SAFS-UW-0114
December 2001

School of Aquatic & Fishery Sciences
University of Washington
Seattle, Washington 98195

FORECAST OF THE 2002 RUN OF SOCKEYE SALMON TO BRISTOL BAY

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ANNUAL REPORT TO

BRISTOL BAY PROCESSORS

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Acknowledgments

A special thanks to ADF&G, Anchorage for providing preliminary statistics that staff collected from the 2001 run. Without these data a forecast could not have been made at this time.

Key Words

Alaska, Bristol Bay fishery, fish size, forecasts, Port Moller, sockeye salmon

FORECASTS OF THE 2002 SOCKEYE SALMON RUNS TO BRISTOL BAY

A Report to the Bristol Bay Processors

DE ROGERS

INTRODUCTION

Salmon runs are characterized by large year-to-year variation in number, most of which is expressed in the annual catches because escapement requirements that are nearly constant from year to year have priority. During the past 50 years, the largest annual catches of sockeye salmon (*Oncorhynchus nerka*) in the major Alaskan fisheries have all been more than 10 times greater than the smallest catch (Fig. 1). In the Bristol Bay sockeye fisheries (the largest in the world), the extreme of variation occurred when the catch went from <1 million fish in 1973 to nearly 40 million fish just 10 years later. This year-to-year variation poses problems for the fishing industry when trying to prepare for the harvesting, processing, transportation, and sale of the salmon with a great deal of uncertainty. An accurate forecast of the catches can solve many of these problems and greatly assist fishery managers in regulating fishing early in the run. For the industry, a forecast is most useful when available well in advance of the run (i.e., ≥6 months).

Sockeye salmon forecasts mostly depend on relationships between numbers of fish in a run and estimates of the numbers of fish at earlier times in their life (e.g., the approaching run, immature fish at sea, seaward migrant smolt, fry in lakes, or number of parent spawners [escapement]). In addition or sometimes as a substitute, characteristics of the salmon (body size, age, sex) or the salmon's environment (temperature) may be used if the measurement explains some of the variation in past runs. The accuracy of a Bristol Bay forecast is largely dependent on (1) how far in advance the forecast is made, (2) the accuracy of the estimates of fish numbers or substitute measures, and (3) the forecaster's experience and methods used.

Measurements needed to forecast the Bristol Bay sockeye salmon runs were not made routinely until about 1950; the first forecasts were made by biologists from the Fisheries Research Institute (FRI) and from what is now the National Marine Fisheries Service (NMFS) late in that decade. About 1962, the Alaska Department of Fish & Game (ADF&G) assembled a staff of biologists to make annual forecasts of the runs from inshore observations (escapements, smolt, age, etc.), and in 1985, salmon processors asked that FRI make forecasts from these same data to provide a second opinion. This report presents a review of the 2001 season and forecasts of the 2002 sockeye salmon runs to Bristol Bay, based mostly on preliminary statistics provided by ADF&G.

REVIEW OF THE 2001 RUN

Forecasts and Actual Runs

The FRI prediction of total run to Bristol Bay in 2001 was 21.5 million with a 13.8 million catch, and the ADF&G predictions were nearly the same at 22.8 and 13.6 million (Tables 1 and 2). The total 2001 run and catch (22 and 14 million) as well as most individual district runs were very close to the preseason forecasts from both agencies.

The catch of 14 million was close to the predicted catch and the third smallest for Bristol Bay since 1978. From 1987 to 1996, our forecasts differed from the actual catches by an average of 22% (range: 5–43%) and ADF&G forecasts differed by an average of 27% (range: 9–56%). In both 1997 and 1998, the forecasts differed from the actual catch by over 100% and thus were the most inaccurate forecasts made since 1990 when forecasts were only about one-half of the actual catch. The 2001catch was very close to the preseason forecast (within 1%).

In addition to the preseason forecasts, we have made inseason forecasts each year since 1987 from a test-fishing program based out of Port Moller. This project has provided more accurate predictions (average error of 5%) than preseason forecasts because we are estimating the relative abundance of the run just 6–8 days before it arrives in the fishing districts. Prior to the 2001 season, a Bristol Bay almanac was provided to processors so they could make daily forecasts of the final 2001 run beginning June 20. The forecast method was based on the past daily cumulative Port Moller indices and the past runs, and assumed average run timing.

Very early in 2001 (June 20), the test boat catches and ocean temperatures indicated that the run was going to be larger than preseason forecasts but much earlier than average (Table 2). By June 24, the age compositions at Port Moller showed a lack of age.2 sockeye, which were expected to provide about 42% of the run. About 80% of the sockeye at Port Moller were age 1.3. There was also a low sockeye-to-chum ratio in the Port Moller catches that, combined with the age data, indicated the run was likely to be much smaller than forecast from the Port Moller sockeye index catches. There was no False Pass fishery in 2001, so the Port Moller program was all that was available. Fishing began early in all districts. It was soon evident that the Kvichak system was low while Naknek was strong. The high proportion of age 1.3 fish signaled a strong showing in the Nushagak District although this age group was strong in all districts. The age composition in the run was close to the age composition predicted from the Port Moller samples (Table 3).

The Fisheries

The Port Moller program indicated that the 2001 run was going to be earlier and larger than the preseason forecast of about 22 million but the catches would be similar. The sockeye were much earlier in arriving in all districts and fishing began in mid June. The first major catches in Bristol Bay were made during June 20–24. Fishing in the Nushagak District did not begin until June 22 in the Igushik section. When the entire district opened on June 25, 25% of the final Wood River escapement passed the counting towers. Total daily catches reached 1 million on June 26 and the 50% point for the total catch was reached on July 2, about 4 days earlier than average. The mid-points of the Egigik (June 27), Naknek/Kvichak (June 30) and Nushagak (July 1) runs were near the dates of the early runs in 1967, 1979, and 1993. Management of the 2001 runs was generally good; however, required gear allocations and the early timing resulted in excess escapement occurring in the Nushagak and Naknek rivers. The Kvichak escapement was again quite small (1.1 million) relative to the goal of 4 million; however, escapements in the other major rivers exceeded management goals.

Fish Size

The sockeye salmon caught in Bristol Bay in 2001 averaged 7.0 lb and were the largest since the very small run in 1973 (Table 4). This was caused by the high percentage of 3-ocean fish (90%) and above average sizes of .3 age groups (Fig. 2). The 2-ocean sockeye were a little below average in length. The body size of Bristol Bay sockeye salmon has been inversely related to the number of fish in the run (large run, small fish) and influenced indirectly by water temperature and the length of time the fish has to grow in the spring of the year it returns. Winter and spring weather over southwest Alaska has been relatively mild since 1976 (Fig. 3). The spring nearshore surface temperatures in the Gulf of Alaska and in Bristol Bay were exceptionally warm in 2000–2001. Large body size tends to occur in early runs, which are associated with warm temperatures. The age 1.2 and 1.3 sockeye were especially small in 1998 given the relatively small numbers in the run.

FORECASTS FOR 2002

The statistics used to forecast the 2002 Bristol Bay sockeye salmon runs came from several sources: (1) the numbers, ages, lengths, and weights of adult salmon in the catches and escapements and smolt in the seaward migrations were from annual reports by ADF&G (e.g., Stratton and Crawford 1994, Crawford and Cross 1994); (2) the relative numbers, ages, and lengths of fry in the Wood River and Kvichak lake systems were from annual reports by FRI (e.g., Rogers et al. 1996); and (3) air temperatures for Bristol Bay were from monthly reports by the U.S. Weather Bureau. The Bristol Bay run statistics used in forecasting do not include estimates of interceptions (i.e., fish caught on the high seas or at False Pass). We are forecasting the inshore run from inshore statistics. The climate for the three brood years (1996–98) that will contribute to the 2002 run was generally favorable, except for the winter 1997–98 (Fig. 3).

Run predictions were made for each major age group (usually four) and summed to obtain a forecast for a river system. The river system forecasts were summed to predict the run to a fishing district, and the predicted catch was obtained by subtracting the recent 5-year average of escapements. To predict the return of an age group in 2002, all relevant statistics from past brood years (since 1981) were assembled and submitted to a stepwise multiple regression procedure. When no measurement (variable) was significantly correlated with past variation in a run, then we used the average runs for the past 5 years or the average of past runs with the same measurement available (e.g., zero jacks or small smolt numbers to predict the 2002 run). Only adult returns since 1985 (1981 brood year) were used because there has been a recent shift in the ocean age composition towards more 3-ocean fish, and the production of sockeye salmon at Egegik has increased greatly since 1980. Egegik was a low producer relative to the size of the lake

(second largest in Bristol Bay); now production is more in line with the other systems in Bristol Bay. In addition, the more recent years are likely to help better predict events in 2002 than earlier observations.

