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FORECASTS OF THE 1998 SOCKEYE SALMON RUNS TO BRISTOL BAY

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ANNUAL REPORT TO

BRISTOL BAY PROCESSORS

Acknowledgments

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Key Words

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

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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 20 years, the largest annual catches of sockeye salmon (*Oncorhynchus nerka*) in the major Alaskan fisheries have all been more than ten 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 and 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 1997 season and forecasts of the 1998 sockeye salmon runs to Bristol Bay, which are based mostly on preliminary statistics provided by ADF&G.

REVIEW OF THE 1997 RUN

Forecasts and Actual Runs

The FRI prediction of total run to Bristol Bay in 1997 was 35 million with a 25 million catch, and the ADF&G predictions were nearly the same at 34 and 25 million (Table 1). The ADF&G forecasts resulting from its statistical analyses were increased by ~33% to adjust for a recent tendency to underforecast the runs (Geiger and Simpson 1995). Therefore, ADF&G's database for the 1997 forecast actually indicated a somewhat lower run than forecast by FRI. The total 1997 run and catch (19 and 12 million, respectively) as well as most individual district runs were much less than the preseason forecasts from both agencies.

The catch of 12.3 million was 50% of the predicted catch and the smallest for Bristol Bay since 1978. For the past 10 years, 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 1997, the forecasts differed from the actual catch by 107% and 102% and thus were the most inaccurate forecasts made since 1990, when forecasts were only about one half of the actual catch. In 1990, however, the inseason forecast from Port Moller correctly forecast that a much larger run was on the way.

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 15%)

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 1997 season, a Bristol Bay almanac was provided to processors so they could make daily forecasts of the final 1997 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 1997 (June 20), the test boat catches and ocean temperatures indicated that the run was going to be large and a little earlier than average (Table 2). The sockeye salmon at Port Moller were larger than average, which indicated that the 1997 indices may be causing overestimation of abundance. Adjusting for the average length of the fish produced a run forecast of between 30 and 40 million. An independent forecast of the run size was provided by the average lengths of the sockeye by age and sex. This also produced a run forecast of between 30 and 40 million. The age composition from Port Moller scale samples through June 30 indicated a shortage of age 1.2 sockeye; however, in later samples this age group increased and, by the end of sampling (July 8), the age composition at Port Moller agreed with the age composition in the preseason forecasts and in the actual run (Table 3).

The Fisheries

The Port Moller program indicated that the 1997 run was going to be large and approximately 2 days early in timing. The catches in the False Pass June fisheries were also consistent with a run of 30-40 million. The first major catch in Bristol Bay was made on June 23 in the Egegik fishery, and the Egegik run was about 2 days early at the beginning (25% date); however, the mid-point of the run was on the average date of July 3. Total daily catches only reached 1 million on July 5, and the 50% point for the total catch was also reached on July 5, the recent average date. The Naknek–Kvichak runs were very weak and no fishing occurred during July 3-8. The Nushagak fishery did not begin until July 1, and most of the fishery after July 9 was in the Wood River, which had the only run that came close to the forecast. The timing of the Naknek–Kvichak and Nushagak runs was one-half day later than average. Management of the 1997 runs was generally very good, with excess escapement occurring only in the Nushagak fishery (Wood River). The Kvichak escapement was again quite small (1.5 million) relative to the goal of 4 million; however, this should have little impact on future Kvichak runs because the 1996 and 1997 smolt migrations and the 1994 and 1995 escapements were large.

Physical conditions in Bristol Bay during the 1997 run were very unusual. Water flows were the lowest recorded and water temperatures were the warmest recorded for this period of time (June 20–July 20). Preseason forecasts, the two forecasts from Port Moller (catch and fish length), and the catches at False Pass all indicated a run between 30 and 40 million. Since the total catch plus escapement was only 19 million, there was reason to believe that an unusually high mortality occurred between Port Moller and the Bristol Bay fishing districts.

Fish Size

The sockeye salmon caught in Bristol Bay in 1997 averaged 5.9 lb (2.6 kg) and were close to the average for recent years (Table 4). This was caused by an average percentage of 3-ocean fish (48%) and average sizes of 3-ocean fish (Fig. 2). The body size of Bristol Bay sockeye salmon is inversely related to the number of fish in the run (large run, small fish), and it is 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 1997 and, combined with a run of only 19 million, should have resulted in much larger sockeye salmon than observed. The 2-ocean sockeye were especially small considering these conditions.

FORECASTS FOR 1998

The statistics used to forecast the 1998 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 US 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 3 brood years (1992–94) that will contribute to the 1998 run was generally favorable (Fig. 3).

Run predictions were made for each major age group (usually 4) 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 1998, all relevant statistics from past brood years (since 1981) were assembled and submitted to a stepwise multiple regression procedure. The forecast data base included adjusted 1997 returns. The 1997 returns were expanded by a factor of 1.8 (34/19) on the assumption that there was a loss of fish in Bristol Bay that did not affect the immature fish in the North Pacific (fish due to return in 1998). However, in forecasting the 1998 runs, the actual return of an age group in 1997 was used. When no measurement (variable) was significantly correlated with past variation in a run, then the average runs for the past 5 years were used to predict the 1998 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 1998 than earlier observations. An exception to this was in the forecast of age 1.2 returns to Kvichak (which has mainly 2-ocean fish). Here, I used statistics starting with the 1974 brood year (1978 run) because recent years did not provide a statistically significant forecast and a 5-year average was not appropriate.

The forecast of the total 1998 Bristol Bay sockeye salmon run is 33.8 million with a predicted catch of 23.5 million (Table 5). If expanded 1997 returns were used to forecast the 1998 runs, the total forecast would be 44 million with a catch of 32 million. Over the past 5 years, there have been large runs of 3-ocean fish, especially 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 1997, so we might expect a larger return of 3-ocean fish in 1998 from the small return of 2-ocean fish in 1997.

