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# FORECASTS OF THE 1995 SOCKEYE SALMON RUNS TO BRISTOL BAY

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A REPORT TO THE  
PACIFIC SEAFOOD PROCESSORS ASSOCIATION

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## **KEY WORDS**

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

## 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 less than one 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 the regulation of 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 or more).

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 1994 season and forecasts of the 1995 sockeye salmon runs to Bristol Bay, which are based mostly on preliminary statistics provided by ADF&G.

## REVIEW OF THE 1994 RUN

### FORECASTS AND ACTUAL RUNS

The FRI prediction of total run to Bristol Bay in 1994 was 49 million with a 34 million catch, and the ADF&G predictions were nearly the same at 52.5 and 40 million (Table 1). The ADF&G forecasts resulting from their statistical analyses were increased by about 39% to adjust for a recent tendency to under forecast the runs (Geiger and Simpson 1994). Therefore, their database for the 1994 forecast actually indicated a lower run than forecast by FRI. The total 1994 run and

catch (50 and 35 million) were in between the pre-season forecasts with the Naknek/Kvichak run a little stronger than predicted and the Egegik run a little lower than predicted.

The catch of 35.2 million was only 3% greater than we predicted and the third largest for Bristol Bay. For the past 8 years, the catches have differed from our forecasts by an average of 29% (range: 3% to 74%) and from the ADF&G forecasts by an average of 49% (range: 11% to 125%). Therefore, both forecasts were relatively accurate in predicting a large catch in 1994.

In addition to the pre-season forecasts, we have made in-season forecasts each year since 1987 from a test-fishing program based out of Port Moller. This project, which was originally operated by ADF&G (1968-1985), has provided more accurate predictions than pre-season forecasts because we are estimating the relative abundance of the run just 6-8 days before arrival in the fishing districts. Prior to the 1994 season, a Bristol Bay almanac was provided to processors so they could make daily forecasts of the final 1994 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 1994 (about June 14), the test boat catches indicated that the run was going to be much later than average and the past method (from the almanac) tended to under-forecast the run (Table 2). The Port Moller samples provided a slightly more accurate estimate of the age composition in the 1994 run than the pre-season forecasts or the False Pass catches; however, all samples tended to under-estimate the percentage of age 2.2 sockeye which were bound mainly for the Kvichak (Table 3).

The fish arrived about 2 days late at Port Moller in 1994 and appeared to take more time than usual to reach the fishing districts (about 9 days). There was an early spring in Bristol Bay in 1994, but water temperatures off Port Moller were only average. We don't know what the water temperatures were in the North Pacific in the spring, because NOAA discontinued temperature measurements at Kodiak and Adak; however, they were probably cool and caused the late arrival of the run. From a post-season analysis, the 1994 run was about 3 days later than the average of July 4 (1985–1994). Early samples from the Port Moller catches showed that the sockeye were much smaller than normal (by age and sex) and indicated a large run was on the way.

## THE FISHERIES

The Port Moller program indicated that the 1994 run was going to be late and, except for Egegik, there was little fishing in June and the mid-point of the Bristol Bay catch was not reached until July 9 (Tables 4 & 5). Total daily catches exceeded 1 million from July 2 to July 17 with the largest single day catch on July 9 (3.5 million). Management of the 1994 Naknek/Kvichak fishery was outstanding as escapement goals were achieved in both major rivers with a large run to the Kvichak but only an average run to the Naknek. There was some over-escapement in the Egegik, Wood, Igushik and Ugashik Rivers which all had relatively large runs; however, only the escapement to Igushik is likely to result in lower future production.

## FISH SIZE

The sockeye salmon caught in Bristol Bay in 1994 averaged 5.3 lb and were the smallest since 1970 (Table 6). This was caused by a high percentage of 2-ocean fish (61%) and small size by age and sex (Fig. 2). The body size of Bristol Bay sockeye is 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), but we don't know what the spring nearshore surface temperatures in the Gulf of Alaska were in 1994. The sockeye caught in the False Pass fishery were also small this year and they were very difficult to catch, which indicates that some unusual ocean conditions prevailed.

## FORECASTS FOR 1995

The statistics used to forecast the 1995 Bristol Bay sockeye salmon runs came from several sources: (1) the numbers, ages, lengths, and weights of adult salmon in the catches and escape-ments and smolt in the seaward migrations were from annual reports by ADF&G (e.g., Stratton and Crawford [1992] and Crawford and Cross [1992]); (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. [1994]); 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 3 brood years (1989-91) that will contribute to the 1995 run were 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 average of escapements in recent years with runs comparable to the forecast. To predict the return of an age group in 1994, all relevant statistics from past brood years (since 1981) were assembled and submitted to a step-wise multiple regression procedure. When no measurement (variable) was significantly correlated with past variation in a run, then the average run was used to predict the 1995 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 used to be a low producer relative to the size of the lake (second largest in Bristol Bay). The recent production is more in line with the other systems. In addition, the more recent years are likely to better predict events in 1994 than earlier observations. An exception to this was in the forecasts of 2-ocean returns to the Kvichak (which has mainly 2-ocean fish). Here I used statistics starting with the 1974 brood year (1978 run).

The forecast of the total 1995 Bristol Bay sockeye salmon run is 53.1 million with a predicted catch of 34.4 million (Table 7). 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 8). The 2-ocean

fish were generally small for these years, so we might expect a large return of 3-ocean fish in 1995 from the small 2-ocean fish in 1994.

The databases and forecast statistics are presented in Tables 9-14. The Egegik, Ugashik, and Nushagak are expected to have smaller runs in 1995 than the 1994 runs; however, the Naknek/Kvichak is expected to have a much larger run in 1995 as a result of a high forecast (24 million) for the Kvichak (Fig. 4). About 34% of the total 1995 forecast of 53.1 million is contained in one individual forecast; the age 2.2 fish in the Kvichak (18 million). Because past runs have sometimes differed considerably from the pre-season forecasts, it will again be very important for the industry to have an accurate in-season forecast from the Port Moller test fishery.

