	5226.67	2.74	547.0
EGEGIK	79	6	28	46	1	25	0.75	29	9280.00	2.40	550.0
EGEGIK	79	6	28	47	2	25	2.25	24	2560.00	2.84	557.0
EGEGIK	79	6	29	48	1	25	1.75	20	2742.86	2.93	548.0

APPENDIX TABLE 1 (Continued)

AREA IDENT.	YR	MO	DY	SET NO.	STATION IDENT.	GEAR LENGTH (FMS)	MEAN FISHING TIME (MIN)	SOCKEYE CATCH	TEST FISHING INDEX (DAILY)	MEAN WT	MEAN LN
EGEGIK	79	6	29	49	2	25	1.75	38	5211.43	2.70	540.0
EGEGIK	79	6	29	50	1	25	1.75	21	2880.00	2.66	538.0
EGEGIK	79	6	29	51	2	25	2.75	14	1221.82	2.50	553.0
EGEGIK	79	6	30	52	1	25	5.75	4	166.96	2.23	527.0
EGEGIK	79	6	30	53	2	25	5.75	18	751.30	2.79	539.0
EGEGIK	79	6	30	54	1	25	22.25	3	32.36	2.17	536.0
EGEGIK	79	6	30	55	2	25	21.75	10	110.34	2.33	533.0
EGEGIK	79	7	1	56	1	25	2.75	14	1221.82	2.67	549.0
EGEGIK	79	7	1	57	2	25	3.75	18	1152.00	2.59	540.0
EGEGIK	79	7	1	58	1	25	1.75	30	4114.29	2.69	550.0
EGEGIK	79	7	1	59	2	25	3.75	16	1024.00	3.02	563.0
EGEGIK	79	7	2	60	1	25	2.75	18	1570.91	2.87	552.0
EGEGIK	79	7	2	61	2	25	3.75	29	1856.00	3.02	560.0
EGEGIK	79	7	2	62	1	25	11.25	6	123.00	2.60	541.0
EGEGIK	79	7	2	63	2	25	1.75	20	2742.86	3.12	553.0
EGEGIK	79	7	3	64	1	25	5.75	15	626.09	2.41	520.0
EGEGIK	79	7	3	65	2	25	10.75	9	200.93	2.50	526.0
EGEGIK	79	7	3	66	1	25	18.25	3	39.45	2.67	551.0
EGEGIK	79	7	3	67	2	25	8.75	29	795.43	2.79	553.0
EGEGIK	79	7	4	68	1	25	7.25	7	231.72	2.64	542.0
EGEGIK	79	7	4	69	2	25	5.25	17	777.14	2.42	540.0
EGEGIK	79	7	4	70	1	25	6.25	13	499.20	2.32	535.0
EGEGIK	79	7	4	71	2	25	1.25	44	8448.00	2.86	553.0
EGEGIK	79	7	5	72	1	25	7.75	3	92.90	2.47	554.0
EGEGIK	79	7	5	73	2	25	1.75	43	5893.14	2.66	545.0
EGEGIK	79	7	5	74	1	25	8.75	2	54.86	3.35	564.0
EGEGIK	79	7	5	75	2	25	4.25	8	451.76	2.72	546.0
EGEGIK	79	7	6	76	1	25	11.25	4	85.33	2.66	531.0
EGEGIK	79	7	6	77	2	25	4.75	13	656.84	2.66	543.0
EGEGIK	79	7	6	78	1	25	9.75	3	73.85	2.58	540.0
EGEGIK	79	7	7	79	2	25	1.75	24	3291.43	2.88	553.0
EGEGIK	79	7	7	80	1	25	6.25	10	384.00	2.99	545.0
EGEGIK	79	7	7	81	2	25	1.75	36	4937.14	2.71	557.0
EGEGIK	79	7	8	82	1	25	6.25	14	537.60	2.81	555.0
EGEGIK	79	7	8	83	2	25	1.75	21	2880.00	2.76	553.0
EGEGIK	79	7	8	84	1	25	6.75	11	391.11	2.43	534.0
EGEGIK	79	7	8	85	2	25	1.75	10	1371.43	2.79	553.0
EGEGIK	79	7	8	86	1	25	10.75	10	223.26	2.53	536.0
EGEGIK	79	7	9	87	2	25	11.75	10	204.00	2.82	562.0
EGEGIK	79	7	9	88	1	25	11.25	2	42.67	3.08	582.0
EGEGIK	79	7	9	89	2	25	17.25	6	83.48	2.68	551.0
EGEGIK	79	7	10	90	1	25	16.75	0	0.	0.	0.
EGEGIK	79	7	10	91	2	25	8.75	3	82.29	2.40	533.0
EGEGIK	79	7	10	92	1	25	10.75	4	89.30	0.	536.0
EGEGIK	79	7	10	93	2	25	5.75	7	292.17	0.	547.0

APPENDIX TABLE 1. (Continued)