The databases and forecast statistics are presented in Tables 7–12. There were unusually large returns of age 1.1 jacks to Naknek, Egegik, Ugashik, and Wood River; however, the Kvichak, which is expected to have the largest run of age 1.2 from the large smolt migration, had relatively few jacks in 1997. The run to Egegik in 1998 is expected to be similar to the 1997 run whereas the runs to the other systems are expected to be larger in 1998 than what actually showed up in 1997 (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. It is felt that the inaccurate forecast in 1997 was caused by very unusual conditions that are unlikely to occur again in the near future.

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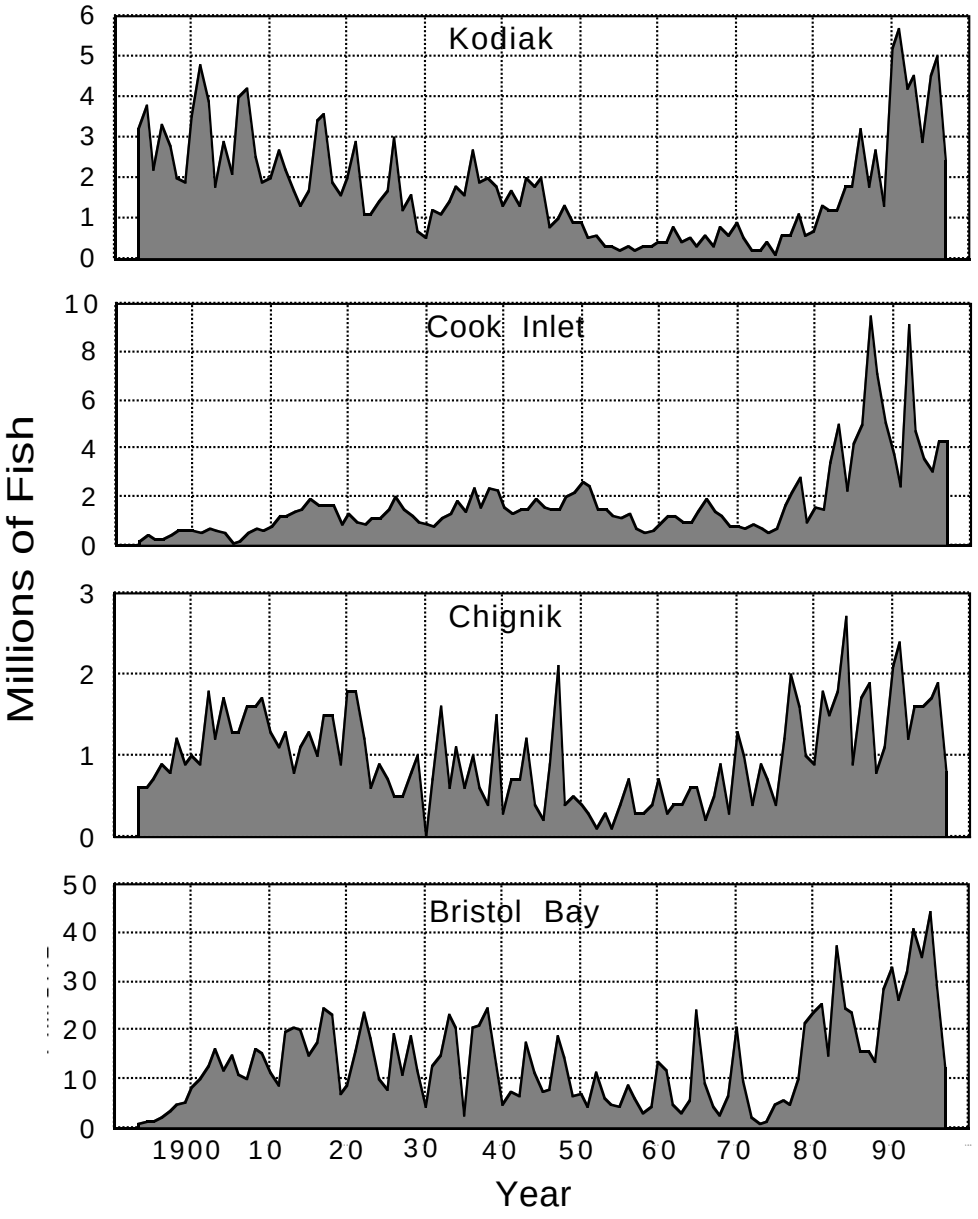

Figure 1. Annual commercial catches of sockeye salmon in the major Alaskan fisheries, 1893–1997.