The forecast of the total 2002 Bristol Bay sockeye salmon run is 17.1 million with a predicted catch of 10 million (Table 5). Over the past 12 years, there have been larger runs of 3-ocean fish relative to the returns of 2-ocean fish in the preceding years (Table 6). The 2-ocean fish were generally small for these years and this was also the case in 2001, so we might expect larger returns of 3-ocean fish in 2002 than the small returns of 2-ocean fish in 2001.

The databases and forecast statistics are presented in Tables 7–12. There were below average returns of jacks to Naknek, Egegik, Ugashik, and Wood River; however, the Kvichak, which might be expected to have the largest run of age 1.2 from the large smolt migration in 2000, had no jacks in 2001. This, along with a small return of 2-ocean sockeye in 2001, points to a relatively small run of 2 million in 2002. The runs to Egegik should be larger than last year whereas all other runs are forecast to be smaller than in 2001 (Fig. 4). Because past runs have sometimes differed considerably from the preseason forecasts, it will again be very important for the industry to have an accurate inseason forecast from the Port Moller test fishery.

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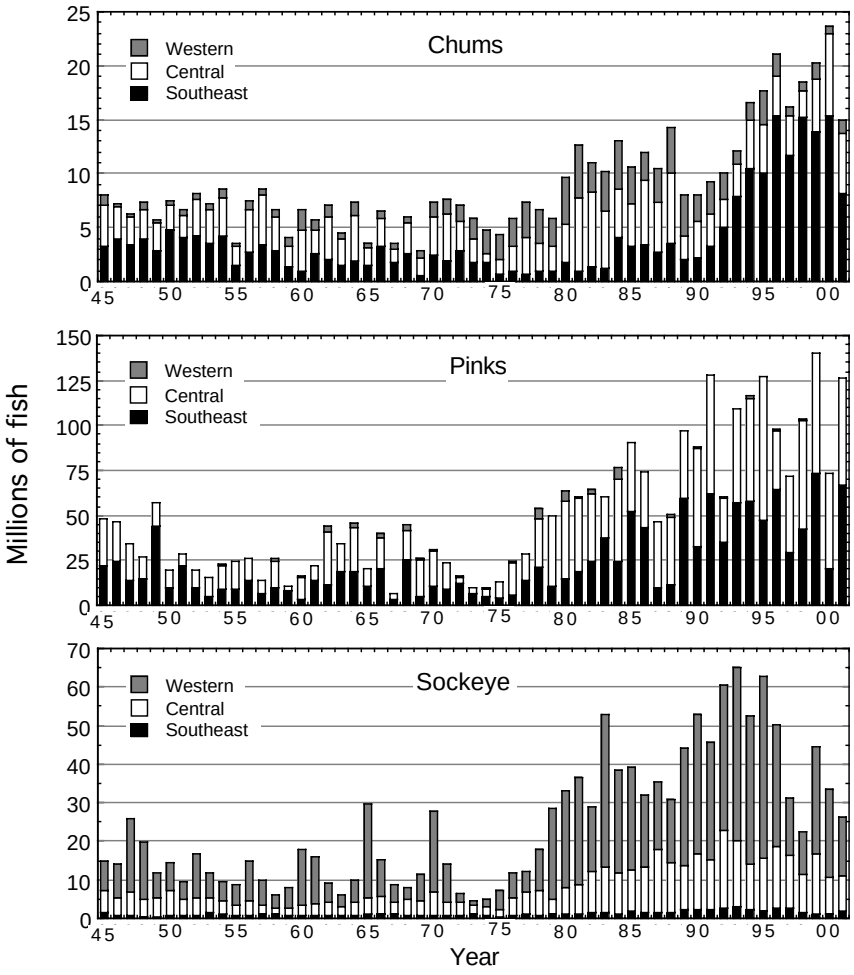

FIGURE 1. Annual catches of sockeye salmon in the major Alaska fisheries, 1945–2001.

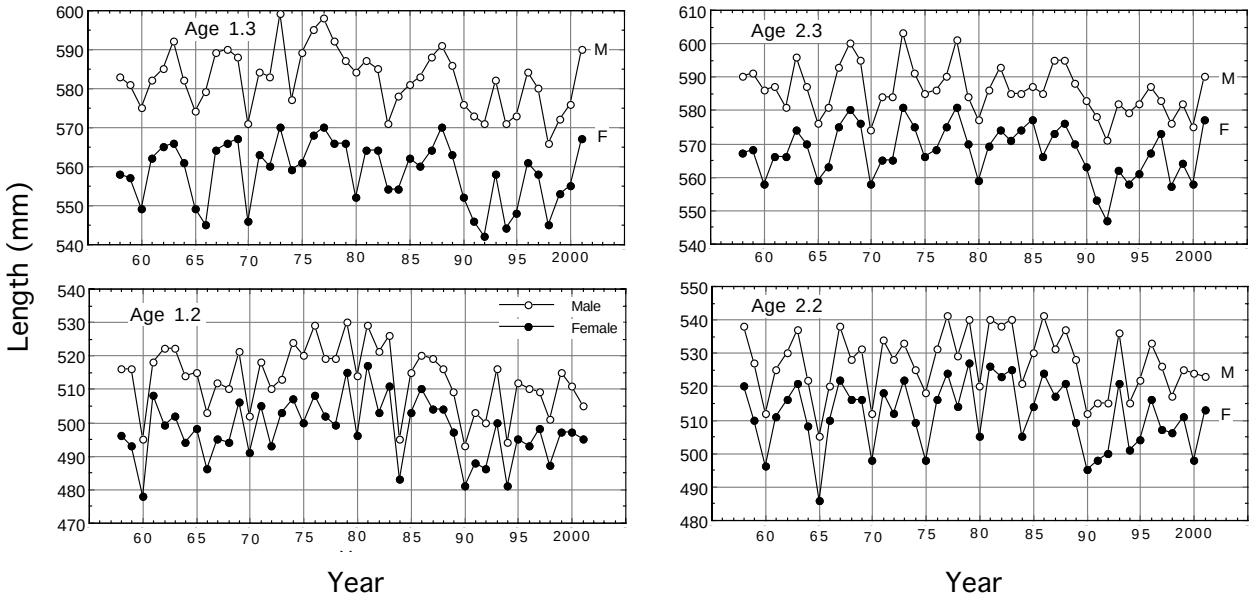

FIGURE 2. Annual mean lengths by age and sex for Bristol Bay sockeye runs, 1958–2001.

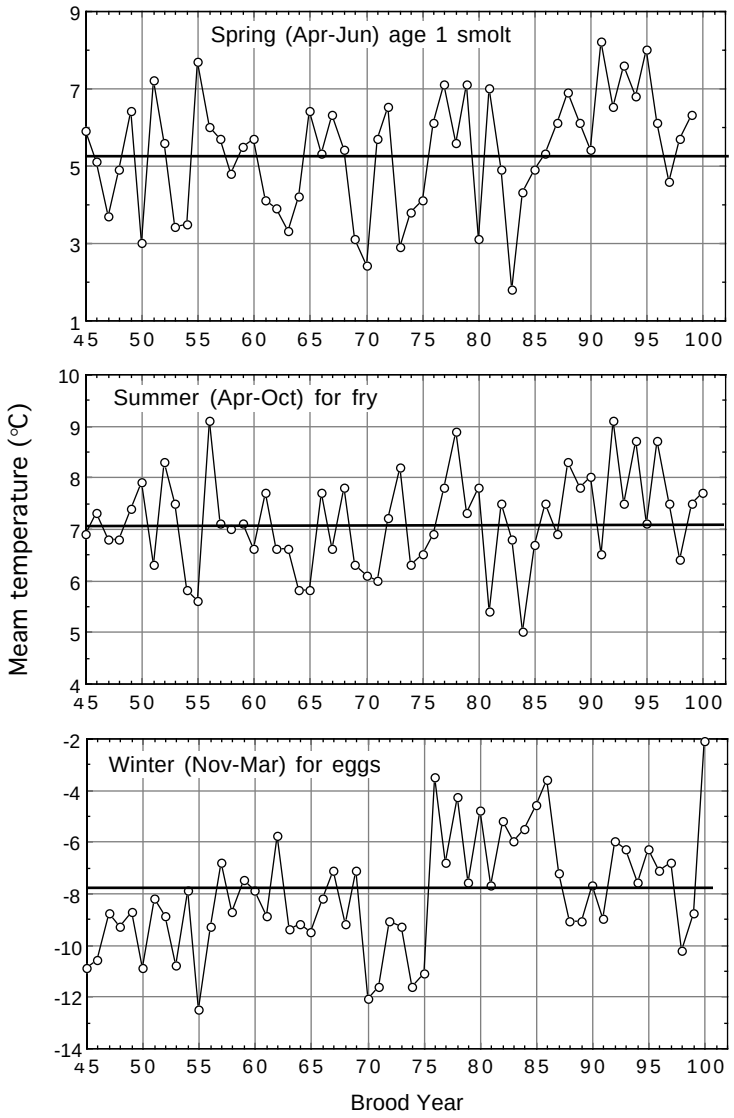

FIGURE 3. Air temperatures in Bristol Bay for the 1945–2000 brood years.