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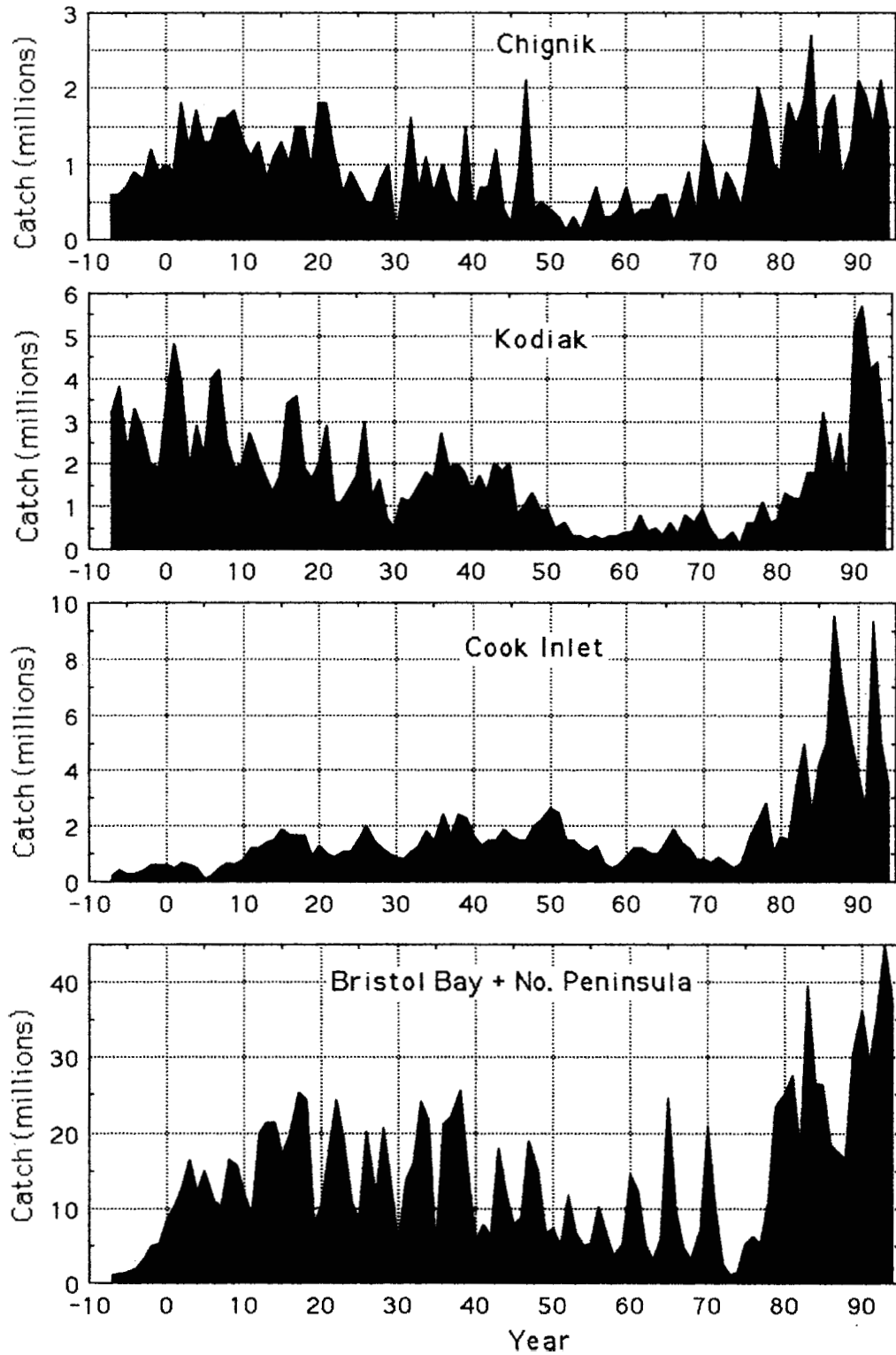


Figure 1. Annual commercial catches of sockeye salmon in the major Alaskan fisheries, 1893-1994.

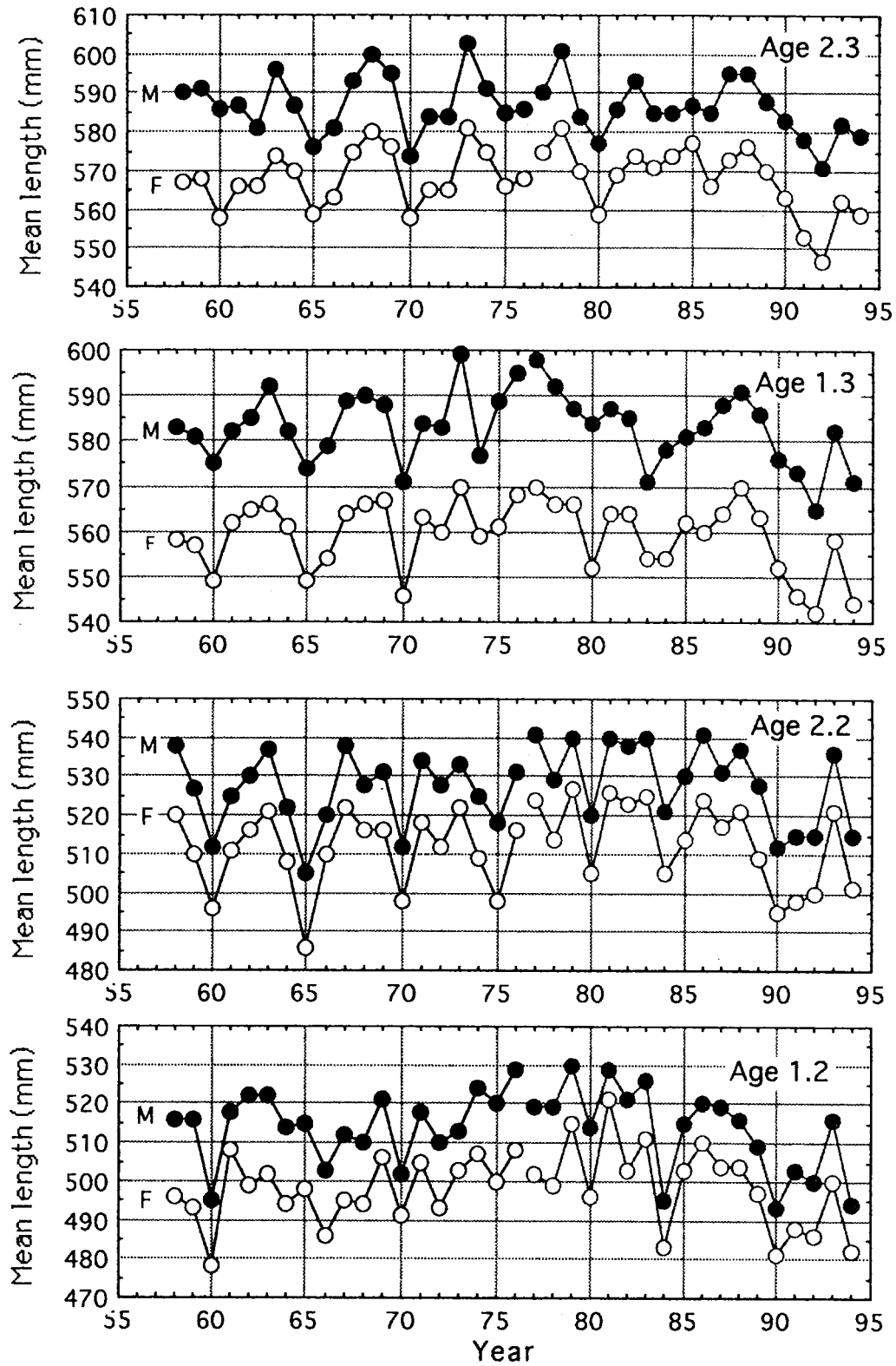


Figure 2. Annual mean lengths (mid-eye to tail fork) by age and sex for sockeye salmon in the Bristol Bay runs, 1958-94.