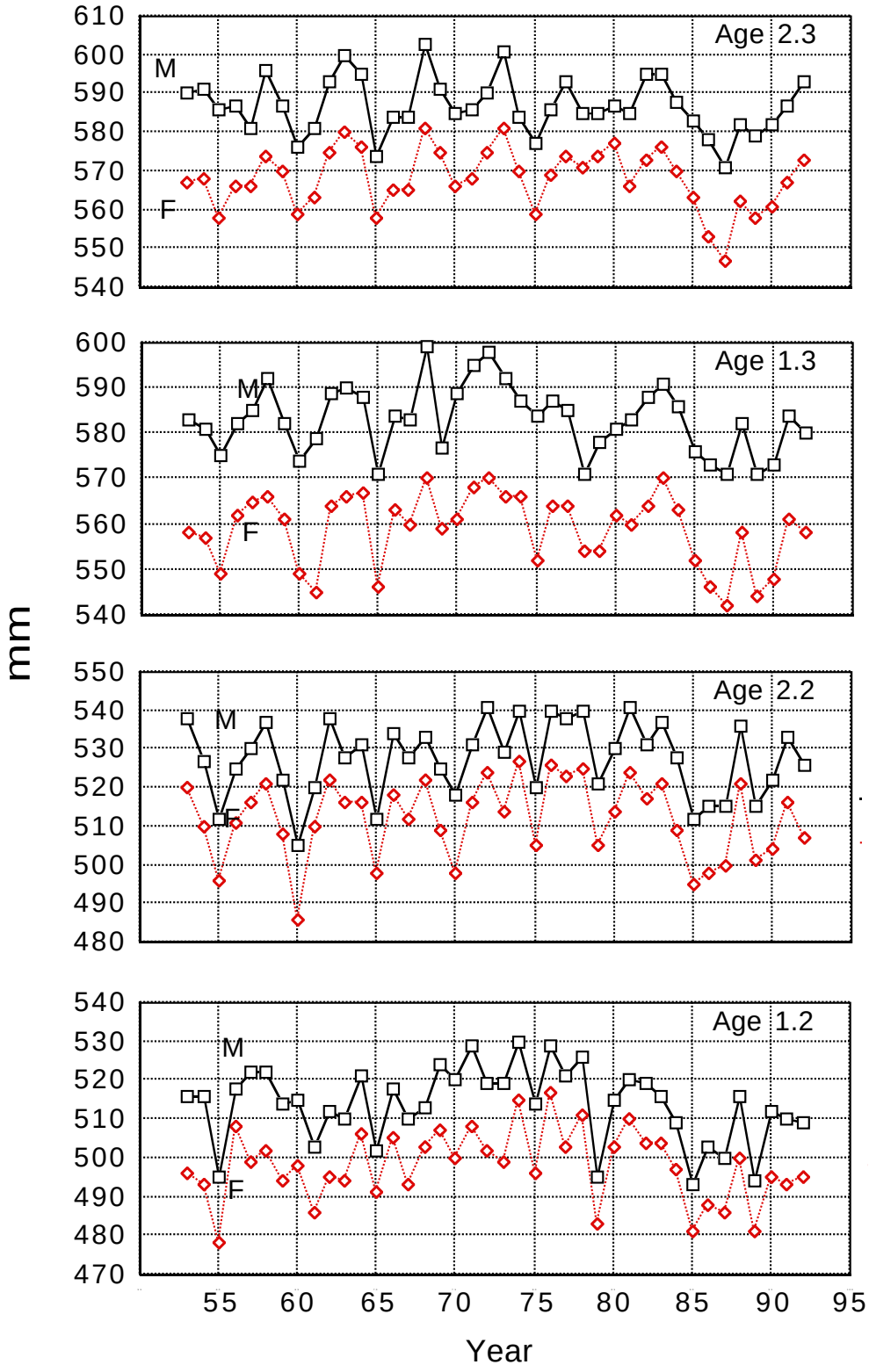

Figure 2. Annual mean lengths by age and sex for sockeye salmon in the Bristol Bay runs, 1958–97.