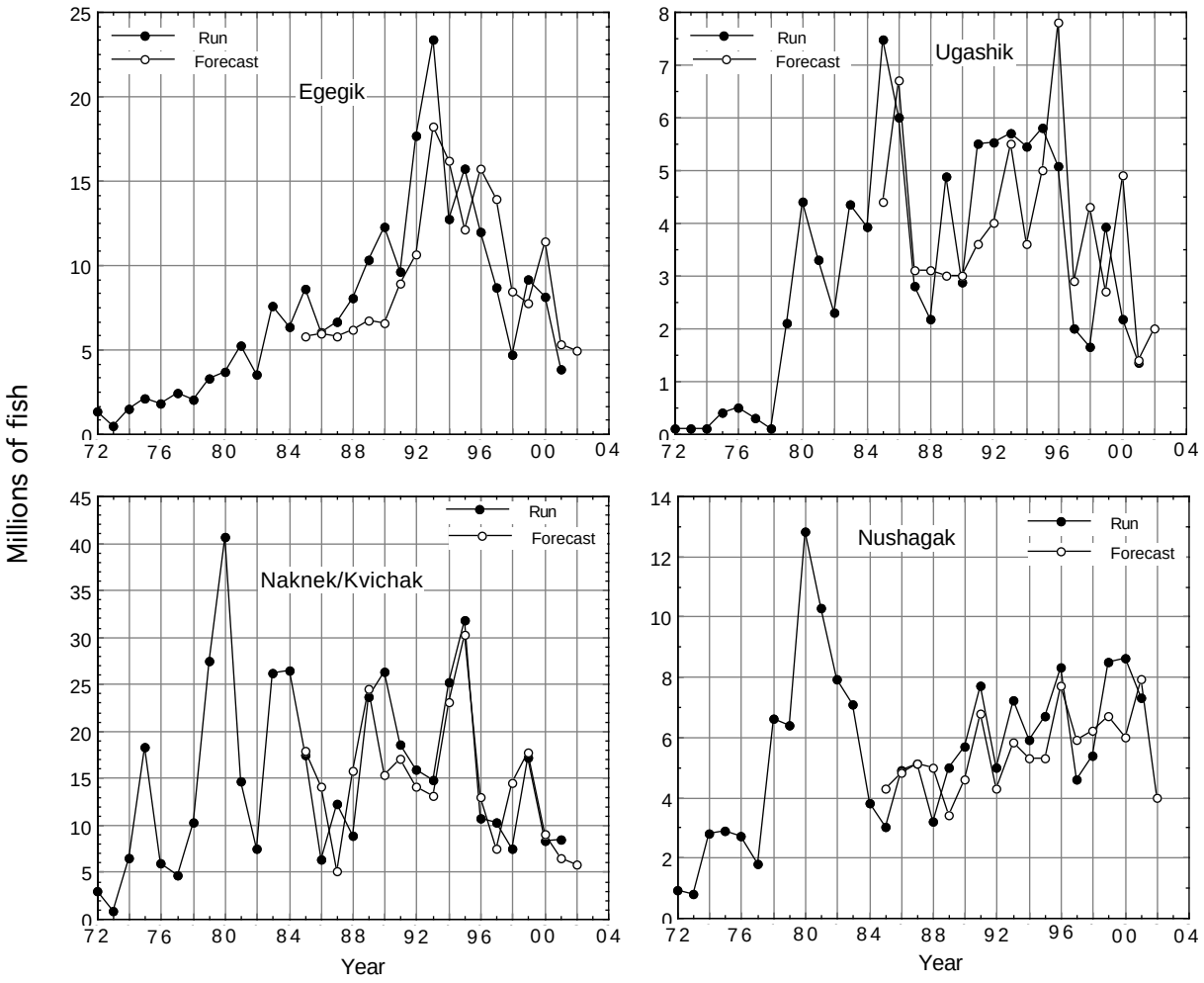

FIGURE 4. Sockeye salmon runs, 1972-2001, and the FRI preseason forecasts, 1985–2002.

TABLE 1. Annual inshore runs of sockeye salmon to Bristol Bay and the pre- and inseason forecasts.

		ADFG pre-season			FRI pre-season*			FRI in-season**		
Year	Run	Forecast	F-R	Error (%)	Forecast	F-R	Error (%)	Forecast	F-R	Error (%)
1962	10.4	8.2	-2.2	-21	7.6	-2.8	-27			
63	6.9	8.6	1.7	25	15.3	8.4	122			
64	10.7	17.4	6.7	63	19.3	8.6	80			
65	53.1	27.8	-25.3	-48	25.3	-27.8	-52			
66	17.5	31.3	13.8	79	32.6	15.1	86			
67	10.3	14.2	3.9	38	21.5	11.2	109			
Means (abs.)	18.2	17.9	8.9	46	20.3	12.3	79			
1968	7.8	10.7	2.9	37	10.5	2.7	35			
69	18.4	21.3	2.9	16	16.2	-2.2	-12			
70	39.4	56.0	16.6	42	57.2	17.8	45			
71	15.8	16.9	1.1	7	18.1	2.3	15			
72	5.4	10.3	4.9	91	6.6	1.2	22			
73	2.4	6.2	3.8	158	5.8	3.4	142			
74	10.8	5.3	-5.5	-51	3.9	-6.9	-64			
75	24.2	12.9	-11.3	-47	12.0	-12.2	-50			
76	11.5	12.0	0.5	4	9.8	-1.7	-15			
77	9.6	8.4	-1.2	-13	8.8	-0.8	-8			
78	19.4	11.5	-7.9	-41	16.5	-2.9	-15			
79	39.5	22.7	-16.8	-43	14.7	-24.8	-63			
Means (abs.)	17.0	16.2	6.3	46	15.0	6.6	40			
1987	27.3	16.8	-10.5	-38	19.5	-7.8	-29	27.0	-0.3	-1
88	23.0	26.5	3.5	15	30.6	7.6	33	15.0	-8.0	-35
89	43.8	28.9	-14.9	-34	38.0	-5.8	-13	43.5	-0.3	-1
90	47.8	25.4	-22.4	-47	29.8	-18.0	-38	49.0	1.2	3
91	42.1	30.0	-12.1	-29	36.7	-5.4	-13	42.5	0.4	1
92	44.9	37.1	-7.8	-17	33.0	-11.9	-27	47.0	2.1	5
93	51.9	41.8	-10.1	-19	43.1	-8.8	-17	59.0	7.1	14
94	50.1	52.4	2.3	5	48.8	-1.3	-3	39.0	-11.1	-22
95	60.8	55.1	-5.7	-9	53.1	-7.7	-13	48.0	-12.8	-21
96	36.9	43.4	6.5	18	45.2	8.3	22	44.5	7.6	21
97	18.8	33.6	14.8	79	35.1	16.3	87	40.0	21.2	113
98	18.2	30.2	12.0	66	33.8	15.6	86	30.0	11.8	65
99	39.4	24.6	-14.8	-38	35.1	-4.3	-11	34.0	-5.4	-14
00	28.3	35.4	7.1	25	37.7	9.4	33	40.0	11.7	41
01	22.0	22.8	0.8	4	21.5	-0.5	-2	50.0	28.0	127
02					17.3					
Means (abs.)	38.8	34.3	10.6	32	37.1	9.2	28	39.9	8.5	32

* FRI pre-season forecasts for 1962-1979 were from purse seine sampling of immature sockeye south of Adak Is. in the year prior to the run (1962-67 was without a sampling plan) and the forecasts for 1987-99 were based on the same inshore data (escapement and smolt numbers) used by ADF&G, but with different analyses.

** Average of forecasts made on 6/25 and 6/30, final forecast made about 7/3-5.

Error= percent that the forecast differred from the run.

In 2001 processors were advised that PM forecasts were much to high as run was very early.