AREA IDENT.	YR	MO	DY	SET NO.	STATION IDENT.	GEAR LENGTH (FMS)	MEAN FISHING TIME (MIN)	SOCKEYE CATCH	TEST FISHING INDEX (DAILY)	MEAN WT	MEAN LN
UGASHIK	79	6	21	1	1	25	6.00	2	80.00	2.82	549.0
UGASHIK	79	6	21	2	1	25	2.50	1	96.00	2.86	530.0
UGASHIK	79	6	22	3	1	25	17.00	0	0.	0.	0.
UGASHIK	79	6	22	4	1	25	22.00	11	120.00	2.85	551.0
UGASHIK	79	6	22	5	1	25	21.00	3	34.28	1.70	481.0
UGASHIK	79	6	22	6	2	25	17.00	2	28.24	3.40	591.0
UGASHIK	79	6	23	7	1	25	25.00	1	9.60	2.30	557.0
UGASHIK	79	6	23	8	2	25	19.00	1	12.63	2.56	531.0
UGASHIK	79	6	23	9	1	25	15.00	1	16.00	2.52	533.0
UGASHIK	79	6	23	10	2	25	12.00	0	0.	0.	0.
UGASHIK	79	6	24	11	1	25	15.50	5	77.42	2.60	539.0
UGASHIK	79	6	24	12	2	25	12.50	2	38.40	1.90	507.0
UGASHIK	79	6	24	13	1	25	25.00	4	38.40	2.90	563.0
UGASHIK	79	6	24	14	2	25	18.00	0	0.	0.	0.
UGASHIK	79	6	25	15	1	25	19.00	17	215.00	2.53	540.0
UGASHIK	79	6	25	16	2	25	13.00	5	92.30	2.68	565.0
UGASHIK	79	6	25	17	1	25	20.50	25	293.00	2.71	562.0
UGASHIK	79	6	25	18	2	25	22.50	4	43.00	2.60	535.0
UGASHIK	79	6	26	19	1	25	10.50	73	1668.00	0.	0.
UGASHIK	79	6	26	20	2	25	9.50	8	202.11	0.	0.
UGASHIK	79	6	26	21	3	25	8.00	12	360.00	2.72	549.0
UGASHIK	79	6	26	22	1	25	7.00	69	2365.70	2.85	523.0
UGASHIK	79	6	26	23	2	25	6.00	9	360.00	2.71	544.0
UGASHIK	79	6	26	24	3	25	7.50	11	352.00	2.59	536.0
UGASHIK	79	6	27	25	1	25	7.50	65	2080.00	2.74	523.0
UGASHIK	79	6	27	26	2	25	6.00	12	480.00	2.44	522.0
UGASHIK	79	6	27	27	3	25	10.00	14	336.00	2.60	535.0
UGASHIK	79	6	27	28	1	25	7.50	74	2368.00	2.66	531.0
UGASHIK	79	6	27	29	2	25	8.00	21	630.00	2.74	540.0
UGASHIK	79	6	27	30	3	25	7.00	5	171.43	2.57	541.0
UGASHIK	79	6	28	31	1	25	4.50	82	4373.30	2.89	548.0
UGASHIK	79	6	28	32	2	25	8.00	19	570.00	2.68	530.0
UGASHIK	79	6	28	33	3	25	9.00	4	106.67	2.87	533.0
UGASHIK	79	6	28	34	3	25	10.50	4	91.43	2.67	534.0
UGASHIK	79	6	28	35	2	25	6.50	28	1033.00	2.77	525.0
UGASHIK	79	6	28	36	1	25	6.00	20	800.00	2.73	575.0
UGASHIK	79	6	29	37	3	25	6.00	8	320.00	2.60	529.0
UGASHIK	79	6	29	38	2	25	7.50	35	1120.00	0.	0.
UGASHIK	79	6	29	39	1	25	2.50	34	3264.00	0.	0.
UGASHIK	79	6	30	40	3	25	10.00	9	216.00	2.72	543.0
UGASHIK	79	6	30	41	2	25	2.50	75	7200.00	2.72	532.0
UGASHIK	79	6	30	42	1	25	2.50	49	4704.00	2.67	542.0
UGASHIK	79	6	30	43	3	25	7.50	14	448.00	2.57	537.0
UGASHIK	79	6	30	44	2	25	2.50	62	5952.00	2.69	553.0
UGASHIK	79	6	30	45	1	25	3.00	58	4640.00	2.72	552.0
UGASHIK	79	7	1	46	3	25	9.00	13	346.67	2.53	520.0
UGASHIK	79	7	1	47	2	25	3.50	59	4045.71	2.72	532.0
UGASHIK	79	7	1	48	1	25	2.50	45	4320.00	2.86	554.0

APPENDIX TABLE 1. (Continued)

AREA IDENT.	YR	MO	DY	SET NO.	STATION IDENT.	GEAR LENGTH (FMS)	MEAN FISHING TIME (MIN)	SOCKEYE CATCH	TEST FISHING INDEX (DAILY)	MEAN WT	MEAN LN
UGASHIK	79	7	1	49	3	25	5.50	23	1003.63	2.45	504.0
UGASHIK	79	7	1	50	2	25	2.50	23	2208.00	2.56	527.0
UGASHIK	79	7	2	51	2	25	2.50	50	4800.00	2.64	541.0
UGASHIK	79	7	2	52	3	25	2.50	32	3072.00	2.96	561.0
UGASHIK	79	7	2	53	1	25	2.50	65	6240.00	2.83	547.0
UGASHIK	79	7	3	54	3	25	6.50	27	996.92	2.65	537.0
UGASHIK	79	7	3	55	2	25	2.50	32	3072.00	2.67	549.0
UGASHIK	79	7	3	56	1	25	2.00	36	4320.00	2.48	542.0
UGASHIK	79	7	3	57	3	25	5.50	36	1570.90	2.39	524.0
UGASHIK	79	7	3	58	2	25	4.50	40	2133.33	2.49	538.0
UGASHIK	79	7	3	59	1	25	2.50	68	6528.00	2.24	518.0
UGASHIK	79	7	4	60	2	25	4.50	45	2400.00	2.57	533.0
UGASHIK	79	7	4	61	3	25	2.50	37	3552.00	2.52	530.0
UGASHIK	79	7	4	62	1	25	2.50	49	4704.00	2.65	538.0
UGASHIK	79	7	4	63	3	25	2.00	21	2520.00	0.	0.
UGASHIK	79	7	4	64	2	25	2.00	34	4080.00	0.	0.
UGASHIK	79	7	4	65	1	25	3.00	56	4480.00	0.	0.
UGASHIK	79	7	5	66	3	25	2.50	26	2496.00	2.67	546.0
UGASHIK	79	7	5	67	2	25	2.50	21	2016.00	2.44	525.0
UGASHIK	79	7	5	68	1	25	3.00	53	4240.00	2.60	538.0
UGASHIK	79	7	6	69	1	25	2.50	26	2496.00	2.73	548.0
UGASHIK	79	7	6	70	3	25	3.50	49	3360.00	2.46	537.0
UGASHIK	79	7	6	71	2	25	2.50	30	2880.00	2.53	543.0
UGASHIK	79	7	7	72	3	25	5.50	40	1745.45	2.54	534.0
UGASHIK	79	7	7	73	2	25	2.50	44	4225.00	2.72	549.0
UGASHIK	79	7	7	74	1	25	2.50	66	6336.00	2.74	538.0
UGASHIK	79	7	7	75	3	25	2.50	43	4128.00	2.64	535.0
UGASHIK	79	7	7	76	2	25	2.50	18	1728.00	2.81	548.0
UGASHIK	79	7	7	77	1	25	2.50	30	2880.00	2.41	533.0
UGASHIK	79	7	8	78	3	25	6.00	15	600.00	2.36	527.0
UGASHIK	79	7	8	79	2	25	2.50	60	5760.00	2.40	523.0
UGASHIK	79	7	8	80	1	25	2.50	52	4992.00	2.52	526.0
UGASHIK	79	7	8	81	3	25	2.50	40	3840.00	2.33	524.0
UGASHIK	79	7	8	82	2	25	4.00	17	1020.00	2.42	535.0
UGASHIK	79	7	8	83	1	25	2.50	45	4320.00	2.49	541.0
UGASHIK	79	7	9	84	3	25	2.50	13	1248.00	2.63	561.0
UGASHIK	79	7	9	85	2	25	2.50	36	3456.00	2.29	540.0
UGASHIK	79	7	9	86	1	25	2.50	32	3072.00	2.70	544.0
UGASHIK	79	7	9	87	3	25	6.00	14	560.00	2.94	474.0
UGASHIK	79	7	9	88	2	25	4.00	21	1260.00	3.16	577.0
UGASHIK	79	7	9	89	1	25	2.50	42	4032.00	2.57	533.0
UGASHIK	79	7	10	90	3	25	4.50	23	1226.67	2.66	553.0
UGASHIK	79	7	10	91	2	25	2.50	40	3840.00	2.69	550.0
UGASHIK	79	7	10	92	1	25	2.50	37	3552.00	2.24	520.0
UGASHIK	79	7	10	93	3	25	4.50	18	960.00	2.64	548.0
UGASHIK	79	7	10	94	2	25	4.50	10	533.33	2.54	547.0
UGASHIK	79	7	10	95	1	25	5.50	24	1047.27	2.59	543.0
UGASHIK	79	7	11	96	1	25	3.50	33	2262.86	2.54	533.0