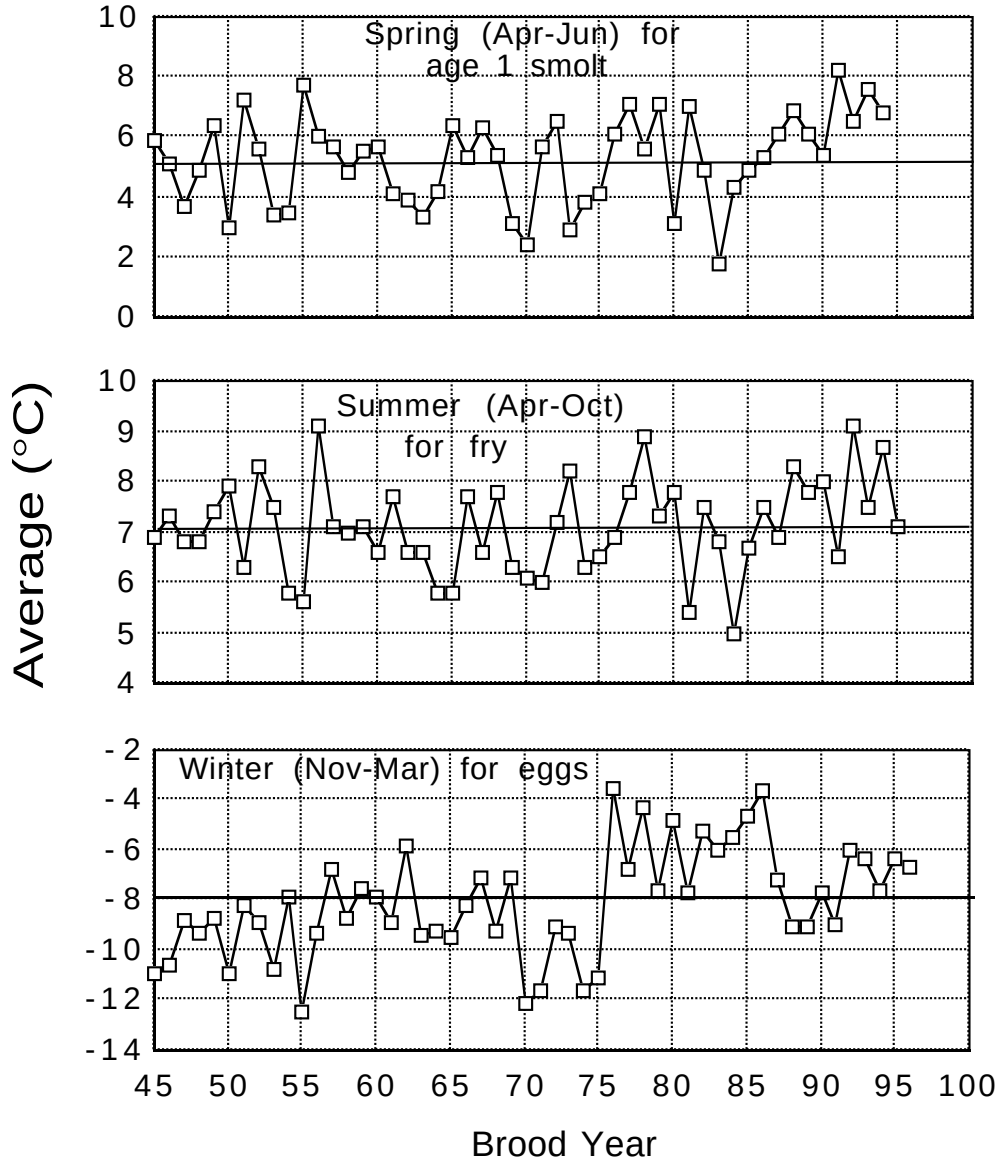

Figure 3. Air temperatures in Bristol Bay for sockeye salmon brood years, 1945–94.

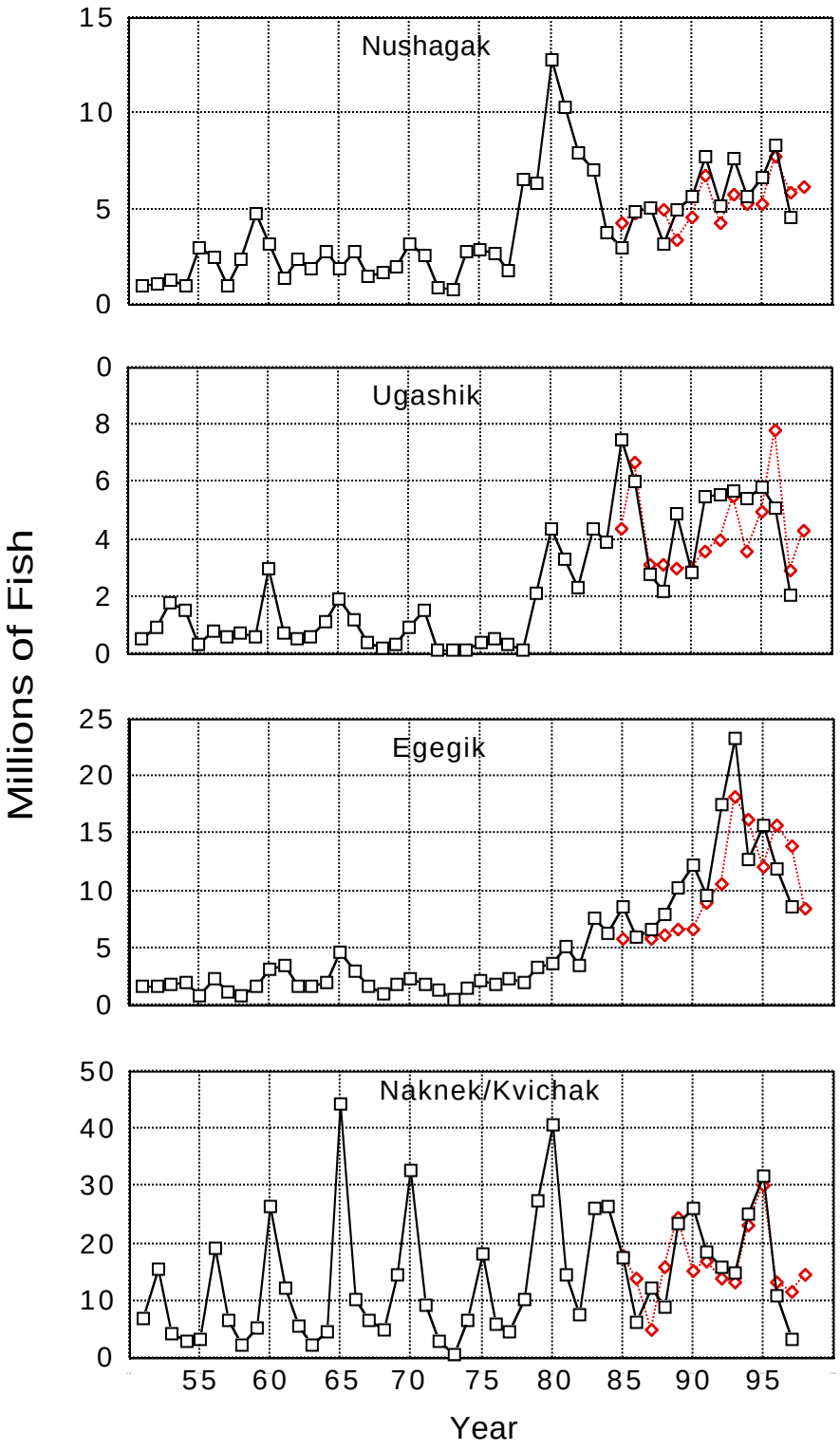

Figure 4. Sockeye salmon runs to the four major Bristol Bay fishing districts, 1951–97, and the FRI preseason forecasts, 1985–98. Symbols: □ = run; ◇ = forecast.

Table 1. Forecasts and actual runs to Bristol Bay, 1990–97.