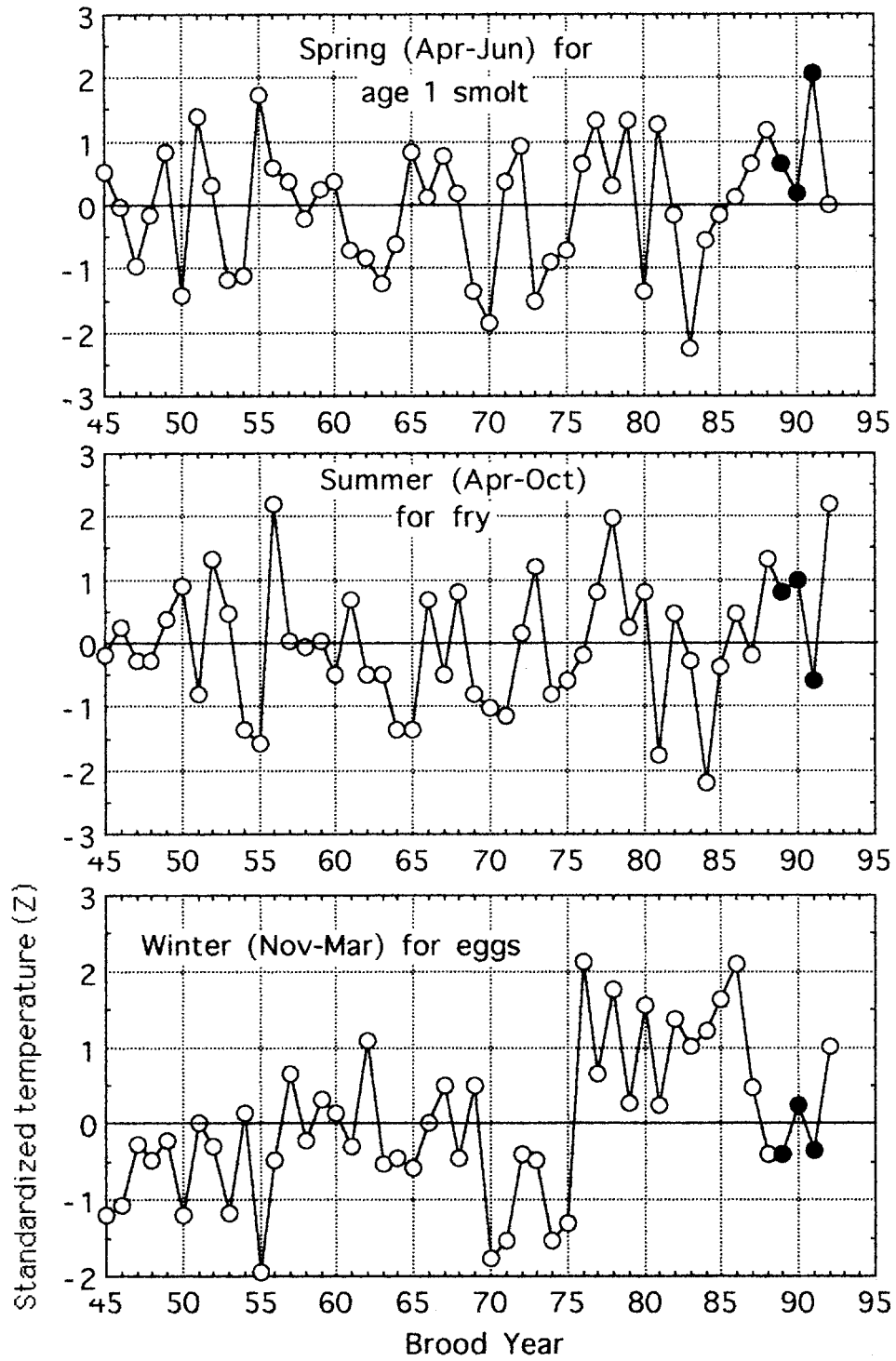


Figure 3. Relative air temperatures (number of standard deviations from the mean) in Bristol Bay (Dillingham and King Salmon) for sockeye salmon brood years, 1945-92.