APPENDIX TABLE 1. (continued)

AREA IDENT.	YR	MO	DY	SET NO.	STATION IDENT.	GEAR LENGTH (FMS)	MEAN FISHING TIME (MIN)	SOCKEYE CATCH	TEST FISHING INDEX (DAILY)	MEAN WT	MEAN LN
05UGASHIK	79	7	11	97	2	25	2.50	24	2304.00	2.47	527.0
05UGASHIK	79	7	11	98	3	25	3.00	4	320.00	2.46	532.0
05UGASHIK	79	7	11	99	3	25	6.50	13	480.00	2.38	518.0
05UGASHIK	79	7	11	100	2	25	3.00	18	1440.00	2.72	539.0
05UGASHIK	79	7	11	101	1	25	4.50	16	853.33	2.33	533.0
05UGASHIK	79	7	12	102	3	25	8.50	3	84.71	2.71	547.0
05UGASHIK	79	7	12	103	2	25	3.50	15	1028.57	2.31	518.0
05UGASHIK	79	7	12	104	1	25	3.50	28	1920.00	2.55	532.0
05UGASHIK	79	7	13	105	3	25	7.50	1	32.00	2.68	528.0
05UGASHIK	79	7	13	106	2	25	4.50	23	1226.67	2.59	546.0
05UGASHIK	79	7	13	107	1	25	3.50	28	1920.00	2.72	549.0

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

Kvichak River

Year	Mean weight (kg)[1]	Mean length (mm)[2]	Return/index	
1969	2.313	516.7	553.3	
1970	2.177	497.7	966.4	
1971	2.540	536.1	184.9	
1972	2.767	540.9	150.4	
1973	3.039	538.8	55.1	
1974	-	-	-	
1975	2.395	508.3	537.8	
1976	2.631	529.1	296.6	Data analyzed pre-season to develop models
1977	3.077	534.6	141.3	
1978	2.390[3]	499.1	389.6	Post-season updated data
1979	2.500[3]	519.3[3]	271.6	

[1] From commercial processors reports.

[2] From tower samples.

[3] From inside test fish samples.

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

Egegik River

Year	Mean weight (kg)[1]	Mean length (mm)[2]	Return/index	
1969	2.495	537.0	293.5	
1970	2.177	492.4	359.9	
1971	2.676	560.0	217.6	
1972	2.722	530.1	206.0	
1973	3.221	587.7	78.2	
1974	-	-	-	
1975	2.585	557.4	104.6	Data analyzed pre-season to develop models
1976	2.676	542.7	49.6	
1977	2.871	567.8	121.8	
1978	3.040[3]	571.4	80.4	
1979	2.690[3]	546.5[3]	60.6[4]	Post-season updated data

[1] From commercial processors reports.

[2] From tower samples.

[3] From inside test fish samples.

[4] Return/index value for 1979 is not comparable with those or prior years due to relocation of test fish project up river.

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

Ugashik River

Year	Mean weight (kg)[1]	Mean length (mm)[2]	Return/index
1961	-	572.7	36.5
1962	-	536.0	15.1
1963	2.812	-	37.1
1964	2.404	-	23.7
1965	2.404	506.1	55.0
1966	2.948	544.6	59.4
1967	2.858	-	26.5
1968	2.676	-	13.3
1978	2.903[3]	543.0	3.8
1979	2.610[3]	538.0[3]	46.1

[1] From commercial processors reports.

[2] From tower samples.

[3] From test fish samples.

1979 IGUSHIK RIVER INSIDE TEST FISHING

by

Douglas N. McBride
and
John H. Clark

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

INTRODUCTION

An inside test fishing project was initiated for the Igushik River in 1976 and continued through 1979. The objective of this research was to obtain a timely estimate of the sockeye salmon *(Oncorhynchus nerka)* escapement into the Igushik River system soon after the fish pass through the commercial fishery.

Historically, management decisions concerning the Igushik River sockeye salmon run have been based primarily on escapement data collected at the Igushik River counting tower. The counting tower is located at the outlet of Amanka Lake approximately 125 km, by river, from the set net and drift gillnet fishery located at the mouth of the Igushik River (Figure 1). While escapement information from the counting tower is very accurate, its in-season value to fishery managers is limited. The major segment of the sockeye run takes place over a 3-week period and escapement estimates from the counting tower are 3 to 10 days removed from the commercial fishery. Because of the delay in obtaining escapement data, this test fishing project was developed to provide the timely escapement information needed to facilitate better management decisions.

Analysis of the developing Igushik River inside test fishing results lead to the mechanism needed to provide timely sockeye salmon escapement data for the Igushik River system (McBride 1978). While the correlation between the estimated escapement at the original test fishing site (site A) and the actual escapement enumerated at the tower was significant (r from 0.9550 in 1978 to 0.9349 in 1976) a high degree of difference still existed between the two on a daily basis. Tagging data showed that approximately 2 to 8% of the total migration past the test fishing site "flushed" back down river to the commercial fishing district. In 1978, a new test fishing (site B) approximately 10 km upstream from the original site was researched in addition to the original site and found to provide more accurate escapement estimates (r 0.99421). Tagging data showed the level of flushing up river to be reduced to 1/2 to 2% of the total migration. The project during 1979 was therefore modified and test fishing was conducted exclusively at the upriver site.