		Pre-season forecasts							
		ADF&G		FRI		Actual		Port Moller forecast (7/2-6)	
Year	District	Run	Catch	Run	Catch	Run	Catch	Run	Catch
1990	Nak/Kvi	13.0	5.8	15.3	8.1	26.4	17.1	23.0	14.0
	Egegik	5.6	4.6	6.6	5.5	12.3	10.1	8.0	6.5
	Ugashik	3.1	2.4	3.0	2.3	2.9	2.1	3.0	2.0
	Nushagak	3.4	1.7	4.6	3.0	5.7	3.6	4.0	2.5
	Togiak	0.3	0.2	0.3	0.1	0.4	0.2	0.5	+
	TOTAL	25.4	14.7	29.8	19.0	47.6	33.1	38.5	25.0
1991	Nak/Kvi	14.1	8.9	17.0	9.5	18.6	10.6	17.0	7.0
	Egegik	8.2	7.2	8.9	7.8	9.6	6.8	7.0	5.0
	Ugashik	3.5	2.8	3.6	2.7	5.5	3.0	5.0	4.0
	Nushagak	3.8	2.1	6.8	4.8	7.7	5.3	8.0	4.5
	Togiak	0.4	0.2	0.4	0.2	0.8	0.5	+	+
	TOTAL	30.0	21.2	36.7	25.0	42.2	26.2	37.0	20.5
1992	Nak/Kvi	16.9	9.7	13.8	7.2	15.9	9.4	14.0	8.0
	Egegik	10.7	9.7	10.4	9.0	17.5	15.7	16.0	14.0
	Ugashik	4.3	3.6	4.0	3.0	5.5	3.4	5.0	4.0
	Nushagak	4.6	2.9	4.3	2.5	5.2	2.9	5.0	3.0
	Togiak	0.6	0.4	0.5	0.3	1.0	0.7	0.5	+
	TOTAL	37.1	26.3	33.0	22.0	45.1	32.0	41.0	29.0
1993	Nak/Kvi	15.5	9.3	13.1	6.9	14.6	8.9	12.0	7.0
	Egegik	15.8	14.8	18.2	16.2	23.3	21.8	18.5	17.0
	Ugashik	4.9	4.2	5.5	4.5	5.7	4.3	5.0	4.0
	Nushagak	5.1	3.3	6.0	4.0	7.6	5.3	6.0	4.0
	Togiak	0.5	0.4	0.5	0.3	0.7	0.5	0.5	0.3
	TOTAL	41.8	32.0	43.3	31.9	51.9	40.8	42.0	32.3
1994	Nak/Kvi	22.5	13.3	23.1	13.1	25.6	16.3	25.2	14.0
	Egegik	18.5	17.5	16.2	14.2	12.7	10.8	11.3	10.0
	Ugashik	5.5	4.8	3.6	2.9	5.4	4.4	3.0	2.0
	Nushagak	5.5	3.8	5.3	3.5	5.9	3.4	5.0	3.0
	Togiak	0.5	0.4	0.6	0.4	0.5	0.3	0.5	0.3
	TOTAL	52.5	39.7	48.8	34.1	50.1	35.2	45.0	29.3
1995	Nak/Kvi	30.8	19.6	30.2	17.7	31.8	20.4	25.1	13.8
	Egegik	13.1	12.1	12.1	10.0	15.7	14.5	13.0	11.5
	Ugashik	5.4	4.7	5.0	3.4	5.8	4.5	5.0	4.0
	Nushagak	5.3	3.5	5.3	3.0	6.7	4.4	5.6	3.6
	Togiak	0.5	0.4	0.5	0.3	0.8	0.6	0.5	0.3
	TOTAL	55.1	40.3	53.1	34.4	60.8	44.4	49.2	33.2
1996	Nak/Kvi	13.9	8.7	13.2	7.5	11.0	8.2	11.5	8.0
	Egegik	16.9	15.9	15.7	13.8	11.9	10.8	15.0	14.0
	Ugashik	6.2	5.5	7.8	6.1	5.1	4.4	6.4	5.5
	Nushagak	5.8	4.1	7.7	5.4	8.3	5.8	7.7	5.7
	Togiak	0.6	0.4	0.8	0.6	0.7	0.5	0.6	0.4
	TOTAL	43.4	34.6	45.2	33.4	37.0	29.7	41.2	33.6
1997	Nak/Kvi	10.8	5.6	11.9	6.3	3.4	0.6	4.6	0.8
	Egegik	12.8	11.8	13.9	12.9	8.7	7.6	10.5	9.5
	Ugashik	3.8	3.1	2.9	2.1	2.0	1.4	5.2	3.0
	Nushagak	5.7	3.9	5.9	3.8	4.6	2.6	5.0	4.0
	Togiak	0.5	0.4	0.5	0.3	0.2	0.1	0.4	0.2
	TOTAL	33.6	24.8	35.1	25.4	18.9	12.3	25.7	17.5

Table 2. Summary of 1997 Bristol Bay sockeye inseason forecasts from the Port Moller test boat.

Date	Forecast from almanac	Date issued	Comment
June			
11		11	Pacific temperatures predict 97 run will be 2 days early but not as early as 79 and 93 runs
18			
19			
20	38.5	20	Average lengths indicate about 60% 3-ocean fish in PM catches or 52% 3-ocean in BB run
21	38		
22	38		
23	38		
24	38	24	Although PM is forecasting 38 million I believe the run will be closer to 30 million
25	39		because of the shortage of age 1.2 and the larger than average size of fish at PM
26	38		
27	40	27	Port Moller index plus age composition forecasts a run of 35 million and the avergae
28	42		lengths in the PM catches forecasts 34 million
29	41		
30	41	30	It looks like the run will be in the mid-30's; however, a poor showing in BB so far (3+).
1	41		Fish may be holding up between PM and BB, perhaps from the record warm temperatures.
2	41		When they do come in they should be concentrated in a few days.
3	42		
4	42		
5	43		
6	42		
7	44	7	Record high temperatures in the lakes; salmon already entering spawning streams-- 3 weeks
8			earlier than normal
9		9	BB run forecasted to be 25.7 million with a 17.5 million catch from C+E through 7/9 and
10			PM age composition
Final run = 19			Run timing was average
catch = 12			Run contained 46% 3-ocean and 4-ocean sockeye

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)
1990	ADF&G	19	42	26	13	61	39	25.4
	FRI	16	40	28	16	56	44	29.8
	False Pass	16	37	20	25	53	45	
	Port Moller	10	37	24	26	48	52	56.0
	BB run	14	41	21	20	56	43	47.8
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

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 in the Bristol Bay commercial catches, 1960–97.