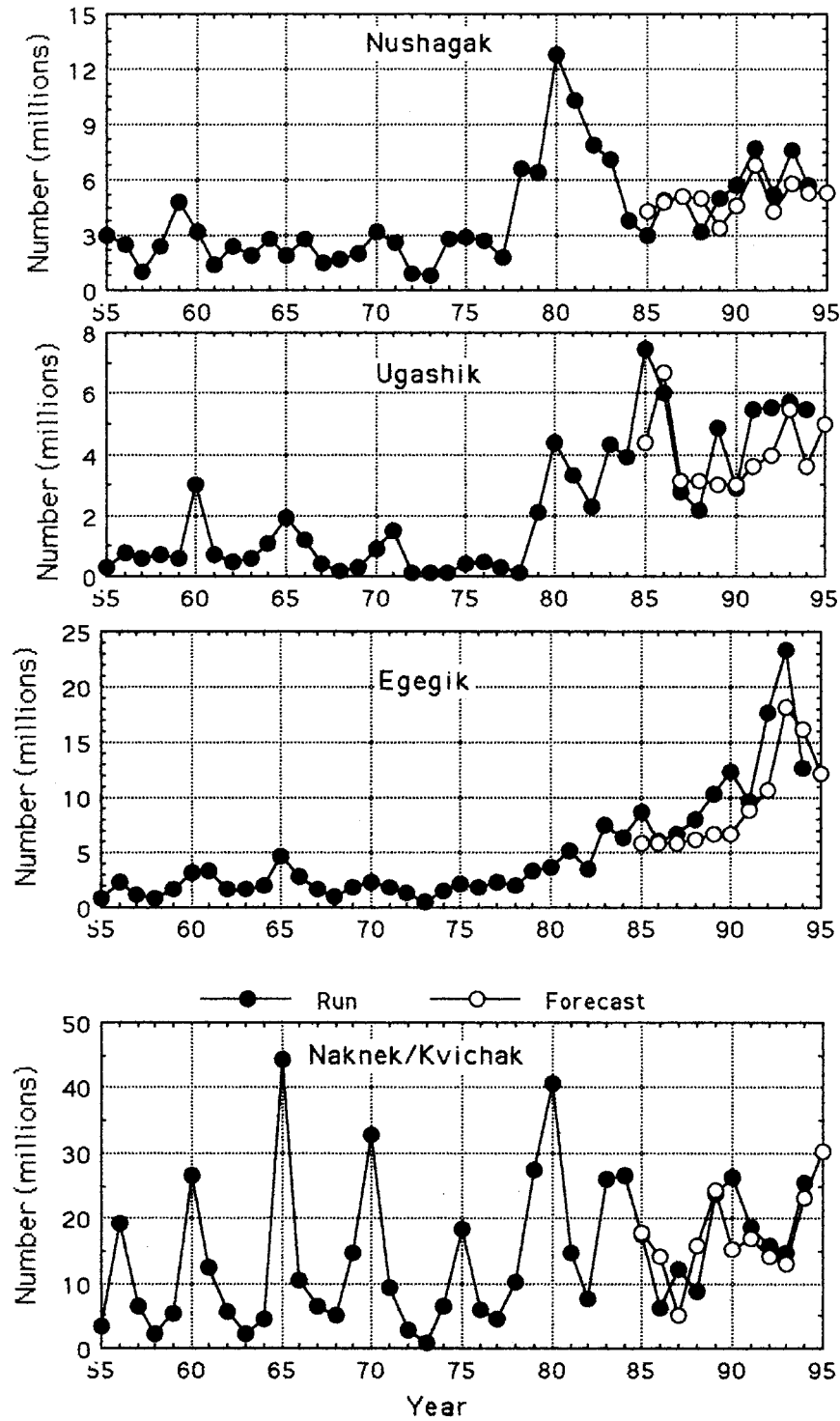


Figure 4. Sockeye salmon runs to the four major Bristol Bay fishing districts, 1955-94, and the FRI pre-season forecasts, 1985-94.

Table 1. Comparisons of forecasts and runs of Bristol Bay sockeye salmon in millions, 1987-94.

| Year | District | Pre-season forecasts |       |      |       | Actual |       | Port     | Moller  |
|------|----------|----------------------|-------|------|-------|--------|-------|----------|---------|
|      |          | ADF&G                |       | FRI  |       | Run    | Catch | forecast | (7/2-6) |
|      |          | Run                  | Catch | Run  | Catch |        |       | Run      | Catch   |
| 1987 | Nak/Kvi  | 5.5                  | 1.7   | 5.1  | 1.8   | 12.3   | 5.0   | 10       |         |
|      | Egegik   | 5.0                  | 4.0   | 5.8  | 4.8   | 6.6    | 5.4   | 8        |         |
|      | Ugashik  | 1.8                  | 1.0   | 3.1  | 2.4   | 2.8    | 2.1   | 3        |         |
|      | Nushagak | 3.4                  | 1.7   | 5.1  | 3.2   | 5.1    | 3.2   | 5        |         |
|      | Togiak   | 0.4                  | 0.3   | 0.4  | 0.2   | 0.6    | 0.3   | +        |         |
|      | TOTAL    | 16.1                 | 8.7   | 19.5 | 12.4  | 27.4   | 16.0  | 26       |         |
| 1988 | Nak/Kvi  | 11.4                 | 5.2   | 15.7 | 9.5   | 8.8    | 3.5   | 8.0      |         |
|      | Egegik   | 5.6                  | 4.6   | 6.2  | 5.2   | 8.0    | 6.4   | 8.0      |         |
|      | Ugashik  | 3.2                  | 2.5   | 3.1  | 2.3   | 2.2    | 1.5   | 1.5      |         |
|      | Nushagak | 5.6                  | 4.0   | 5.0  | 3.4   | 3.2    | 1.7   | 3.5      |         |
|      | Togiak   | 0.7                  | 0.5   | 0.6  | 0.4   | 1.0    | 0.7   | 1.0      |         |
|      | TOTAL    | 26.5                 | 16.8  | 30.6 | 20.8  | 23.2   | 13.8  | 22.0     | 12      |
| 1989 | Nak/Kvi  | 16.0                 | 6.8   | 24.3 | 15.0  | 23.5   | 13.8  | 26.5     | 16.0    |
|      | Egegik   | 5.6                  | 4.6   | 6.7  | 5.7   | 10.5   | 8.9   | 8.0      | 7.0     |
|      | Ugashik  | 3.6                  | 2.9   | 3.0  | 2.2   | 4.9    | 3.1   | 2.5      | 1.5     |
|      | Nushagak | 3.1                  | 1.4   | 3.4  | 2.0   | 4.9    | 2.8   | 5.0      | 3.5     |
|      | Togiak   | 0.6                  | 0.5   | 0.6  | 0.5   | 0.2    | 0.1   | +        | +       |
|      | TOTAL    | 28.9                 | 16.2  | 38.0 | 25.4  | 44.0   | 28.7  | 42.0     | 28.0    |
| 1990 | Nak/Nek  | 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/Nek  | 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   | 17.6   | 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   | 0.8    | 0.6   | 0.5      | +       |
|      | TOTAL    | 37.1                 | 26.3  | 33.0 | 22.0  | 45.0   | 32.0  | 41.0     | 29.0    |
| 1993 | Nak/Nek  | 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/Nek  | 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       | 29.3    |

Table 2. Summary of 1994 Bristol Bay sockeye in-season forecasts (in millions) from the Port Moller test boat.