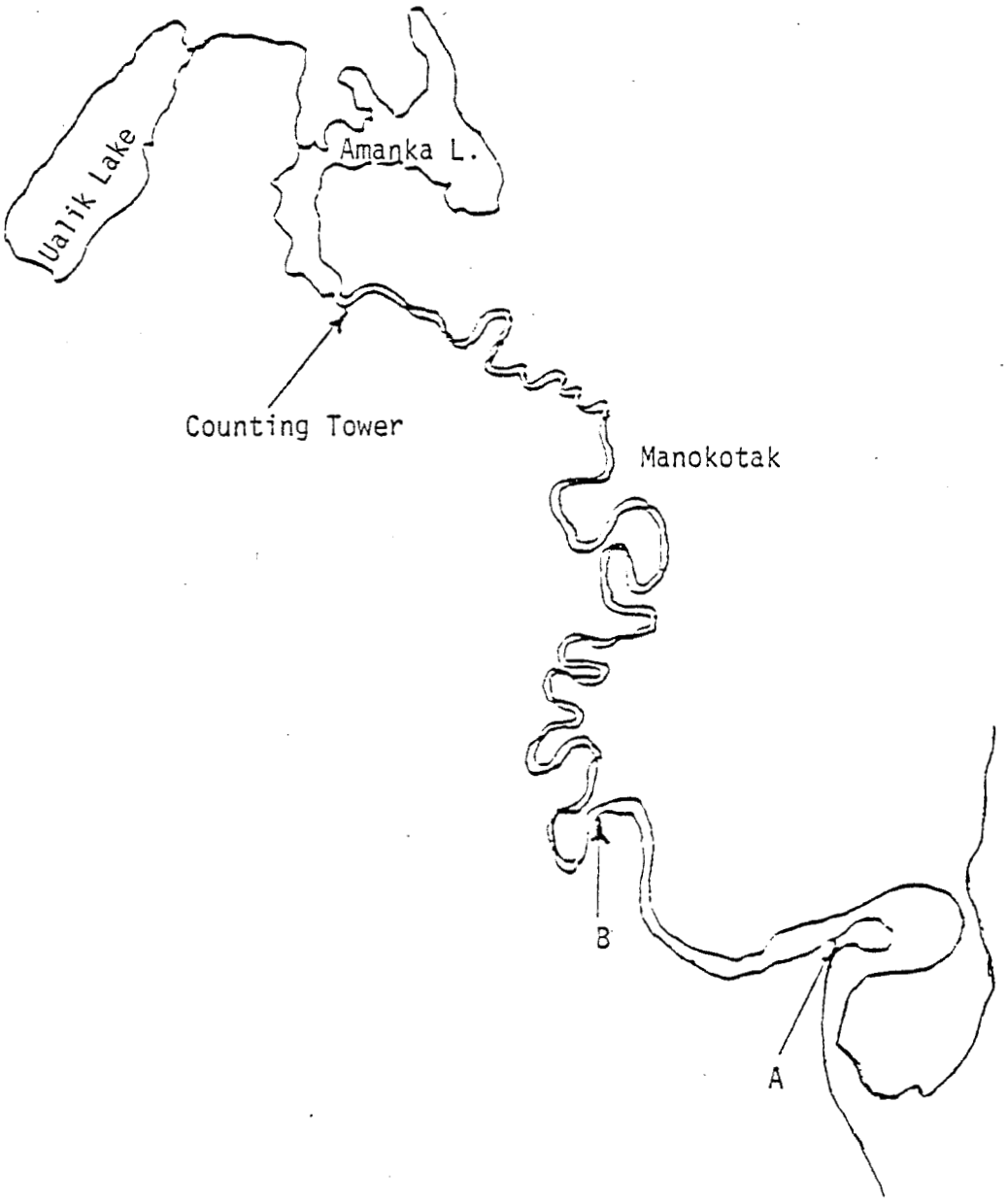

Figure 1. Location of the Igushik River counting tower, the village of Manokotak, the original test fishing site (A; 1976-1978), and the new test fishing site (B; 1978-1979).

MATERIALS AND METHODS

Gillnet Test Fishing

The Igushik River inside test fishing project personnel consisted of a two-person crew that fished a 25 fm set gillnet (5-3/8 in mesh) during each high tide at a single location on the left bank facing upstream (Figure 1). The gillnet was set 1/2 hour before each high tide as indicated in the local tide books and remained fishing 30 minutes or until approximately 25 salmon were caught, whichever came first. The objective was to minimize the catch while still obtaining a good estimate of fish passage rates.

Catch per unit of effort (CPUE) data was calculated for the migrating sockeye salmon population. The standard test fish index (catch per 100 fm hours) was calculated from sockeye catch, gillnet length, and fishing time. The CPUE data were then used to estimate the sockeye salmon escapement into the Igushik River. In addition to the CPUE data, representative samples of length, weight, and sex data as well as scale samples were collected.

Escapement Estimates

Test fish indices were calculated for each high tide and averaged for each day to yield a daily test fish index value. The daily test fish indices were combined to yield an average by 3-day period.

In-season estimates of the accumulative escapement at the Igushik River test fishing site for a particular day were calculated by multiplying the accumulative test fish index for that day by the best estimate of tower counts per test fish index point or catchability at that time. In-season estimation of catchability was determined in two ways. First, catchability was estimated by determining mean weight of sockeye caught in the test fishery and relating it to catchability curves calculated from past years data (Figure 2). Second, it was estimated by correlating accumulative test fish indices with accumulative escapement counts with various lag times (Paulus 1968).

Tagging Studies

Three "flag" tagging experiments were conducted in addition to the index gillnetting program during 1979. The objectives of the tagging experiments were to monitor: (1) "lag time" for sockeye migrating from the test fishing site to the counting tower, (2) the proportion of the migrating sockeye salmon population that "flushed" in and out of the Igushik River between the test fishing site and the commercial fishing district, and (3) the proportion of the migrating sockeye salmon population indexed at the test fishing site that "drifted" from the Igushik River to other home river systems. The flag tags consisted of a 2 ft piece of colored surveyor's tape inserted just anterior and below the dorsal fin, easily visible to observers in the counting tower. A different colored tag was used for each of the three tagging experiments.