	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
Means												
85-96	5.2	4.6	4.9	7.3	6.2	6.7	6.2	5.4	5.8	28	51	51

Table 5. Forecasts of the 1998 Bristol Bay sockeye runs.

		Runs by age group (millions)								
River system	District	1.2	2.2	2-ocean	0.3	1.3	2.3	3-ocean	Total	Catch
Kvichak		5.7	3.7	9.4		0.6	0.4	1.0	10.4	
Naknek		0.3	0.7	1.0		1.3	1.2	2.5	3.5	
Branch		0.2	0.2	0.4		0.1	0.1	0.2	0.6	
	Naknek/Kvichak	6.2	4.6	10.8		2.0	1.7	3.7	14.5	8.2
	Egegik	0.8	3.3	4.1		1.0	3.3	4.3	8.4	7.4
	Ugashik	1.2	0.9	2.1		1.5	0.7	2.2	4.3	3.3
Wood		2.6	0.1	2.7		1.6	+	1.6	4.3	
Igushik		0.2	0.1	0.3		0.8	0.0	0.8	1.1	
Nush/Nuy		0.1	0.0	0.1	0.2	0.5	0.0	0.7	0.8	
	Nushagak	2.9	0.2	3.1	0.2	2.9	0.0	3.1	6.2	4.4
	Togiak	0.1	0.0	0.1		0.3	+	0.3	0.4	0.2
	Bristol Bay	11.2	9.0	20.2	0.2	7.7	5.7	13.6	33.8	23.5

+ indicates less than 100,000 predicted

Table 6. Bristol Bay sockeye runs by age group, 1958–97 and forecasts for 1998.

Year	1-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		**11.2**	**9.0**	**20.2**	**7.7**	**5.7**	**13.6**		**33.8**	**24**
Means 1987-96	0.1	6.9	16.4	23.4	10.8	7.8	19.2	0.3	43.0	30

Table 7. Kvichak sockeye salmon statistics for forecasting 1998 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	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	**.58**			518
94	8.34	94	277	6.5	.003	**5.66**				

1) 98 forecast of age 1.2 from return of age 1.1 (.003) and number of smolt (277) for 1974-93. R^2=.53; F2,17= 9.7 Y=1.06 +166.6(age 1.1) +.0148(smolt)

2) 98 forecast of age 1.3 from return of age 1.2 (.79) and mean length of age 1.2 (518) for 1981-92. R^2=.81; F2,10= 21.8 Y=11.2+.326(age 1.2)-.021 (1.2 length)

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	**.40**			533
93	4.03	69	96	11.3	.001	**3.69**				

1) 98 forecast of age 2.2 from return of 2.1 (.001) and number of age 2 smolt (96), 1981-91. R^2= .93; F2,9= 63.3 Y= .28 + 147.7(age 2.1) + .034 (age 2 smolt)

2) 98 forecast of age 2.3 from return of age 2.2 (.51) and regression for 1981-90. R^2=.65; F1,9=16.8 Y= .35 + .098 (age 2.2)

Table 8. Sockeye salmon escapements and returns to the 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	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	.008	.46	1.46	5.17	475	502
82	1.16	13	32	13	.003	.18	.75	.000	.21	.45	1.59	477	487
83	.89	65	6	19	.000	.14	.48	.007	.32	.45	1.40	475	506
84	1.24	65	22		.001	.46	.88	.022	1.17	1.76	4.29	480	491
85	1.85	58			.002	.64	3.41	.019	1.26	2.68	8.01	471	472
86	1.98	21			.003	1.90	6.95	.006	1.23	2.61	12.70	451	475
87	1.06	20			.000	.32	1.18	.004	.53	3.11	5.14	461	476
88	1.04	48			.000	.27	.76	.013	.47	.52	2.03	448	493
89	1.16	68			.001	.21	.87	.005	1.13	.55	2.77	467	470
90	2.09	56		29	.001	.39	1.18	.046	1.30	1.30	4.22	454	490
91	3.58	23	24	42	.013	.53	5.08	.001	.24	.33	6.19	484	491
92	1.61	28	33		.000	.25	.52	.001	.23	**1.16**		460	503
93	1.54	21			.000	.27	**1.26**	.011	**.72**			486	
94	.99	65			.006	**.33**							

1) 98 forecast of age 1.2 from recent 5-year average (.37).
2) 98 forecast of age 1.3 from return of 1.2 (.27) and escapement (1.54).
   R^2= .93; F2,9 = 60.3 Y= 3.07(1.2 return)+1.23(escape.) -1.46
3) 98 forecast of age 2.2 from return of age 2.1 (.011).
   R^2= .42; F1,10= 7.2 Y= .48 + 22.1(age 2.1)
4) 98 forecast of age 2.3 from 5-year mean (1.63)

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	**.06**	
93	.35	76	.004	.12	**.14**	.000	**.19**		
94	.24	84	.001	**.18**					

1) 98 forecast for age 1.2 from return of age 1.1 (.001) and regression of 1.2 on 1.1 returns
   R^2= .60; F1,11= 6.0 Y= .15 + 33.6(age 1.1)
2) 98 forecasts of returns for ages 2.2, 1.3 and 2.3 from recent 5-year averages.

Table 9. Egegik sockeye salmon statistics for forecasting runs by freshwater age.