TABLE 2. Annual catches (millions) of sockeye salmon in Bristol Bay and the pre- and inseason forecasts.

		ADFG pre-season			FRI pre-season			Port Moller FRI in-season		
Year	Catch	Forecast	F-C	Error (%)	Forecast	F-C	Error (%)	Forecast	F-C	Error (%)
1987	16.0	8.7	-7.3	-46	12.4	-3.6	-23	17.0	1.0	6
88	13.8	16.8	3.0	22	20.8	7.0	51	12.0	-1.8	-13
89	28.7	16.2	-12.5	-44	25.4	-3.3	-11	28.0	-0.7	-2
90	33.1	14.7	-18.4	-56	19.0	-14.1	-43	25.0	-8.1	-24
91	26.2	21.2	-5.0	-19	25.0	-1.2	-5	20.5	-5.7	-22
92	32.0	26.3	-5.7	-18	22.0	-10.0	-31	29.0	-3.0	-9
93	40.8	32.0	-8.8	-22	31.9	-8.9	-22	32.3	-8.5	-21
94	35.2	39.7	4.5	13	34.1	-1.1	-3	29.0	-6.2	-18
95	44.4	40.3	-4.1	-9	34.4	-10.0	-23	33.0	-11.4	-26
96	29.7	34.6	4.9	16	33.4	3.7	12	34.0	4.3	14
97	12.3	24.8	12.5	102	25.4	13.1	107	17.0	4.7	38
98	10.0	20.6	10.6	106	23.5	13.5	135	10.7	0.7	7
99	25.8	13.8	-12.0	-47	21.2	-4.6	-18	26.0	0.2	1
00	20.5	22.3	1.8	9	24.4	3.9	19	20.0	-0.5	-2
01	14.0	15.6	1.6	11	13.8	-0.2	-1	15.0	1.0	7
02					10.3					
Means (abs.)	25.5	23.2	7.5	36.0	23.6	6.5	33.6	23.2	-2.3	-4.3

Pre-season forecasts from October in prior year and in-season forecast about 7/2-5 in year of run.
Error= percent that the forecast differred from the catch.

TABLE 3. Comparison of the age compositions of sockeye salmon in Bristol Bay runs with age compositions in Port Moller catches, the False Pass fishery, and preseason forecasts.

Year		Age composition (%) 1.2	2.2	1.3	2.3	all .2	all .3	Forecast/ run (millions)
1991	ADF&G	28	25	31	16	53	47	30.0
	FRI	41	14	31	14	55	45	36.7
	False Pass	21	33	36	6	54	46	
	Port Moller	12	14	55	13	28	71	37.0
	BB run	19	20	46	11	39	60	42.1
1992	ADF&G	19	39	27	13	58	42	37.1
	FRI	18	39	27	14	57	43	33.0
	False Pass	6	35	25	30	42	58	
	Port Moller	8	35	31	22	43	53	45.0
	BB run	13	34	27	22	47	50	45.1
1993	ADF&G	23	41	21	14	64	35	41.8
	FRI	16	41	20	21	56	43	43.3
	False Pass	14	46	14	23	61	38	
	Port Moller	7	27	19	44	34	65	45.0
	BB run	13	33	18	33	46	53	51.9
1994	ADF&G	14	43	19	22	57	43	52.5
	FRI	17	37	15	29	55	45	48.8
	False Pass	8	34	33	22	42	57	
	Port Moller	7	42	20	28	50	50	41.0
	BB run	8	56	14	18	65	34	50.1
1995	ADF&G	16	53	17	13	69	31	55.1
	FRI	9	50	19	20	59	41	53.1
	False Pass	19	57	12	11	76	24	
	Port Moller	14	51	15	19	65	34	49.2
	BB Run	16	56	12	14	73	27	60.7
1996	ADF&G	18	36	26	19	54	48	43.4
	FRI	13	22	32	31	35	65	45.2
	False Pass	15	24	38	20	39	61	
	Port Moller	8	13	51	24	21	79	44.0
	BB Run	10	13	51	24	23	76	36.9
1997	ADF&G	22	31	25	20	53	47	33.6
	FRI	28	27	29	15	56	44	35.1
	False Pass	19	44	23	11	64	36	
	Port Moller	9	26	33	27	36	62	35.0
	BB Run	20	34	26	18	54	44	18.9
1998	ADF&G	25	32	24	18	57	43	30.2
	FRI	33	26	23	17	59	41	33.8
	False Pass	14	9	39	37	24	76	
	Port Moller	18.8	9	38	33	28	72	30.7
	BB Run	34	13	29	22	47	52	18.2
1999	ADF&G	26	41	25	8	67	33	24.6
	FRI	28	41	24	7	69	31	35.1
	False Pass	56	19	21	3	75	25	
	Port Moller	48	28	17	7	76	24	38.0
	BB Run	51	24	17	7	75	24	39.4
2000	ADF&G	20	27	37	16	47	53	33.3
	FRI	14	20	53	12	34	66	42.7
	False Pass	26	20	42	7	46	58	
	Port Moller	19	9	59	13	28	72	37.0
	BB run	18	10	57	15	28	72	28.3
2001	ADF&G	19	31	34	17	50	51	22.8
	FRI	28	15	42	14	43	56	21.5
	False Pass	not available						
	Port Moller	3	5	79	10	8	91	
	BB run	4	3	81	9	7	91	22.0

Forecasts and runs do not include jacks (ages 1.1 and 2.1).
The Port Moller forecast is on 6/30 and the age composition is through 6/30 only.

TABLE 4. Average weights of sockeye salmon (lb) in the Bristol Bay commercial catches, 1960–2001.

	2-ocean			3-ocean			All	All	All	BB	Percent	Percent
Year	Male	Female	Combined	Male	Female	Combined	males	females	fish	millions	3-ocean	females
1960	4.7	4.0	4.4	7.2	6.0	6.5	4.9	4.7	4.8	14	20	38
61	5.4	4.7	5.2	7.4	6.2	6.8	6.7	5.9	6.3	12	71	49
62	5.6	4.8	5.2	7.4	6.3	6.8	6.0	5.3	5.7	5	27	50
63	5.7	4.9	5.3	7.9	6.5	7.1	6.6	5.5	6.0	3	51	54
64	5.4	4.7	5.1	7.7	6.5	7.0	5.8	5.3	5.6	6	27	47
65	4.7	4.2	4.5	6.9	5.9	6.3	4.9	4.5	4.7	24	11	40
66	5.1	4.7	4.9	7.5	6.3	6.7	6.9	6.0	6.3	9	80	62
67	5.6	4.9	5.2	7.7	6.5	6.9	6.3	5.6	5.9	4	39	56
68	5.4	4.8	5.1	8.0	6.7	7.2	6.4	5.8	6.1	3	47	53
69	5.5	4.9	5.2	7.4	6.4	6.9	5.7	5.2	5.4	7	15	52
70	5.0	4.5	4.8	6.7	5.7	6.0	5.2	4.7	5.0	21	10	47
71	5.3	4.7	4.9	7.2	6.0	6.5	6.4	5.5	5.9	10	62	60
72	5.4	4.7	5.1	7.6	6.3	6.9	6.6	5.8	6.2	2	60	48
73	5.5	5.1	5.3	8.4	6.8	7.5	7.9	6.6	7.2	1	86	53
74	5.5	4.9	5.2	7.5	6.6	7.1	6.0	5.4	5.7	1	27	52
75	5.4	4.7	5.1	7.7	6.4	6.9	6.0	5.4	5.7	5	32	49
76	5.7	4.9	5.4	8.0	6.7	7.2	6.4	5.8	6.1	6	40	47
77	5.5	4.9	5.2	8.3	6.8	7.5	7.0	6.2	6.6	5	60	53
78	5.4	4.7	5.1	8.2	6.6	7.3	6.5	5.6	6.1	10	44	48
79	5.8	5.2	5.5	7.4	6.3	6.8	6.1	5.5	5.8	21	20	50
80	5.2	4.6	4.9	7.4	6.0	6.6	5.8	5.0	5.4	24	29	51
81	5.7	5.0	5.3	7.6	6.4	7.0	6.7	5.7	6.2	26	53	52
82	5.3	4.8	5.0	7.5	6.4	6.9	7.0	6.0	6.5	15	77	50
83	5.7	4.8	5.2	7.1	6.2	6.6	5.9	5.1	5.5	37	18	52
84	5.1	4.5	4.9	7.2	6.3	6.7	5.8	5.2	5.5	25	35	46
85	5.4	4.7	5.1	7.3	6.4	6.8	6.2	5.5	5.8	24	44	48
86	5.7	4.9	5.3	7.4	6.2	6.7	6.6	5.7	6.1	16	57	54
87	5.3	4.8	5.0	7.5	6.5	6.9	6.3	5.7	6.0	16	49	53
88	5.4	4.7	5.1	7.6	6.6	7.1	6.7	5.9	6.3	14	60	47
89	5.3	4.6	4.9	7.4	6.2	6.8	6.0	5.0	5.5	28	29	53
90	5.0	4.6	4.8	7.4	6.2	6.7	6.1	5.4	5.8	33	50	53
91	5.1	4.3	4.7	7.2	5.9	6.5	6.5	5.4	5.9	26	67	54
92	4.8	4.3	4.6	6.7	5.7	6.1	5.8	5.1	5.5	32	58	45
93	5.5	4.7	5.1	7.3	6.2	6.7	6.4	5.6	6.0	41	54	53
94	4.9	4.4	4.6	7.0	5.7	6.3	5.7	4.9	5.3	35	39	54
95	5.1	4.4	4.8	6.9	6.1	6.1	5.6	4.9	5.3	44	29	45
96	5.3	4.5	4.9	7.5	6.2	6.4	7.0	5.8	6.4	30	77	50
97	5.2	4.4	4.9	7.5	6.4	6.5	6.3	5.4	5.9	12	48	44
98	4.8	4.1	4.5	6.8	5.8	5.9	6.0	5.1	5.6	10	60	47
99	5.0	4.3	4.7	7.2	5.8	6.1	5.6	4.7	5.2	25	28	47
00	5.4	4.6	5.0	6.7	6.1	6.0	6.4	5.7	6.1	20	76	48
01	5.1	4.7	4.9	7.7	6.8	6.7	7.5	6.8	7.0	14	90	56
Means												
85-00	5.2	4.5	4.9	7.2	6.1	6.5	6.2	5.4	5.8	25	52	50