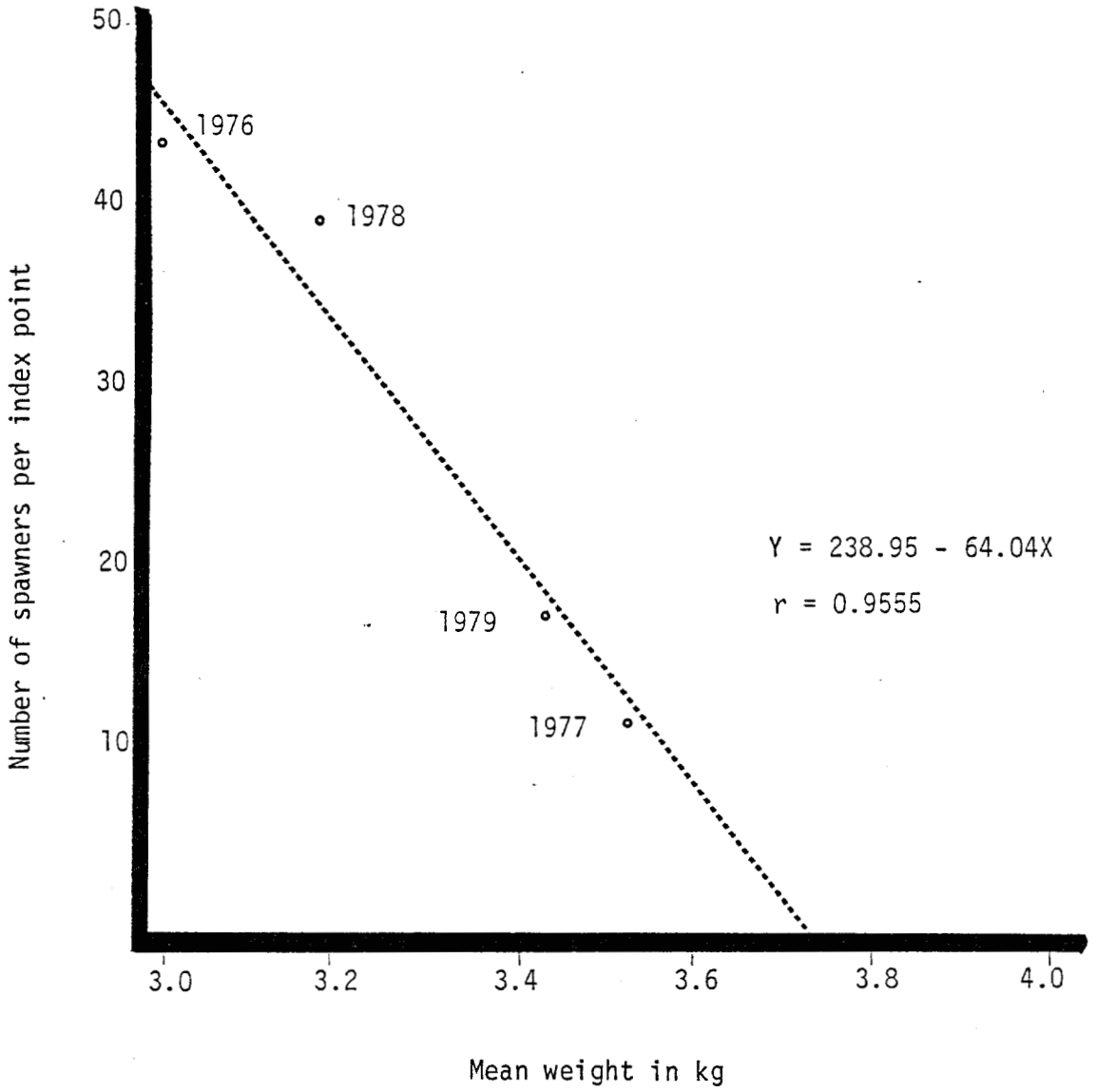

Figure 2. Correlation analysis of mean weight of Igushik River system sockeye salmon with the number of spawners per test fishing index point, 1976-1979.

All live sockeye salmon captured during index sets were also marked with a Floy tag just anterior and below the dorsal fin and released. While the Floy tags could not be easily observed from counting towers and hence data resulting from these tagged fish could not be used to calculate lag time, the data did provide another data base to examine the extent of flushing and drifting. The advantages of using Floy tags instead of flag tags were as follows: (1) more sockeye could be tagged because of ease of application, and (2) smaller Floy tags do not affect the behavior of the salmon as much as do the larger flag tags.

RESULTS

Tagging Studies

A total of 573 flag tags was deployed between 29 June and 5 July (Table 1). A total of 78 flag tags were observed at Igushik tower. It took an average (geometric mean) of 5.1 days for salmon to migrate to the tower from the test fishing site. The six tag sightings with lag times of over 14 days caused the data to be skewed (Figure 3), made the arithmetic average of mean lag time (6.1 days) to be larger, hence the geometric mean.

A total of 808 Floy tags were deployed between 20 June and 4 July. A total of 9 of these Floy tags as well as 16 flag tags was returned from other locations (Table 2). A small percentage of the tagged fish were observed to have flushed back into the commercial fishing district (Floy tag, 1.1%; flag tag, 2.8%). No tags of either type were observed in the escapement of any other river system during 1979.

Escapement Estimates

The accumulative test fish index (averaged by 3-day period) model was found to closely parallel the accumulative tower escapement count (Table 3, Table 4, and Figure 4). Visual inspection of this relationship (Figure 4) suggested a 2-3 day lag time as opposed to the 5.1 day lag time calculated from the flag tagging experiment. Correlation analysis of the accumulative test fish index curve with the accumulative actual escapement (Paulus 1968) verified that a 2-day lag time produced the best statistical fit between tower counts and test fish indices (Table 5).

In-season escapement estimates based on test fish indices remained within 30% of the actual escapement after 26 June (on that date, only 7% of the total escapement had entered the river (Table 6). The correlation coefficient between the estimated escapement determined in-season by the test fish indice method and the actual escapement determined at the counting tower was 0.9960 (Figure 5).

The final post-season relationship of the number of spawners per index point or catchability was calculated by dividing the total 1979 tower count of escapement by the accumulative test fish index; thus 786,220/45, 245 = 17.4 spawners/index point. Individual mean weight of sockeye salmon escaping into the Igushik River during 1979 was calculated at 3.42 kg.

Table 1. Summary of Igushik River flag tagging studies, 1979.

Tag color	Date tagged	Number tagged	Number of days between tagging and subsequent sightings at Igushik tower 1	2	3	4	5	6	7	8	9	10	11	12	13	14	>14	Total number	% of total	Average no. of days between tagging and sightings (Geometric mean)
Blue	29 June	226	5	6	6	7	3	7	1	2	0	1	0	1	0	2		41	18.1	5.0
Blue/orange	4 July	197	2	4	3	1	3	1	1				1			1		17	8.6	4.8
Blue/yellow	5 July	150	1	2	6	2	3	1	1	1						3		20	13.3	5.7
Total		573																78	13.6	5.1

Table 2. Summary of all tag returns outside of the Igushik River system, 1979.