Smolt 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
89	1.27	54	72	8.9	.000	.86	4.34	5.20	7.2	496
94	1.94	63	55	9.7	.000	.32	1.04	1.36	2.5	508
85	0.79	88	55	10.4	.002	1.72	2.69	4.41	8.0	509
88	1.15	74	36	10.2	.002	1.76	3.59	5.35	14.9	483
93	2.79	56	20	9.3	.001	1.33	3.87	5.20	26.0	502
84	1.03	88	17	10.1	.002	1.01	1.79	2.80	16.5	510
96	1.90	70	16	10.5	.008	**.77**				
86	1.17	69	14	9.0	.001	.58	.93	1.51	10.8	502
95	1.52	44	7	9.3	.002	.46	**1.05**			502
92	2.19	70	6	9.7	.000	.40	.84	1.24	20.7	480
91	1.61	58	5	10.3	.000	.59	.43	1.02	20.4	522
90	1.61	57	4	9.6	.001	.40	1.43	1.83	45.7	472
87	1.10	67	4	11.6	.000	.54	1.33	1.87	46.8	511
83	0.69	71	2	9.5	.000	.52	.95	1.47	73.5	519

1) 98 forecast of age 1.2 from number of age1 smolt (16) and regression of age 1.2 on age1 smolt
R^2= .38; F1,12= 2.1 Y= .65 + .0075(age 1 smolt)
2) 98 forecast of age 1.3 from number of age 1. smolt (7) and return of age 1.2 (.46)
R^2= .82; F2,10=10.6 Y= .29 + .026(age 1 smolt) + 1.25(age 1.2)

Smolt 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
91	1.61	58	89	15.6	.063	10.24	5.48	15.78	17.7	520
90	1.27	54	52	14.5	.064	8.41	10.73	19.20	36.9	492
95	1.95	65	50	11.6	.053	4.51	**3.25**			502
87	1.17	69	46	14.1	.083	6.17	4.74	10.91	23.7	524
94	2.77	56	39	13.7	.020	2.98	2.49	5.47	14.0	520
93	2.19	70	38	12.2	.065	9.28	4.61	13.89	36.6	512
84	0.70	71	32	12.2	.060	3.30	1.39	4.69	14.7	528
86	0.79	88	30	15.7	.007	3.03	2.61	5.64	18.8	520
89	1.15	74	27	15.4	.010	3.79	4.21	8.00	29.6	502
92	1.61	54	17	13.3	.034	5.98	3.92	9.90	58.2	488
88	1.10	67	13	14.3	.031	4.17	1.22	5.39	41.5	498
85	1.03	29	11	16.8	.012	1.74	1.59	3.33	30.3	529
96	1.52	44	8	16.1	.029	**3.29**				

1) 98 forecast of age 2.2 from number of smolt (8) and return of age 2.1 (.029)
R^2= .84; F1,11= 12.7 Y= 1.43 + .061(age 2 smolt) + 47.4 (age 2.1)
2) 98 forecast of age 2.3 from return of age 2.2 (4.51) and regression of 2.3 on 2.2 returns
R^2= .67: F1,11= 8.9 Y= .28 + .658(age 2.2)

Table 10. Ugashik sockeye salmon statistics for forecasting 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	Total	Smolt/ adult survival (%)	Mean length age 1.2
79	1.70	53			.020	2.95	.81	3.76		528
80	3.32	59			.001	1.14	2.10	3.24		496
81	1.33	42	31	7.6	.002	1.51	2.51	4.02	13.0	514
82	1.16	20	75	6.8	.001	.41	.69	1.10	1.5	514
83	1.00	90	13	8.3	.000	.60	.34	0.94	7.2	512
84	1.24	81	38	5.8	.000	.45	.55	1.00	2.6	512
85	1.00	75	6	7.9	.001	.49	.69	1.18	19.7	507
86	1.00	41	183	5.7	.001	.48	2.38	2.86	1.6	488
87	0.67	56	89	6.5	.001	.81	1.55	2.36	2.7	502
88	0.64	54	15	6.7	.002	.45	.67	1.12	7.5	498
89	1.68	84	26	7.7	.007	.66	.37	1.04	4.0	517
90	0.73	60			.001	.34	.67	1.01		488
91	2.48	57	58	8.0	.006	1.93	3.08	5.02	8.6	504
92	2.17	49	24	6.7	.003	.18	.54	0.72	3.0	498
93	1.41	48	7	7.8	.002	.24	**1.49**			490
94	1.08	79	1	9.9	.011	**1.24**				

1) 98 forecast of age 1.2 from return age 1.1 and recent 5-year average
R^2=.66; F1,13=25.2 Y=.47+120.4(age 1.1) and 5-year average (.7).

2) 98 forecast of age 1.3 from return of age1. 2 (.24) and mean length of age 1.2 (490).
R^2= .52; F2,11= 5.9 Y= 29.2 + .917 (age 1.2) - .057(ML age 1.2)

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	28.5	517
91	2.48	57	6	11.2	.001	.57	.30	.87	14.5	512
92	2.17	49	15	11.1	.004	.88	**.67**			506
93	1.41	48	1	13.5	.006	**.86**				

1) 98 forecast of age 2.2 from return of age 2.1 (.006) and age 2 smolt (1).
R^2= .78; F2,7= 12.5 Y=.56 + 47(age 2.1) + .016(age 2 smolt)

2) 98 forecast of age 2.3 from return of age 2.2 (.88) and 5-year average ratio of 2.3/2.2 (.76)