| Date          | Forecast from almanac | Date issued | Comment   |
|---------------|-----------------------|-------------|---|
| June          |                       |             |   |
| 14            |                       | 14          | Small early catches (smallest ever) only mean that main body of run has not arrived, i.e. similar to the 1991 run.  |
| 15            |                       |             |   |
| 16            |                       | 16          | Sockeye lengths indicate a higher percentage of 2-ocean fish than in pre-season forecasts, but only by 5-10%.   |
| 17            |                       |             |   |
| 18            |                       |             |   |
| 19            |                       | 19          | Very small sockeye(4 lb) and many pinks in False Pass test catches, but it doesn't mean much for the Bristol Bay run.   |
| 20            | 30                    | 20          |   |
| 21            | 32                    | 23          |   |
| 22            | 32                    | 23          |   |
| 23            | 36                    | 23          | Large index catch (155)--they are on their way.   |
| 24            | 36                    | 26          | Sockeye at Port Moller are small, indicating a large run.   |
| 25            | 37                    | 26          | Chum index catches in 1994 (to date) are the largest ever.  |
| 26            | 38                    | 26          | Early age compositions in BB and PM similar to pre-season forecasts.  |
| 27            | 39                    | 27          | Low catches at False Pass, but it may be like 1990--low False Pass, but large BB.   |
| 28            | 40                    | 28          | Bristol Bay run is late but likely to be in the 40 millions   |
| 29            | 40                    | 29          | Only showing of fish is at Egegik, but total catch and escapement there is only 650,000.  |
| 30            | 41                    | 30          | Average weights converted from lengths show 2-ocean fish are small.   |
| 1             | 42                    | 1           | Large index catch on the 30th of 224. Total Bay catch (mostly Egegik) only 1.3 million  |
| 2             | 43                    | 2           | Total Bristol Bay escapement past towers less than 500,000 through 7/2.   |
| 3             | 43                    | 3           |   |
| 4             | 45                    | 4           | Using a 10-day lag, 1994 run is on track to a 43 million run, with a mid-point of 7/9 (catch 7/10-11). Age comp.= 11% age1.2, 49% age2.2, 19% age1.3, and 21% age 2.3 |
| 5             | 45                    | 7           | Through 7/5 total Bristol Bay catch plus escapement totals only 11.6 million.   |
| 6             | 46                    | 7           | River system forecasts issued (totals of 45 million run and 29 million catch) on 7/6.   |
| 10            |                       | 10          | Large catches and escapements on 7/9 prompted a final forecast of a 48 million run.   |
| Final run= 50 |                       |             |   |
| catch= 35     |                       |             |   |

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 pre-season forecasts.

| Year |             | Age composition (%) |     |     |     |        | Forecast/<br>run<br>(millions) |        |
|------|-------------|---------------------|-----|-----|-----|--------|--------------------------------|--------|
|      |             | 1.2                 | 2.2 | 1.3 | 2.3 | all .2 |                                | all .3 |
| 1989 | ADF&G       | 22                  | 45  | 24  | 9   | 67     | 33                             | 28.9   |
|      | FRI         | 13                  | 62  | 18  | 7   | 75     | 25                             | 38.0   |
|      | False Pass  | 8                   | 62  | 13  | 15  | 70     | 28                             |        |
|      | Port Moller | 13                  | 45  | 22  | 17  | 58     | 39                             | 37.0   |
|      | BB run      | 11                  | 62  | 16  | 9   | 73     | 26                             | 43.8   |
| 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                             | 44.9   |
| 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   |

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.

In 1989 and 1993, the percentage of 2-ocean fish increased with date, whereas in 1990 the percentage of 2-ocean fish at Port Moller decreased with date.

Table 4. Timing of Nushagak and Naknet/Kvichak sockeye catches, 1958-94.

| Year                 | Nushagak            |                     |      |     |      | Naknek/Kvichak      |                     |      |     |      |
|----------------------|---------------------|---------------------|------|-----|------|---------------------|---------------------|------|-----|------|
|                      | Catch<br>(millions) | Percentage through: |      |     |      | Catch<br>(millions) | Percentage through: |      |     |      |
|                      |                     | 6/25                | 6/30 | 7/5 | 7/10 |                     | 6/25                | 6/30 | 7/5 | 7/10 |
| 1958                 | 1.1                 | 5                   | 40   | 73  | 88   | 0.9                 | 2                   | 27   | 48  | 91   |
| 59                   | 1.7                 | 1                   | 3    | 38  | 74   | 1.7                 | 4                   | 8    | 35  | 61   |
| 60                   | 1.5                 | 12                  | 36   | 62  | 71   | 9.8                 | 1                   | 17   | 50  | 69   |
| 61                   | 0.5                 | 9                   | 29   | 71  | 84   | 8.2                 | 1                   | 32   | 80  | 96   |
| 62                   | 1.5                 | 4                   | 4    | 62  | 82   | 2.2                 | 14                  | 28   | 48  | 78   |
| 63                   | 0.8                 | +                   | +    | 61  | 91   | 1.0                 | 5                   | 29   | 70  | 85   |
| 64                   | 1.4                 | 7                   | 18   | 63  | 80   | 2.2                 | 5                   | 16   | 26  | 92   |
| 65                   | 0.8                 | 13                  | 28   | 49  | 73   | 19.1                | 5                   | 29   | 50  | 72   |
| 66                   | 1.2                 | 2                   | 3    | 39  | 73   | 5.4                 | 2                   | 20   | 63  | 93   |
| 67                   | 0.6                 | 18                  | 73   | 87  | 89   | 2.3                 | 26                  | 55   | 77  | 86   |
| 68                   | 0.7                 | 17                  | 66   | 80  | 92   | 1.2                 | 4                   | 33   | 45  | 92   |
| 69                   | 0.8                 | +                   | +    | 58  | 81   | 4.7                 | 1                   | 18   | 59  | 77   |
| 70                   | 1.2                 | 2                   | 15   | 59  | 89   | 17.8                | 3                   | 31   | 65  | 91   |
| 71                   | 1.3                 | 1                   | 5    | 21  | 53   | 5.9                 | 1                   | 10   | 28  | 43   |
| 72                   | 0.4                 | 1                   | 10   | 50  | 96   | 1.1                 | 10                  | 53   | 76  | 94   |
| 73                   | 0.3                 | 1                   | 29   | 77  | 77   | 0.2                 | 14                  | 29   | 79  | 79   |
| 74                   | 0.5                 | 0                   | 0    | 26  | 64   | 0.5                 | 0                   | 0    | 13  | 65   |
| 75                   | 0.6                 | 0                   | 0    | +   | 62   | 3.1                 | 0                   | 0    | 17  | 57   |
| 76                   | 1.2                 | 2                   | 8    | 49  | 68   | 2.5                 | 0                   | 8    | 40  | 62   |
| 77                   | 0.6                 | 3                   | 21   | 66  | 79   | 2.2                 | 1                   | 23   | 76  | 84   |
| 78                   | 3.1                 | 5                   | 21   | 62  | 92   | 5.1                 | 2                   | 26   | 26  | 82   |
| 79                   | 3.3                 | 7                   | 40   | 63  | 82   | 15.0                | 7                   | 32   | 63  | 84   |
| 80                   | 4.5                 | 0                   | 0    | 28  | 72   | 15.1                | 1                   | 3    | 33  | 71   |
| 81                   | 7.5                 | 5                   | 18   | 49  | 83   | 11.0                | 5                   | 22   | 60  | 86   |
| 82                   | 5.9                 | 1                   | 19   | 54  | 86   | 5.0                 | 2                   | 19   | 45  | 86   |
| 83                   | 5.1                 | 1                   | 18   | 53  | 78   | 21.6                | 2                   | 25   | 58  | 82   |
| 84                   | 2.2                 | 11                  | 24   | 51  | 78   | 14.2                | 3                   | 11   | 38  | 75   |
| 85                   | 1.3                 | +                   | 21   | 48  | 86   | 8.1                 | 2                   | 37   | 68  | 82   |
| 86                   | 2.8                 | +                   | 8    | 33  | 68   | 2.9                 | 1                   | 1    | 36  | 52   |
| 87                   | 3.3                 | 6                   | 15   | 32  | 73   | 4.9                 | 1                   | 3    | 6   | 27   |
| 88                   | 1.7                 | 0                   | 16   | 58  | 58   | 3.6                 | 7                   | 18   | 52  | 56   |
| 89                   | 2.9                 | 0                   | 16   | 59  | 80   | 13.9                | 7                   | 25   | 57  | 80   |
| 90                   | 3.3                 | 0                   | 0    | 17  | 65   | 17.4                | 1                   | 11   | 46  | 70   |
| 91                   | 5.3                 | 0                   | 1    | 38  | 77   | 10.6                | 1                   | 4    | 44  | 76   |
| 92                   | 2.9                 | 1                   | 15   | 39  | 61   | 9.3                 | 2                   | 10   | 38  | 72   |
| 93                   | 5.3                 | 5                   | 29   | 67  | 91   | 8.9                 | 12                  | 40   | 78  | 94   |
| 94                   | 3.4                 | 2                   | 2    | 26  | 68   | 16.3                | +                   | +    | 15  | 58   |
| Average<br>(1981-94) | 3.8                 | 2                   | 14   | 45  | 75   | 10.6                | 3                   | 16   | 46  | 71   |