TABLE 5. Forecasts of the 2002 Bristol Bay sockeye runs.

River system	District	Runs by age group (millions) 1.2	2.2	2-ocean	0.3	1.3	2.3	3-ocean	4-ocean	Total	Catch
Kvichak		0.5	0.6	1.1		0.7	0.2	0.9		2.0	
Naknek		0.4	0.6	1.0		1.4	0.9	2.3	0.2	3.5	
Branch		0.2	0.1	0.3		0.2	0.0	0.2		0.5	
	Naknek/Kvichak	1.1	1.3	2.4		2.3	1.1	3.4	0.2	6.0	2.7
	Egegik	0.4	3.4	3.8		0.4	0.7	1.1	0.0	4.9	3.9
	Ugashik	0.5	0.4	0.9		0.7	0.4	1.1	0.0	2.0	1.2
Wood		1.6	0.2	1.8		0.3	0.1	0.4	0.1	2.3	
Igushik		0.2	0.0	0.2		0.5	0.0	0.5	0.0	0.7	
Nush/Nuy		0.2	0.0	0.2	0.1	0.6	0.0	0.7	0.1	1.0	
	Nushagak	2.0	0.2	2.2	0.1	1.4	0.1	1.6	0.2	4.0	2.3
	Togiak	0.1	0.0	0.1		0.3	0.0	0.3	0.0	0.4	0.2
	Bristol Bay	4.1	5.3	9.4	0.1	5.1	2.3	7.5	0.4	17.3	10.3

TABLE 6. Bristol Bay sockeye runs (millions) by age group, 1958-2001 and forecasts for 2002.

Year	-ocean	Age 1.2	Age 2.2	Total 2-ocean	Age 1.3	Age 2.3	Total 3-ocean	4-ocean	Total	Catch
58		1.5	1.5	3.0	1.4	1.3	2.7		5.7	3
59		4.8	5.8	10.9	1.0	0.9	1.9		12.8	5
60		30.0	2.0	32.0	2.8	1.5	4.3		36.4	14
61	+	0.4	5.6	6.1	10.9	1.0	12.0	+	18.1	12
62	+	2.4	4.8	7.3	1.0	2.1	3.1	+	10.4	5
63	+	1.9	1.9	3.9	1.1	1.7	2.9	+	6.9	3
64	0.2	5.6	2.8	8.4	1.5	0.7	2.3	+	10.9	6
65	+	1.2	47.6	48.9	3.1	1.1	4.2	+	53.1	24
66	+	1.3	3.0	4.4	3.5	9.6	13.1	+	17.5	9
67	+	1.1	5.7	6.8	1.3	2.0	3.5	+	10.3	4
68	0.2	3.1	1.9	5.0	1.7	1.1	2.8	+	8.0	3
69	0.6	10.8	5.3	16.2	1.2	1.0	2.2	+	19.0	7
70	+	3.4	32.2	35.6	2.7	1.0	3.7	0.0	39.4	21
71	+	1.6	4.8	6.4	6.8	2.6	9.4	+	15.8	10
72	+	1.0	1.7	2.7	1.2	1.4	2.7	+	5.4	2
73	+	0.2	0.2	0.4	1.0	0.9	2.0	+	2.4	1
74	0.1	2.0	6.8	8.8	1.4	0.6	2.0	+	10.9	1
75	+	1.6	17.2	19.1	2.3	2.7	5.1	+	24.2	5
76	+	1.6	5.3	7.3	2.6	1.5	4.2	+	11.5	6
77	+	1.6	2.8	4.5	1.8	3.2	5.1	+	9.6	5
78	0.4	10.5	1.5	12.0	4.9	2.3	7.2	0.2	19.8	10
79	0.3	11.0	21.1	32.2	5.3	2.0	7.3	+	39.8	22
80	0.3	12.0	34.1	46.2	13.6	2.2	15.9	+	62.4	24
81	+	5.7	10.2	15.9	13.8	4.5	18.4	+	34.3	26
82	0.1	4.2	1.2	5.4	12.8	3.6	16.4	0.2	22.1	15
83	0.1	27.6	9.8	37.4	6.6	1.3	7.9	0.3	45.7	37
84	0.1	6.2	22.2	28.4	7.9	4.2	12.2	+	40.7	25
85	0.1	4.7	16.7	21.4	9.2	5.8	15.0	+	36.6	24
86	+	3.0	7.0	10.0	10.1	3.1	13.5	0.1	23.6	16
87	+	13.5	3.2	16.7	7.0	3.5	10.5	+	27.3	16
88	0.2	4.9	5.1	10.0	9.7	3.0	12.7	0.2	23.2	14
89	0.1	4.7	27.3	32.1	7.0	4.0	11.6	0.1	43.9	29
90	+	7.0	19.7	27.0	9.9	9.5	20.6	0.2	47.8	33
91	0.1	7.9	8.6	16.6	19.5	4.8	25.4	0.1	42.2	26
92	0.1	5.8	15.3	21.3	12.1	10.0	22.7	1.1	45.1	32
93	0.2	6.7	17.2	24.0	9.6	17.1	27.3	0.6	52.1	41
94	0.2	4.3	28.3	32.8	7.2	8.9	17.0	0.3	50.3	35
95	+	9.8	34.2	44.3	7.2	8.8	16.3	0.2	60.8	44
96	0.1	3.9	4.7	8.7	18.7	8.7	28.1	0.1	37.0	30
97	0.1	3.8	6.3	10.1	4.8	3.4	8.3	0.4	18.9	12
98	0.2	6.2	2.3	8.6	5.3	4.1	9.4	0.1	18.3	10
99	+	20.1	9.5	29.6	6.8	2.7	9.6	0.2	39.4	25
00	+	5.0	2.8	7.8	16.2	4.3	20.5	+	28.3	20
01	+	0.9	0.7	1.6	17.8	2.0	20.0	0.3	22.0	14
02		**4.1**	**5.3**	**9.4**	**5.1**	**2.3**	**7.5**	**0.4**	**17.3**	**10**
Means 1987-01	0.1	7.0	12.3	19.4	10.6	6.3	17.3	0.3	37.1	25

TABLE 7. Kvichak sockeye salmon statistics to forecast the 2002 run by freshwater age.