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	2.3	Total	Mean length of 1.2
81	1.23	37	5.4	7.0	.000	.60	.08	1.14	.09	1.91	490
82	.98	34	7.5	4.9	.003	.50	.13	.90	.02	1.55	501
83	1.36	75	6.8	1.8	.001	1.91	.02	1.23	.07	3.23	495
84	1.00	22	5.0	4.3	.000	.52	.03	1.32	.02	1.89	502
85	.94	49	6.7	4.9	.003	1.11	.03	1.37	.01	2.52	501
86	.82	36	7.5	5.3	.002	1.16	.07	1.94	.06	3.23	480
87	1.34	82	6.9	6.1	.000	1.36	.09	.74	.09	2.28	486
88	.87	37	8.3	6.9	.001	1.59	.09	1.39	.03	3.10	482
89	1.19	49	7.8	6.1	.004	2.17	.01	1.82	.04	4.04	496
90	1.07	50	8.0	5.4	.001	1.08	.28	1.15	.16	2.67	477
91	1.16	36	6.5	8.2	.012	2.53	.05	2.43	.07	5.08	496
92	1.29	73	9.1	6.5	.001	2.32	.09	1.60	**.05**		495
93	1.18	59	7.5	7.6	.000	1.67	**.10**	**1.59**			491
94	1.47	52	8.7	6.8	.010	**2.56**					

1) 98 return of age 1.2 from return age 1.1 (.010) and percent age .2 in escapement (52)
R^2=.43; F2,10= 3.9 Y= 122.6 (age 1.1) + .026 (% age .2) - .03
2) 98 forecast of age 1.3 was from return of age 1.2 (1.67) and percent age .2 in escapement (59)
R^2=.62; F2,9= 7.2 Y= 1.04 + .788(age 1.2) - .013(% age .2)
3) 98 return of age 2.2 from recent 5-year average (.10).
4) 98 return of age 2.3 from escapement (1.29) and return of age 2.2 (.09)
R^2= .60; F2,8= 5.9 Y= .137 (escapement) + .418 (age 2.2) - .12

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	2.3	Total	Mean length of 1.2
81	.59	24	5.4	7.0	.15	.00	.83	.05	1.03	512
82	.42	5	7.5	4.9	.05	.01	.48	.01	.55	548
83	.18	73	6.8	1.8	.15	.01	.33	.03	.52	508
84	.19	9	5.0	4.3	.03	.05	.63	.03	.74	525
85	.21	37	6.7	4.9	.51	.08	.90	.08	1.57	525
86	.31	7	7.5	5.3	.23	.03	2.20	.03	2.49	494
87	.17	40	6.9	6.1	.16	.01	.57	.03	.77	516
88	.17	12	8.3	6.9	.19	.04	1.02	.04	1.29	503
89	.46	49	7.8	6.1	.48	.06	1.05	.05	1.64	519
90	.37	25	8.0	5.4	.16	.18	1.36	.15	1.85	494
91	.76	6	6.5	8.2	.31	.00	1.31	.02	1.64	507
92	.31	26	9.1	6.5	.04	.01	.13	**.03**		517
93	.41	31	7.5	7.6	.12	**.06**	**.76**			507
94	.45	27	8.7	6.8	**.22**					

1) 98 returns of age 1.2 and 2.2 from recent 5-year averages.
3) 98 return of age 1.3 from mean length of age 1.2 (507), and percent age .2 in escapement (31)
R^2= .76: F2,9= 6.1 Y= 13.3 - .012(%.2 Esc) - .024(Length 1.2)
4) 98 returns of age 2.3 from return of age 2.2 (.01) and regression of age 2.3 on age 2.2
R^2=.85; F1,9= 49.' Y= .02 + .668 (age 2.2)

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		1.39	486	563
93	.72	11	.04	.03		.06	**.47**			474	
94	.51	6	.00	**.17**		**.12**					
95	.28	39									

1) 98 returns of age 1.2 from recent 5-year average.
2) 98 forecast of age 0.3 from age 0.2 return (.00) and mean length of age 1.2 (474).
R^2= .78; F2,10= 1 Y = 4.29 + 5.01(age 0.2) - .0087(ML age 1.2)
3) 98 forecast of age 1.3 from return of age 1.2 (.06) and regression of 1.3 on 1.2 return
R^2=.70; F1,10= 2[illegible] Y = .17 + 4.97(age1.2)

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	Total	Mean length 1.2	1.3
81	.31	19	.002	.01	.05	.24	.01	.02	.33	501	568
82	.29	30	.000	.02	.11	.24	.01	.02	.40	513	579
83	.21	28	.001	.00	.28	.91	.01	.02	1.22	516	586
84	.15	41	.000	.01	.02	.11	.00	.02	.16	520	583
85	.15	20	.000	.01	.03	.21	.04	.08	.37	513	579
86	.20	27	.000	.03	.08	.44	.08	.11	.74	504	572
87	.28	39	.000	.01	.19	.53	.03	.08	.84	514	567
88	.31	73	.001	.01	.11	.39	.03	.05	.59	515	592
89	.10	3	.000	.04	.12	.31	.01	.04	.52	522	561
90	.19	24	.001	.02	.10	.43	.07	.04	.66	495	570
91	.28	41	.001	.00	.18	.42	.03	.03	.66	516	589
92	.20	23	.001	.03	.05	.11	.03	**.05**	.27	525	581
93	.19	24	.000	.00	.06	**.25**	**.03**			512	
94	.17	45	.000		**.10**						

1) 98 forecasts of ages 1.2 and 2.2 from recent 5-year averages
2) 98 forecast of age 1.3 from return of 1.2 (.06) and mean length of age 1.2 (512)
R^2= .87; F2,9= 29 Y = 2.76 + 2.58(age 1.2) - .0052 (ML age 1.2)
4) 98 forecast of age 2.3 from return of 2.2 (.03) and regression of 2.3 on 2.2 returns
R^2= .55; F1,9= 10 Y= .023 + .864 (age 2.2)