Recovery site	Floy tags		Flag tags					
			Blue		Blue and orange		Blue and yellow	
	Number of tags recovered	Percent of total released	Number of tags recovered	Percent of total released	Number of tags recovered	Percent of total released	Number of tags recovered	Percent of total released
Igushik District	7	0.9	8	3.5	4	1.8	1	0.4
Nushagak District	1	0.1	2	0.9	1	0.4		
Egegik District	1	0.1						
TOTAL	9	1.1	10	4.4	5	2.2	1	0.4

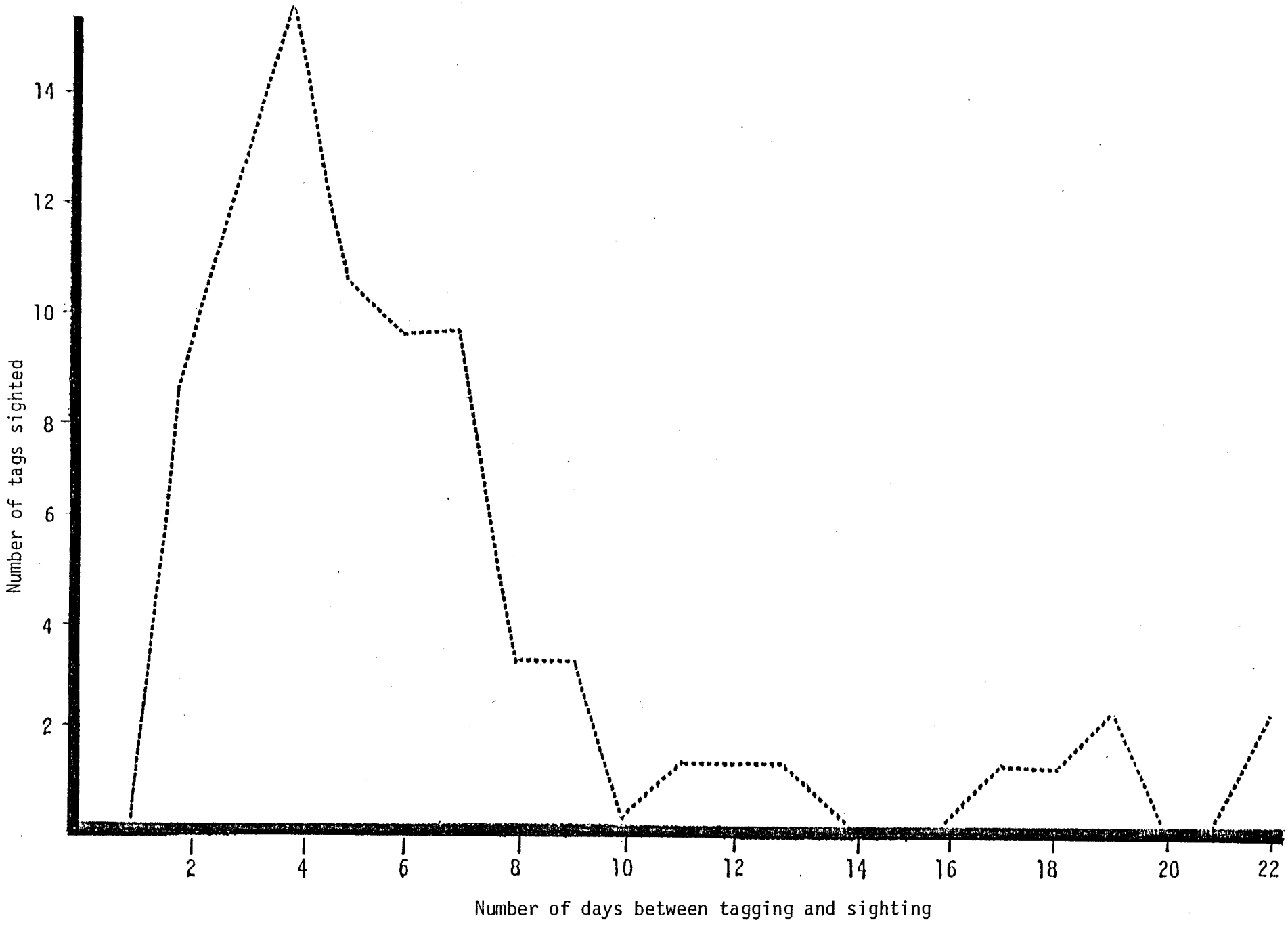

Figure 3. Number of flag tags sighted past Igushik tower, 1979.

Table 3. Sockeye salmon escapement into the Igushik River system as indexed at the Igushik River inside test fishing project, 1979

Date	Test fish index	Average of both tides for each day: Daily test fish index	Average of both tides for each day: Accumulative test fish index	Average by 3-day period: Daily test fish index	Average by 3-day period: Accumulative test fish index
June 19	84	84	84	80	80
20	156	156	240	112	192
21	98	98	338	107	299
22	62				
22	70	66	404	72	371
23	42				
23	56	52	456	111	482
24	346				
24	84	215	671	739	1,221
25	3,420				
25	480	1,950	2,621	1,510	2,731
26	4,251				
26	480	2,366	4,987	1,971	4,702
27	2,832				
27	362	1,597	6,584	1,566	6,268
28	1,380				
28	93	736	7,320	1,210	7,478
29	2,320				
29	274	1,297	8,617	1,605	9,083
30	2,843				
30	2,720	2,782	11,399	2,812	11,895
July 1	7,800				
1	916	4,358	15,757	4,704	16,599
2	5,880				
2	8,064	6,972	22,729	4,698	21,297
3	886				
3	4,640	2,763	25,492	3,628	24,925
4	1,392				
4	907	1,149	26,641	1,739	26,664
5	280				
5	2,331	1,306	27,947	1,538	28,202
6	2,160	2,160	30,107	2,815	31,017
7	6,120				
7	3,840	4,980	35,087	3,091	34,108
8	3,240				
8	1,028	2,134	37,221	2,863	36,971
9	1,609				
9	1,440	1,524	38,745	1,547	38,518
10	1,488				
10	576	1,032	39,777	1,797	40,315
11	2,400				
11	326	1,363	41,140	1,249	41,564
12	2,000				
12	706	1,353	42,493	1,745	43,309
13	2,520	1,520	45,013	1,936	45,245

Table 4. Final sockeye salmon escapement counts for the Igushik River system, 1979.