Brood year	Escapement Number millions	Escapement Percent age .2	Age 1 smolt Number millions	Age 1 smolt Mean weight	Adult return (millions) 1.1	1.2	1.3	Total	Smolt/ adult survival (%)	Mean length age 1.2
74	4.43	91	108	5.8	.009	6.14	1.93	8.08	7.5	501
75	13.14	96	78	5.5	.005	5.50	1.18	6.69	8.6	517
76	1.97	81	32	6.0	.005	5.04	.76	5.81	18.1	500
77	1.34	86	29	6.0	.039	1.82	.84	2.70	9.3	518
78	4.15	81	182	5.9	.000	1.66	1.09	2.75	1.5	513
79	11.22	90	220	5.4	.057	17.60	2.14	19.80	9.0	510
80	17.50	96	150	5.1	.002	2.81	1.49	4.30	2.9	478
81	1.75	82	7	4.9	.000	.77	.22	.99	14.1	523
82	1.14	65	52	6.8	.000	.44	.52	.96	1.8	528
83	3.57	93	24	5.3	.001	8.38	2.98	11.36	47.3	515
84	10.49	80	83	5.5	.000	2.46	1.87	4.33	5.2	512
85	7.21	68	11	4.5	.007	1.00	1.24	2.25	20.4	505
86	1.18	74	13	5.6	.000	.66	1.05	1.71	13.2	490
87	6.07	96	147	5.5	.004	4.04	2.38	6.42	4.4	493
88	4.06	56	47	5.8	.004	2.43	2.37	4.80	10.2	495
89	8.32	92	87	5.5	.002	2.01	1.56	3.57	4.1	511
90	7.00	91	18	5.6	.008	1.50	1.14	2.65	14.7	487
91	4.20	77	22	6.0	.001	2.59	1.23	3.82	17.4	506
92	4.73	77	54	5.7	.000	.41	.21	.62	1.1	517
93	4.05	69	210	6.2	.001	.79	.84	1.63	0.8	518
94	8.34	94	277	6.5	.003	1.75	1.12	2.87	1.0	506
95	10.04	87	269	6.8	.017	7.31	1.80	9.13	3.4	501
96	1.45	40	192	6.7	.000	.34	1.19	1.53	0.8	504
97	1.50	79	131	5.5	.000	.13	**.67**	0.8	0.6	524
98	2.30	78	106	5.8	.000	**.47**				

1) Age1.2= Mean return with no jacks and parent esc. less than 4 million (5 yrs)

2) Age 1.3= Mean return with less than 1 million age 1.2 (6 yrs)

Brood year	Escapement Number millions	Escapement Percent age .2	Age 2 smolt Number millions	Age 2 smolt Mean weight	Adult return (millions) 2.1	2.2	2.3	Total	Smolt/ adult survival (%)	Mean length age 2.2
74	4.43	91	114	10.1	.301	16.38	.72	17.40	15.3	528
75	13.14	96	213	7.8	.298	28.18	.55	29.03	13.6	508
76	1.97	81	26	10.3	.043	3.85	.24	4.13	15.9	532
77	1.34	86	10	10.7	.002	.18	.09	.27	2.7	531
78	4.15	81	32	10.2	.016	1.24	.80	2.06	6.4	524
79	11.22	90	89	9.1	.073	17.01	3.28	20.36	22.9	504
80	17.50	96	76	8.5	.020	7.79	.38	8.19	10.8	523
81	1.75	82	38	10.0	.000	.91	.16	1.07	2.8	536
82	1.14	65	2	9.2	.001	.50	.14	.64	32.1	521
83	3.57	93	53	10.4	.003	1.13	.54	1.67	3.2	533
84	10.49	80	330	7.0	.043	16.35	2.39	18.78	5.7	513
85	7.21	68	87	8.3	.028	13.08	1.51	14.62	16.8	497
86	1.18	74	7	10.0	.000	1.34	1.23	2.57	36.7	506
87	6.07	96	41	10.5	.030	4.24	.68	4.95	12.1	514
88	4.06	56	34	9.9	.019	4.02	.53	4.57	13.4	538
89	8.32	92	61	9.3	.117	18.47	3.24	21.83	35.8	502
90	7.00	91	205	8.2	.082	20.55	1.22	21.85	10.7	510
91	4.20	77	30	9.5	.002	.67	.16	.83	2.8	522
92	4.73	77	11	9.8	.002	.51	.14	.65	5.9	533
93	4.03	69	96	11.3	.001	.59	.55	1.14	1.2	520
94	8.34	94	94	10.7	.029	3.60	.24	3.87	4.1	518
95	10.04	87	103	11.9	.000	.47	.08	.55	0.5	524
96	1.45	40	12	10.5	.000	.02	**.25**	.27	2.3	532
97	1.50	79	24	9.5	.000	**.63**				

1) Age 2.2 =Average return when less than 3,000 age 2.1, jacks. The average since 1981 is .63 million for 8 years.

2) Age 2.3= .248 + .104 (age 2.2) F1,13 = 23 R^2 = .69

TABLE 8. Sockeye salmon escapements and returns to Naknek and Branch Rivers.

Naknek

Brood year	Escapement Number millions	Escapement % age .2	Smolt millions age 1	Smolt millions age 2	Adult return (millions) 1.1	1.2	1.3	1.4	2.1	2.2	2.3	Total	Mean length 1.2	Mean length 2.2
81	1.80	29	37	49	.004	.76	2.48	.01	.009	.46	1.46	5.18	475	502
82	1.16	13	32	13	.003	.18	.75	.02	.000	.21	.45	1.61	477	487
83	.89	65	6	19	.000	.14	.48	.00	.007	.32	.45	1.40	475	506
84	1.24	65	22		.001	.46	.88	.02	.023	1.17	1.76	4.31	480	491
85	1.85	58			.002	.64	3.41	.04	.020	1.26	1.40	6.77	471	472
86	1.98	21			.003	1.90	6.95	.35	.006	1.23	2.61	13.05	451	475
87	1.06	20			.000	.32	1.18	.09	.004	.53	3.11	5.23	461	476
88	1.04	48			.000	.27	.76	.04	.013	.47	.52	2.07	448	493
89	1.16	68			.001	.21	.87	.00	.005	1.13	.55	2.77	467	470
90	2.09	56		29	.001	.39	1.18	.01	.046	1.30	1.30	4.23	454	490
91	3.58	23	24	42	.013	.53	5.08	.04	.001	.24	.33	6.23	484	491
92	1.61	28	33		.000	.25	.52	.01	.001	.23	.32	1.33	460	503
93	1.54	21			.000	.27	1.27	.02	.012	.44	.62	2.63	486	480
94	.99	65			.006	.48	.57	.00	.015	.57	.51	2.15	464	482
95	1.11	59			.009	1.90	3.59	.06	.001	.31	.28	6.15	472	487
96	1.08	7			.001	.33	6.05	**.18**	.000	.08	**.89**	7.53	463	503
97	1.03	35			.000	.12	**1.38**		.009	**.59**		2.10	463	
98	1.20	53			.001	**.35**								

Age 1.2= Mean return from past years (4) with .001 age 1.1
Age 2.2= .37 + 24.7 (age 2.1) F1,14= 11.3 R^2= .45
Age 1.3= 2.62 + 2.47 (age 1.2) - .044 (%.2 esc) F2,13 = 8.4 R^2 = .59
Age 2.3= .90 + 1.78 (age2.2) - .022 (%.2 esc.) F2,13= 6.8 R^2= .53
Age 1.4= .034 (age1.3) - .02 R^2= .58

Branch River

Brood year	Escapement Number millions	Escapement % age .2	Adult return (millions) 1.1	1.2	1.3	2.1	2.2	2.3	Total
81	.08	49	.000	.05	.17	.000	.05	.01	.28
82	.24	15	.000	.17	.13	.000	.00	.00	.30
83	.10	85	.000	.14	.13	.000	.03	.00	.30
84	.22	37	.001	.15	.14	.000	.04	.02	.35
85	.12	30	.003	.35	.11	.000	.09	.01	.56
86	.23	64	.001	.33	.26	.000	.19	.01	.79
87	.15	63	.000	.15	.16	.000	.16	.08	.55
88	.19	60	.001	.15	.14	.000	.26	.04	.59
89	.20	79	.005	.33	.16	.002	.17	.16	.83
90	.17	85	.002	.26	.12	.000	.32	.00	.70
91	.28	69	.000	.19	.22	.004	.16	.00	.57
92	.22	75	.002	.09	.07	.000	.06	.01	.23
93	.35	76	.004	.12	.14	.000	.08	.05	.39
94	.24	84	.001	.15	.25	.002	.04	.04	.48
95	.22	83	.004	.67	.19	.000	.12	.02	1.00
96	.31	66	.003	.38	.30	.000	.01	**.02**	.71
97	.22	75	.002	.06	**.15**		**.06**		
98	.25	83	.002	**.24**					

Age 1.2= .13 + 54.8(age 1.1) F1,15= 6.8 .14 + .12
Age 1.2= .13 + 54.8 (age1.1) F1,15=6.8 R^2=.31
Age 2.2= Recent 5-year average
Age 1.3= .14 + .12 (age 1.2) R^2= .10
Age 2.3= .02 + .087 (Age 2.2) R^=.03

TABLE 9. Egegik sockeye salmon statistics to forecast runs by freshwater age.