+ = less than 1%

Table 5. Timing of Egegik and Ugashik sockeye catches, 1958-94.

| Year                 | Egegik              |                     |      |     |      | Ugashik             |                     |      |     |      |
|----------------------|---------------------|---------------------|------|-----|------|---------------------|---------------------|------|-----|------|
|                      | Catch<br>(millions) | Percentage through: |      |     |      | Catch<br>(millions) | Percentage through: |      |     |      |
|                      |                     | 6/25                | 6/30 | 7/5 | 7/10 |                     | 6/25                | 6/30 | 7/5 | 7/10 |
| 1958                 | 0.5                 | 3                   | 19   | 72  | 92   | 0.4                 | 5                   | 32   | 58  | 89   |
| 59                   | 0.7                 | 7                   | 17   | 37  | 66   | 0.4                 | 5                   | 12   | 28  | 65   |
| 60                   | 1.4                 | 8                   | 22   | 42  | 68   | 0.8                 | 3                   | 13   | 31  | 63   |
| 61                   | 2.7                 | 14                  | 33   | 58  | 96   | 0.4                 | 5                   | 11   | 40  | 77   |
| 62                   | 0.6                 | 10                  | 26   | 67  | 88   | 0.2                 | 7                   | 7    | 26  | 72   |
| 63                   | 0.7                 | 5                   | 14   | 44  | 81   | 0.2                 | 6                   | 25   | 51  | 72   |
| 64                   | 1.1                 | 11                  | 28   | 33  | 85   | 0.6                 | 6                   | 10   | 20  | 66   |
| 65                   | 3.2                 | 7                   | 42   | 68  | 88   | 0.9                 | 3                   | 23   | 48  | 83   |
| 66                   | 2.1                 | 8                   | 17   | 68  | 96   | 0.4                 | 3                   | 9    | 32  | 78   |
| 67                   | 1.1                 | 37                  | 84   | 95  | 95   | 0.2                 | 32                  | 52   | 65  | 82   |
| 68                   | 0.7                 | 18                  | 72   | 99  | 99   | 0.1                 | 6                   | 34   | 56  | 83   |
| 69                   | 0.9                 | 10                  | 41   | 72  | 99   | 0.2                 | 2                   | 6    | 82  | 91   |
| 70                   | 1.4                 | 23                  | 37   | 76  | 95   | 0.2                 | 7                   | 29   | 29  | 56   |
| 71                   | 1.3                 | 6                   | 17   | 34  | 76   | 1.0                 | +                   | 2    | 12  | 50   |
| 72                   | 0.8                 | 9                   | 25   | 82  | 100  | +                   | ...                 | ...  | ... | ...  |
| 73                   | 0.2                 | 12                  | 56   | 96  | 96   | +                   | ...                 | ...  | ... | ...  |
| 74                   | 0.2                 | 2                   | 2    | 42  | 94   | +                   | ...                 | ...  | ... | ...  |
| 75                   | 1.0                 | +                   | 2    | 18  | 94   | +                   | ...                 | ...  | ... | ...  |
| 76                   | 1.3                 | 2                   | 12   | 62  | 93   | 0.2                 | 2                   | 5    | 18  | 60   |
| 77                   | 1.8                 | 7                   | 30   | 62  | 86   | 0.1                 | 28                  | 28   | 28  | 28   |
| 78                   | 1.2                 | 13                  | 30   | 30  | 71   | +                   | ...                 | ...  | ... | ...  |
| 79                   | 2.3                 | 16                  | 38   | 71  | 85   | 0.4                 | 2                   | 8    | 18  | 22   |
| 80                   | 2.6                 | 2                   | 10   | 41  | 74   | 0.9                 | +                   | 3    | 8   | 33   |
| 81                   | 4.4                 | 12                  | 34   | 64  | 89   | 2.1                 | 2                   | 7    | 19  | 55   |
| 82                   | 2.4                 | 11                  | 28   | 33  | 87   | 1.1                 | 2                   | 11   | 25  | 74   |
| 83                   | 6.8                 | 3                   | 28   | 58  | 84   | 3.3                 | 1                   | 10   | 30  | 58   |
| 84                   | 6.3                 | 7                   | 34   | 49  | 75   | 2.7                 | 2                   | 10   | 27  | 44   |
| 85                   | 7.5                 | 6                   | 44   | 59  | 86   | 6.3                 | 1                   | 13   | 31  | 65   |
| 86                   | 5.0                 | 2                   | 6    | 43  | 63   | 4.9                 | 2                   | 2    | 29  | 54   |
| 87                   | 5.4                 | 3                   | 34   | 58  | 80   | 2.1                 | 3                   | 3    | 30  | 56   |
| 88                   | 6.4                 | 18                  | 41   | 63  | 80   | 1.5                 | 4                   | 4    | 7   | 21   |
| 89                   | 8.7                 | 8                   | 28   | 51  | 73   | 3.2                 | 2                   | 2    | 8   | 43   |
| 90                   | 10.0                | 1                   | 4    | 36  | 74   | 2.1                 | 2                   | 2    | 12  | 47   |
| 91                   | 6.8                 | +                   | 4    | 49  | 75   | 3.0                 | 1                   | 1    | 10  | 54   |
| 92                   | 15.7                | 7                   | 18   | 49  | 78   | 3.4                 | 1                   | 3    | 3   | 21   |
| 93                   | 21.8                | 17                  | 42   | 78  | 95   | 4.3                 | 3                   | 5    | 19  | 75   |
| 94                   | 10.8                | 2                   | 6    | 36  | 72   | 4.4                 | +                   | 1    | 4   | 30   |
| Average<br>(1981-94) | 8.4                 | 7                   | 27   | 53  | 80   | 3.2                 | 2                   | 5    | 18  | 50   |