Date	Daily Counts	Accumulative Counts	Average by 3-Day Period: Daily Counts	Average by 3-Day Period: Accumulative Counts
June 21	324	324	464	464
22	1,068	1,392	768	1,232
23	912	2,304	1,192	2,424
24	1,596	3,900	1,420	3,844
25	1,752	5,652	2,900	6,744
26	5,352	11,004	8,640	15,384
27	18,816	29,820	17,256	32,640
28	27,600	57,420	25,624	58,264
29	30,456	87,876	29,254	87,518
30	29,706	117,582	29,280	116,798
July 1	27,678	145,260	40,468	157,266
2	64,020	209,280	60,128	217,394
3	88,686	297,966	72,186	289,580
4	63,852	361,818	74,888	364,468
5	72,126	433,944	64,310	428,778
6	56,952	490,896	58,406	487,184
7	46,140	537,036	54,462	541,646
8	60,294	597,330	53,194	594,840
9	53,148	650,478	51,186	646,026
10	40,116	690,594	39,438	685,464
11	25,050	715,644	29,536	715,000
12	23,442	739,086	22,988	737,988
13	20,742	759,828	18,812	756,800
14	12,522	772,350	16,152	772,952
15	15,192	787,542	13,268	786,220
16	12,090	799,632	11,756	797,976
17	7,986	807,618	8,558	806,534
18	5,598	813,216	6,290	812,824
19	5,286	818,502	4,922	817,746
20	3,882	822,384	4,428	822,174
21	4,116	826,500	4,228	826,402
22	4,686	831,186	5,572	831,974
23	7,914	839,100	6,120	838,094
24	5,760	844,860	6,382	844,476
25	5,472	850,332	6,150	850,626
26	7,218	857,550	4,900	855,526
27	2,010	859,560	4,614	860,140

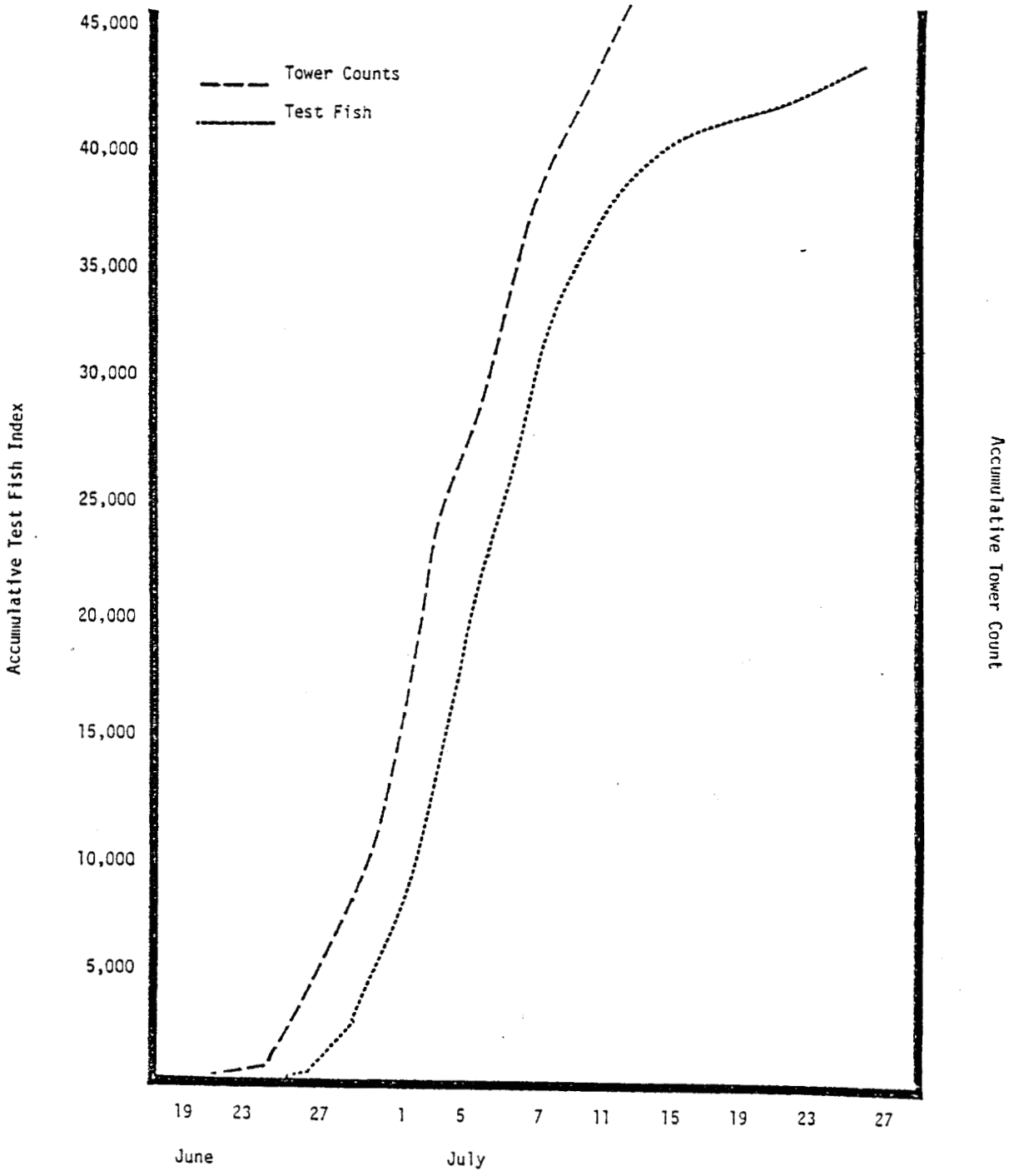

Figure 4. Igushik River accumulative test fishing indices and tower counts averaged by 3-day periods, 1979.

Table 5. Correlation analysis of accumulative test fish indices with accumulative escapement counts at Igushik tower with lag times from 1 to 7 days, 1979.

Lag time	Correlation coefficient
1 day lag	0.99572
2 day lag	0.99843[1]
3 day lag	0.99556
4 day lag	0.98763
5 day lag	0.97549
6 day lag	0.95984
7 day lag	0.94114

[1] Highest r value and used in this project.

Table 6. Sockeye salmon escapement into the Igushik River system as estimated in-season by the Igushik River inside test fishing project, 1979.