Brood Year	Escapement Number millions	Escapement Percent age .2	Age 1 smolt Number millions	Age 1 smolt Mean weight	Adult return (millions) 1.1	1.2	1.3	1.4	Total	Smolt/ adult survival (%)	Mean length age 1.2
81	0.69	71	2	9.5	.000	.52	.95	.01	1.47	73.5	519
82	1.03	88	17	10.1	.002	1.01	1.79	.01	2.80	16.5	510
83	0.79	88	55	10.4	.002	1.72	2.69	.01	4.41	8.0	509
84	1.17	69	14	9.0	.001	.58	.93	.01	1.51	10.8	502
85	1.10	67	4	11.6	.000	.54	1.33	.01	1.87	46.8	511
86	1.15	74	36	10.2	.002	1.76	3.59	.09	5.35	14.9	483
87	1.27	54	72	8.9	.000	.86	4.34	.09	5.20	7.2	496
88	1.61	57	4	9.6	.001	.40	1.43	.00	1.83	45.7	472
89	1.61	58	5	10.3	.000	.59	.43	.00	1.02	20.4	522
90	2.19	70	6	9.7	.000	.40	.84	.00	1.24	20.7	480
91	2.79	56	20	9.3	.001	1.33	3.87	.05	5.20	26.0	502
92	1.94	63	55	9.7	.000	.32	1.04	.00	1.36	2.5	508
93	1.52	44	7	9.3	.002	.46	.53	.01	0.99	14.1	502
94	1.90	70	22	10.5	.008	.36	.94	.00	1.30	5.9	484
95	1.27	76	12	9.2	.007	3.05	3.10	.02	6.15	51.3	498
96	1.08	37	50	9.0	.001	.47	1.79	**.01**	2.26	4.5	490
97	1.10	69	1	9.5	.000	.03	**.35**		0.38	38.0	487
98	1.11	38	1	10.1	.000	**.42**					

Age 1.2= average return age 1.2 when smolt <10 and 0 age 1.1 (5 years).
Age 1.3= .29 + 1.02 (age1.2) + .027 (age 1 smolt) F2,13=12.4 R^2=.66
Age 1.4= average of past years with 1-2 million age 1.3

Brood Year	Escapement Number millions	Escapement Percent age .2	Age 2 smolt Number millions	Age 2 smolt Mean weight	Adult return (millions) 2.1	2.2	2.3	Total	Smolt/ adult survival (%)	Mean length age 2.2
81	0.70	71	32	12.2	.060	3.30	1.39	4.69	14.7	528
82	1.03	29	11	16.8	.012	1.74	1.59	3.33	30.3	529
83	0.79	88	30	15.7	.007	3.03	2.61	5.64	18.8	520
84	1.17	69	45	14.1	.083	6.17	4.74	10.91	24.2	524
85	1.10	67	13	14.3	.031	4.17	1.22	5.39	41.5	498
86	1.15	74	27	15.4	.010	3.79	4.21	8.00	29.6	502
87	1.27	54	52	14.5	.064	8.41	10.73	19.20	36.9	492
88	1.61	58	89	15.6	.063	10.24	5.48	15.78	17.7	520
89	1.61	54	18	12.4	.034	5.98	3.92	9.90	55.0	488
90	2.19	70	38	12.2	.065	9.28	4.61	13.89	36.6	512
91	2.77	56	39	13.7	.020	2.98	2.49	5.47	14.0	520
92	1.95	65	50	11.6	.053	4.51	2.80	7.36	14.7	502
93	1.52	44	8	16.1	.029	0.84	0.98	1.85	23.1	502
94	1.90	70	15	13.7	.065	4.13	3.03	7.23	48.2	500
95	1.27	76	29	13.7	.004	1.52	1.45	2.97	10.3	510
96	1.08	37	8	17.6	.005	0.51	**.66**	1.175	14.7	516
97	1.11	69	31	12.8	.019	**3.45**				

Age 2.2 = .33 + 49.8 (age 2.1) + .07 (age 2 smolt) F2,13=15.4 R^2= .70
Age 2.3 = .32 + .66 (age2.2) F1,13 = 17.4 R^2 = .57

TABLE 10. Ugashik sockeye salmon statistics to forecast runs by freshwater age.

Brood year	Escapement Number millions	Escapement Percent age .2	Age 1 smolt Number millions	Age 1 smolt Mean weight	Adult return (millions) 1.1	1.2	1.3	1.4	Total	Smolt/ adult survival (%)	Mean length age 1.2
81	1.33	42	31	7.6	.002	1.51	2.51	.01	4.02	13.0	514
82	1.16	20	75	6.8	.001	.41	.69	.01	1.10	1.5	514
83	1.00	90	13	8.3	.000	.60	.34	.00	0.94	7.2	512
84	1.24	81	38	5.8	.000	.45	.55	.01	1.00	2.6	512
85	1.00	75	6	7.9	.001	.49	.69	.00	1.18	19.7	507
86	1.00	41	183	5.7	.001	.48	2.38	.07	2.86	1.6	488
87	0.67	56	89	6.5	.001	.81	1.55	.02	2.36	2.7	502
88	0.64	54	15	6.7	.002	.45	.67	.04	1.12	7.5	498
89	1.68	84	26	7.7	.007	.66	.37	.01	1.04	4.0	517
90	0.73	60			.001	.34	.67	.00	1.01		488
91	2.48	57	58	8.0	.006	1.93	3.08	.01	5.02	8.6	504
92	2.17	49	24	6.7	.003	.18	.54	.00	0.72	3.0	498
93	1.41	48	7	7.8	.002	.24	.32	.00	0.56	8.0	490
94	1.08	79	1	9.9	.011	.32	.31	.01	0.64	53.4	488
95	1.30	80	14	7.8	.018	2.71	1.51	.02	4.24	29.6	509
96	0.67	16	10	6.4	.000	.22	.98	**.02**	1.20	11.7	499
97	0.62	65	11	6.6	.000	.23	**.67**		0.90	8.2	507
98	0.92	45	2	8.4	.001	**.49**					

Age 1.2 = .39 + 97 (age 1.1) F1,14= 11.3 R^2 = .45
Age 1.3 = .49 + .787 (age 1.2) F1,14 = 9.4 R^2 = .40

Brood year	Escapement Number millions	Escapement Percent age.2	Age 2 smolt Number millions	Age 2 smolt Mean weight	Adult return (millions) 2.1	2.2	2.3	Total	Smolt/ adult survival (%)	Mean length age 2.2
79	1.70	53			.008	1.39	.52	1.91		502
80	3.32	59	13	13.3	.039	3.19	.78	3.97	30.5	520
81	1.33	42	83	10.3	.004	2.20	.90	3.10	3.7	524
82	1.16	22	21	11.8	.001	.58	.72	1.30	6.2	517
83	1.00	90	15	10.9	.006	.59	.30	.89	5.9	528
84	1.24	80	21	11.1	.054	3.50	.69	4.24	20.2	523
85	1.00	75	33	10.8	.002	.95	.46	1.41	4.3	504
86	1.00	41	32	10.7	.001	1.83	1.63	3.46	10.8	506
87	0.67	56	39	11.8	.010	1.78	2.26	4.04	10.4	499
88	0.64	58	48	11.6	.026	2.03	2.18	4.24	8.8	527
89	1.68	84			.014	2.43	.93	3.37		490
90	0.73	61	12	12.5	.015	2.23	1.18	3.43	27.6	517
91	2.48	57	6	11.2	.001	.57	.30	.87	15.3	512
92	2.17	49	15	11.1	.004	.88	.74	1.62	10.6	506
93	1.41	48	1	13.5	.006	.23	.20	.44	31.1	508
94	1.08	79	1	12.7	.012	.67	.27	.95	79.3	509
95	1.30	80	2	11.1	.001	.17	.08	.25	10.9	516
96	0.67	16	<1	19.6	.000	.04	**.43**	.47		519
97	0.62	65	9	11.8	.000	**.44**				

Age 2.2 = .24 + 49.9 (age 2.1) + .022 (age2 smolt) F2,12 = 29.8 R^2 = .83
Age 2.3 = .43 + .018 (age 2 smolt) F1,12 = 5.6 R^2 = .32

TABLE 11. Sockeye salmon escapements and returns to the Wood and Igushik rivers.