Table 6. Average weights of sockeye salmon (lb) in the Bristol Bay commercial catches, 1960-94.

| Year  | 2-ocean |        |          | 3-ocean |        |          | All males | All females | All fish | BB Catch millions | Percent 3-ocean | Percent females |
|-------|---------|--------|----------|---------|--------|----------|-----------|-------------|----------|-------------------|-----------------|-----------------|
|       | Male    | Female | Combined | Male    | Female | Combined |           |             |          |                   |                 |                 |
| 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      | 7.1     | 5.7    | 6.2      | 5.7       | 4.9         | 5.3      | 35                | 39              | 55              |
| Means |         |        |          |         |        |          |           |             |          |                   |                 |                 |
| 85-94 | 5.2     | 4.6    | 4.9      | 7.3     | 6.2    | 6.7      | 6.2       | 5.4         | 5.8      | 27                | 51              | 52              |

Table 7. Forecasts of the 1995 Bristol Bay sockeye runs.

| River System | District       | Runs by age group (millions) |      |         |     |      |      |         | Total | Catch |
|--------------|----------------|------------------------------|------|---------|-----|------|------|---------|-------|-------|
|              |                | 1.2                          | 2.2  | 2-ocean | 0.3 | 1.3  | 2.3  | 3-ocean |       |       |
| Kvichak      |                | 1.5                          | 17.8 | 19.3    |     | 1.9  | 2.4  | 4.3     | 23.6  |       |
| Naknek       |                | 0.6                          | 1.8  | 2.4     |     | 1.4  | 2.3  | 3.7     | 6.1   |       |
| Branch       |                | 0.1                          | 0.2  | 0.3     |     | 0.2  | +    | 0.2     | 0.5   |       |
|              | Naknek/Kvichak | 2.2                          | 19.8 | 22.0    |     | 3.5  | 4.7  | 8.2     | 30.2  | 17.7  |
|              | Egegik         | 0.8                          | 5.5  | 6.3     |     | 1.1  | 4.7  | 5.8     | 12.1  | 10.0  |
|              | Ugashik        | 0.6                          | 1.3  | 1.9     |     | 1.7  | 1.4  | 3.1     | 5.0   | 3.4   |
| Wood         |                | 1.0                          | 0.1  | 1.1     |     | 1.5  | +    | 1.5     | 2.6   |       |
| Igushik      |                | 0.2                          | +    | 0.2     |     | 1.4  | 0.1  | 1.5     | 1.7   |       |
| Nush/Nuy     |                | 0.1                          | +    | 0.1     | 0.3 | 0.4  | +    | 0.7     | 1.0 * |       |
|              | Nushagak       | 1.3                          | 0.1  | 1.4     | 0.3 | 3.3  | 0.1  | 3.7     | 5.3   | 3.0   |
|              | Togiak         | 0.1                          | +    | 0.1     |     | 0.4  | +    | 0.4     | 0.5   | 0.3   |
|              | Bristol Bay    | 5.0                          | 26.7 | 31.7    | 0.3 | 10.0 | 10.9 | 21.2    | 53.1  | 34.4  |

+ indicates less than 100,000 predicted.

\*The Nushagak/Nuyakuk forecast includes 0.2 million 4-ocean fish.

Catches estimated by subtracting recent (5-year) mean escapements from runs.

Table 8. Bristol Bay sockeye runs (millions) by age group, 1958-94, and forecasts for 1995.

| Year             | 1-ocean | Age 1.2    | Age 2.2     | Total       |             |             | Total       |            | Total       | Catch     |
|------------------|---------|------------|-------------|-------------|-------------|-------------|-------------|------------|-------------|-----------|
|                  |         |            |             | 2-ocean     | Age 1.3     | Age 2.3     | 3-ocean     | 4-ocean    |             |           |
| 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        | 12.0        | 10.0        | 22.5        | 1.1        | 45.0        | 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               |         | <b>5.0</b> | <b>26.7</b> | <b>31.7</b> | <b>10.0</b> | <b>10.9</b> | <b>21.2</b> | <b>0.2</b> | <b>53.1</b> | <b>34</b> |
| Means<br>1984-94 | 0.1     | 6.2        | 15.5        | 21.8        | 9.9         | 6.7         | 17.1        | 0.3        | 39.3        | 26        |

Table 9. Kvichak sockeye salmon statistics to forecast 1995 runs by freshwater age.

| Brood year | Escapement      |                | Age 1 smolt     |             | Adult return (millions) |             |             |       | Smolt/ adult survival (%) | Mean length age 1.2 |
|------------|-----------------|----------------|-----------------|-------------|-------------------------|-------------|-------------|-------|---------------------------|---------------------|
|            | Number millions | Percent age .2 | Number millions | Mean weight | 1.1                     | 1.2         | 1.3         | Total |                           |                     |
| 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        | <b>1.90</b> |       |                           | 487                 |
| 91         | 4.20            | 77             | 22              | 6.0         | .001                    | <b>1.50</b> |             |       |                           |                     |