Date	Accumulative test fish index	Estimated spawners per index point	Accumulative estimated escapement	Accumulative actual escapement	Accuracy
June 21	338	18.0	6,084	2,304	2.6
22	404	22.0	8,888	3,900	2.8
23	456	22.0	10,032	5,652	1.8
24	671	22.0	14,800	11,004	1.3
25	2,621	22.0	57,662	29,820	1.9
26	4,987	12.0	59,844	57,420	1.0
27	6,584	12.0	79,008	87,876	0.9
28	7,320	12.0	87,840	117,582	0.7
29	8,617	12.0	103,404	145,260	0.7
30	11,399	13.3	151,606	209,280	0.7
July 1	15,757	19.8	311,989	297,966	1.0
2	22,729	19.8	450,034	361,818	1.2
3	25,492	19.8	504,742	433,944	1.2
4	26,641	19.8	527,492	490,896	1.1
5	27,947	20.1	561,735	537,036	1.0
6	30,107	20.1	605,151	597,330	1.0
7	35,087	20.1	705,249	650,478	1.1
8	37,221	20.1	748,142	690,594	1.1
9	38,745	20.1	778,774	715,644	1.1
10	39,777	20.1	799,517	739,086	1.1
11	41,140	20.1	826,914	759,828	1.1
12	42,493	20.1	854,109	772,350	1.1
13	45,013	20.1	904,761	787,542	1.1

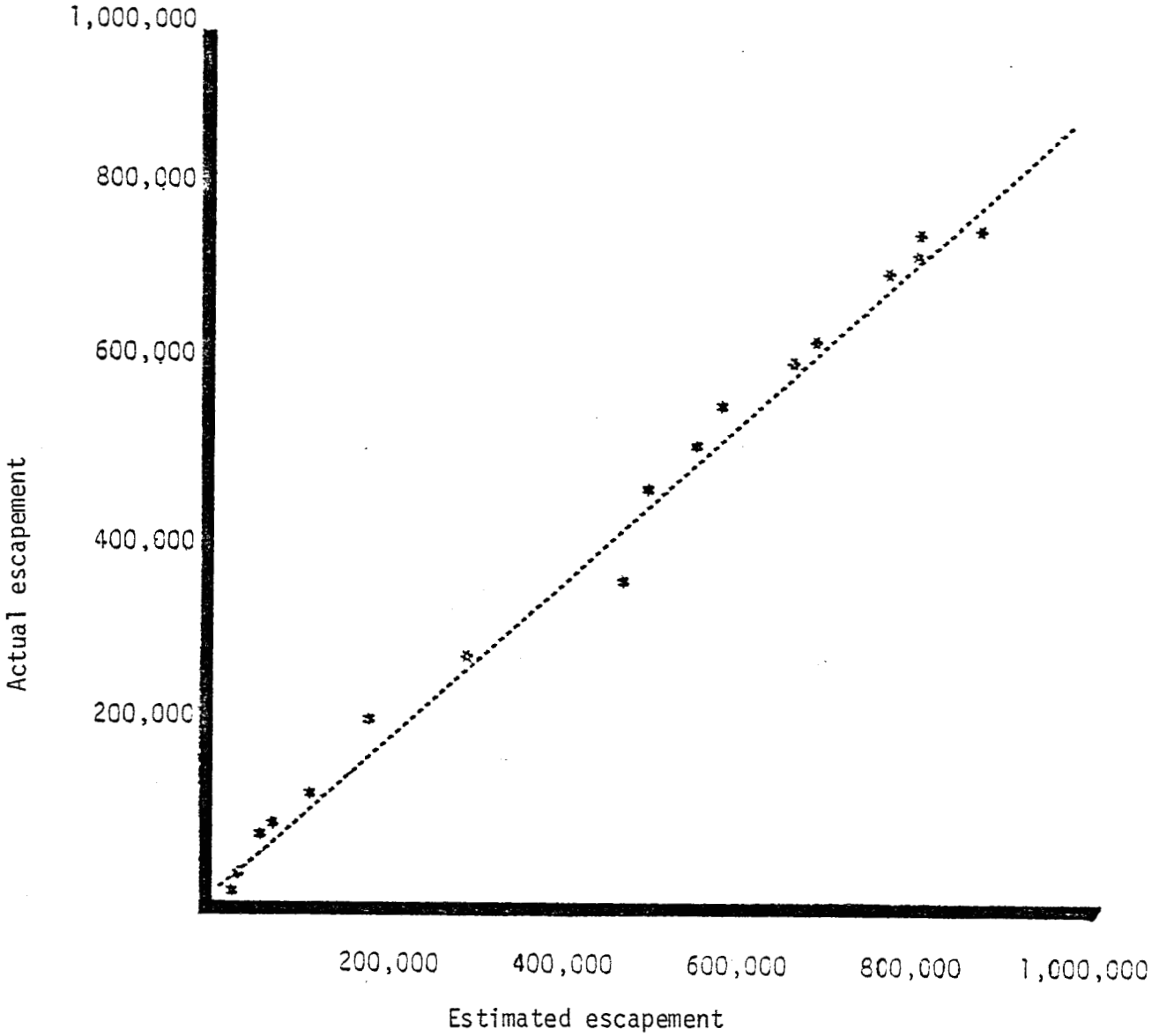

Figure 5. Correlation analysis of sockeye salmon escapement as estimated by the Igushik River inside test fishing project with the actual sockeye salmon escapement as estimated at Igushik tower, 1979.

DISCUSSION

A large discrepancy in determining lag time by two independent methods occurred in 1979. The estimate of lag time estimated from flag tagging experiments was 5.1 days whereas lag time calculated from the correlation analysis was 2 days. In past years, both methods yielded comparable results. It is undetermined why this discrepancy existed. The correlation analysis was considered to be a more accurate determination of lag time and was used in this analysis. The tagging data collected during 1979 further substantiated the conclusions of the 1978 study that showed flushing and drifting of fish from the new upriver test fishing site to be virtually non-existent.

While the test fish estimates of escapement only provided 2 days of lead time as opposed to tower counts during 1979, these estimates were useful to decision makers. It appears that sockeye migration times were significantly faster throughout Bristol Bay during 1979, although reasons behind this alteration of normal behavior are unknown. Lag times closer to the 6-day long-term average for the Igushik River will probably be observed in the future. The in-season escapement model built in 1979 was shown to be very accurate and useful early in the run. In-season escapement estimates remained within 30% of the actual accumulative escapement after only 7% of the sockeye run had entered the river. The 1979 Igushik inside test fishing project has been developed into an in-season escapement monitoring tool capable of providing timely and sufficiently accurate data to fishery decision makers.

LITERATURE CITED

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

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

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

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