Wood River

Brood year	Escapement Number millions	Escapement Percent age .2	Temperatures for Fry Apr-Oct	Temperatures for Smolt Apr-June	Adult return (millions) 1.1	1.2	2.2	1.3	1.4	2.3	Total	Mean length of 1.2
81	1.23	37	5.4	7.0	.000	.60	.08	1.14	.00	.09	1.91	490
82	.98	34	7.5	4.9	.003	.50	.13	.90	.01	.02	1.55	501
83	1.36	75	6.8	1.8	.001	1.91	.02	1.23	.00	.07	3.23	495
84	1.00	22	5.0	4.3	.000	.52	.03	1.32	.02	.02	1.89	502
85	.94	49	6.7	4.9	.003	1.11	.03	1.37	.00	.01	2.52	501
86	.82	36	7.5	5.3	.002	1.16	.07	1.94	.01	.06	3.23	480
87	1.34	82	6.9	6.1	.000	1.36	.09	.74	.01	.09	2.28	486
88	.87	37	8.3	6.9	.001	1.59	.09	1.39	.01	.03	3.10	482
89	1.19	49	7.8	6.1	.004	2.17	.01	1.82	.00	.04	4.04	496
90	1.07	50	8.0	5.4	.001	1.08	.28	1.15	.00	.16	2.67	477
91	1.16	36	6.5	8.2	.012	2.53	.05	2.43	.06	.07	5.08	496
92	1.29	73	9.1	6.5	.001	2.32	.09	1.60	.00	.05	4.06	495
93	1.18	59	7.5	7.6	.000	1.67	.13	.98	.00	.19	2.97	491
94	1.47	52	8.7	6.8	.010	2.77	.43	1.93	.00	.09	5.22	488
95	1.48	73	7.1	8.0	.005	3.37	.14	2.51	.06	.03	6.05	501
96	1.65	49	8.7	6.1	.000	2.54	.00	3.58	**.07**	**.09**	6.21	502
97	1.51	56	7.5	4.6	.000	.17	**.16**	**.31**			.64	529
98	1.76	70	6.4	5.7	.003	**1.57**						

Age 1.2 = 158 (age 1.1) + .027 (%age .2 in esc.) - .79 F2,14= 8.6 R^2=.55
Age1.3 = 1.40 + .807 (age 1.2) - .022 (%age .2 in esc) F2,13 = 13.7 R^2 = .68
Age 2.2= recent 5-year average
Age 2.3= recent 5-year average
Age 1.4 = .026 (age1.3) - .027 R^2= .46

Igushik

Brood Year	Escapement Number millions	Escapement Percent age.2	Mean air temp. for: Fry Apr-Oct	Mean air temp. for: Smolt Apr-June	Adult returns (millions) 1.2	2.2	1.3	1.4	2.3	Total	Mean length of 1.2
81	.59	24	5.4	7.0	.15	.00	.83	.00	.05	1.03	512
82	.42	5	7.5	4.9	.05	.01	.48	.00	.01	.55	548
83	.18	73	6.8	1.8	.15	.01	.33	.00	.03	.52	508
84	.19	9	5.0	4.3	.03	.05	.63	.01	.03	.75	525
85	.21	37	6.7	4.9	.51	.08	.90	.01	.08	1.58	525
86	.31	7	7.5	5.3	.23	.03	2.20	.02	.03	2.51	494
87	.17	40	6.9	6.1	.16	.01	.57	.01	.03	.78	516
88	.17	12	8.3	6.9	.19	.04	1.02	.00	.04	1.29	503
89	.46	49	7.8	6.1	.48	.06	1.05	.01	.05	1.65	519
90	.37	25	8.0	5.4	.16	.18	1.36	.00	.15	1.85	494
91	.76	6	6.5	8.2	.31	.00	1.31	.01	.02	1.65	507
92	.31	26	9.1	6.5	.04	.01	.13	.00	.02	.20	517
93	.41	31	7.5	7.6	.12	.02	.29	.00	.04	.47	507
94	.45	27	8.7	6.8	.24	.09	.84	.00	.03	1.20	488
95	.47	30	7.1	8.0	.65	.02	1.60	.02	.01	2.30	512
96	.40	3	8.7	6.1	.16	.00	1.24	**.01**	**.02**	1.43	516
97	.13	52	7.5	4.6	.03	**.03**	**.54**			.60	520
98	.22	41	6.4	5.7	**.24**						

Age 1.2 = Recent 5-year average
Age 2.2 = Recent 5-year average
Age 1.3 = .49 + 1.67 (age1.2) R^2= .52
Age 2.3 = .017 + .62 (age2.2) F1,13 = 36 R^2 = .74

TABLE 12. Sockeye salmon escapements and returns to the Nushagak and Togiak Rivers.

Nushagak/Nuyakuk

Brood year	Escapement Number millions	Escapement Percent age .2	Adult return (millions) 0.2	0.3	0.4	1.2	1.3	1.4	Total	Mean length 1.2	1.3
81	1.01	13	.01	.12	.01	.16	1.43	.06	1.79	487	554
82	.60	7	.04	.33	.05	.16	.85	.06	1.49	497	572
83	.40	35	.10	.57	.12	.11	.62	.02	1.54	502	570
84	.59	16	.01	.22	.03	.12	.55	.02	.95	493	568
85	.50	48	.06	.49	.06	.06	.59	.01	1.27	459	558
86	.99	6	.06	.83	.06	.11	.67	.21	1.94	471	554
87	.39	28	.14	.92	.25	.04	.52	.10	1.97	462	541
88	.48	16	.07	.52	.12	.21	1.39	.06	2.37	468	573
89	.50	14	.07	.47	.03	.12	.66	.02	1.37	480	555
90	.67	22	.05	.75	.10	.04	.24	.01	1.19	454	556
91	.50	5	.01	.13	.01	.17	.99	.12	1.43	461	569
92	.70	31	.08	.49	.01	.22	.59	.05	1.44	486	563
93	.72	11	.04	.03	.00	.06	.68	.12	.93	474	546
94	.51	6	.00	.04	.00	.08	.66	.01	.79	456	565
95	.28	39	.00	.01	.00	.14	.90	.10	1.15	462	559
96	.50	18	.00	.00	.00	.47	1.75	**.08**	2.30	501	590
97	.37	9	.00	.13	**.03**	.07	**.60**		0.83	444	
98	.46	8	.00	**.08**		**.16**					

Age 1.2 = Recent 5-year average
Age 1.3= .38 + 3.08 (age1.2) F1,14= 26 R^2 .65
Age 0.3 = .08 + 6.64 (age 0.2) F 1,15= 34 R^2= .69
Age 0.4 = .016 + .128 (age 0.3) F1,14= 9.7 R^2 = .41
Age 1.4 = Recent 5-year average

Togiak

Brood year	Escapement Number millions	Escapement Percent age .2	Adult Return (millions) 0.2	0.3	1.2	1.3	2.2	2.3	1.4	Total	Mean length 1.2	1.3
81	.31	19	.002	.01	.05	.24	.01	.02	.00	.33	501	568
82	.29	30	.000	.02	.11	.24	.01	.02	.01	.40	513	579
83	.21	28	.001	.00	.28	.91	.01	.02	.00	1.22	516	586
84	.15	41	.000	.01	.02	.11	.00	.02	.00	.16	520	583
85	.15	20	.000	.01	.03	.21	.04	.08	.00	.37	513	579
86	.20	27	.000	.03	.08	.44	.08	.11	.01	.74	504	572
87	.28	39	.000	.01	.19	.53	.03	.08	.01	.84	514	567
88	.31	73	.001	.01	.11	.39	.03	.05	.00	.59	515	592
89	.10	3	.000	.04	.12	.31	.01	.04	.00	.52	522	561
90	.19	24	.001	.02	.10	.43	.07	.04	.01	.66	495	570
91	.28	41	.001	.00	.18	.42	.03	.03	.01	.66	516	589
92	.20	23	.001	.03	.05	.11	.03	.03	.00	.25	525	581
93	.19	24	.000	.00	.06	.25	.01	.02	.00	.34	512	561
94	.17	45	.000	.00	.04	.16	.03	.01	.00	.24	515	552
95	.21	36	.000	.00	.33	.97	.03	.16	.01	1.49	498	584
96	.19	20	.001	.00	.08	.99	.00	**.02**	**.01**	1.09	522	588
97	.15	49	.000	.01	.04	**.25**	**.02**			.32	520	
98	.18	22	.000		**.11**							

Age 1.2 = Recent 5-year average
Age 1.3= .158 + 2.24 (age1.2) F1,14= 17.5 R^2= .56
Age 2.2 = Recent 5-year average
Age 2.3 = .022 + .768(Age2.2) F1,13 = 7.2 R^2= .36