- 1) 95 forecast of age 1.2 from return of age 1.1 (.001) and number of smolt (22) for 1974-90.  $R^2=.56$ ;  $F_{2,14}=9.0$   $Y=.83+148(\text{age } 1.1)+.023(\text{smolt})$
- 2) 95 forecast of age 1.3 from return of age 1.2 (1.50) and mean length of age 1.2 (487) for 1981-89.  $R^2=.86$ ;  $F_{2,7}=21.7$   $Y=14.6+.309(\text{age } 1.2)-.027 (\text{1.2 length})$

| Brood year | Escapement      |                | Age 2 smolt     |             | Adult return (millions) |              |             |       | Smolt/ adult survival (%) | Mean length age 2.2 |
|------------|-----------------|----------------|-----------------|-------------|-------------------------|--------------|-------------|-------|---------------------------|---------------------|
|            | Number millions | Percent age .2 | Number millions | Mean weight | 2.1                     | 2.2          | 2.3         | Total |                           |                     |
| 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        | <b>2.40</b> |       |                           | 502                 |
| 90         | 7.00            | 91             | 205             | 8.2         | .082                    | <b>17.80</b> |             |       |                           |                     |

- 1) 95 forecast of age 2.2 from return of 2.1 (.082) and mean weight of smolts (8.2); 1981-89.  $R^2=.94$ ;  $F_{2,6}=22.2$   $Y=31.4+13.2(\text{age } 2.1)-2.98(\text{smolt wt})$
- 2) 95 forecast of age 2.3 from return of age 2.2 (18.47) and regression for 1981-88.  $R^2=.79$ ;  $F_{1,6}=19.6$   $Y=.30+.112(\text{age } 2.2)$



Table 11. Egegik sockeye salmon statistics to forecast runs by freshwater age (ordered by number of smolt).

| Smolt<br>Year | Escapement         |                   | Age 1 smolt        |                | Adult return (millions) |            |             |       | Smolt/<br>adult sur-<br>vival (%) | Mean<br>length<br>age 1.2 |
|---------------|--------------------|-------------------|--------------------|----------------|-------------------------|------------|-------------|-------|-----------------------------------|---------------------------|
|               | Number<br>millions | Percent<br>age .2 | Number<br>millions | Mean<br>weight | 1.1                     | 1.2        | 1.3         | Total |                                   |                           |
| 89            | 1.27               | 54                | 72                 | 8.9            | .000                    | .86        | 4.34        | 5.20  | 7.2                               | 496                       |
| 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                    | <b>.80</b> |             |       |                                   |                           |
| 84            | 1.03               | 88                | 17                 | 10.1           | .002                    | 1.01       | 1.79        | 2.80  | 16.5                              | 510                       |
| 86            | 1.17               | 69                | 14                 | 9.0            | .001                    | .58        | .93         | 1.51  | 10.8                              | 502                       |
| 92            | 2.19               | 70                | 6                  | 9.7            | .000                    | .40        | <b>1.10</b> | 1.50  |                                   | 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) 95 forecast of age 1.2 from return of age 1.1 (.001) and number of age 1 smolt (20)  
 $R^2 = .80$ ;  $F_{2,7} = 14.4$        $Y = .30 + 306(\text{age } 1.1) + .008(\text{age } 1 \text{ smolt})$
- 2) 95 forecast of age 1.3 from number of age 1. smolt (6) and regression of age 1.3 on age 1 smolt  
 $R^2 = .81$ ;  $F_{1,7} = 29.4$        $Y = .86 + .047(\text{age } 1 \text{ smolt})$

| Smolt<br>Year | Escapement         |                   | Age 2 smolt        |                | Adult return (millions) |             |             |       | Smolt/<br>adult sur-<br>vival (%) | Mean<br>length<br>age 2.2 |
|---------------|--------------------|-------------------|--------------------|----------------|-------------------------|-------------|-------------|-------|-----------------------------------|---------------------------|
|               | Number<br>millions | Percent<br>age .2 | Number<br>millions | Mean<br>weight | 2.1                     | 2.2         | 2.3         | Total |                                   |                           |
| 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                       |
| 87            | 1.17               | 69                | 46                 | 14.1           | .083                    | 6.17        | 4.74        | 10.91 | 23.7                              | 524                       |
| 93            | 2.19               | 70                | 38                 | 12.2           | .065                    | <b>5.50</b> |             |       |                                   |                           |
| 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        | <b>4.70</b> |       |                                   | 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                       |

- 1) 95 forecast of age 2.2 from number of smolt (38) and regression of smolt on return of 2.2  
 $R^2 = .72$ ;  $F_{1,7} = 18.4$        $Y = 1.81 + .096(\text{age } 2 \text{ smolt})$
- 2) 95 forecast of age 2.3 from return of age 2.2 (5.98) and regression of 2.3 on 2.2 returns  
 $R^2 = .56$ ;  $F_{1,6} = 7.7$        $Y = .812(\text{Age } 2.2) - .15$

Table 12. Ugashik sockeye salmon statistics to forecast runs by freshwater age.

| Brood year | Escapement      |                | Age 1 smolt     |             | Adult return (millions) |            |             |       | Smolt/ adult survival (%) | Mean length age 1.2 |
|------------|-----------------|----------------|-----------------|-------------|-------------------------|------------|-------------|-------|---------------------------|---------------------|
|            | Number millions | Percent age .2 | Number millions | Mean weight | 1.1                     | 1.2        | 1.3         | Total |                           |                     |
| 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        | <b>1.67</b> |       |                           | 488                 |
| 91         | 2.48            | 57             | 58              | 8.0         | .006                    | <b>.55</b> |             |       |                           |                     |

- 1) 95 forecast of age 1.2 from recent 5-year average (.55)
- 2) 95 forecast of age 1.3 from return of age 1.2 (.34) and mean length of 1.2 (488)  
 $R^2 = .82$ ;  $F_{2,6} = 14.0$        $Y = 31.25 + 2.00(\text{age } 1.2) - .062(\text{mean length age } 1.2)$

| Brood year | Escapement      |                | Age 2 smolt     |             | Adult return (millions) |             |             |       | Smolt/ adult survival (%) | Mean length age 2.2 |
|------------|-----------------|----------------|-----------------|-------------|-------------------------|-------------|-------------|-------|---------------------------|---------------------|
|            | Number millions | Percent age .2 | Number millions | Mean weight | 2.1                     | 2.2         | 2.3         | Total |                           |                     |
| 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        | <b>1.44</b> |       |                           | 490                 |
| 90         | 0.73            | 61             | 12              | 12.5        | .015                    | <b>1.30</b> |             |       |                           |                     |

- 1) 95 forecast of age 2.2 from return of age 2.1 (.015) and age 2 smolt (12).  
 $R^2 = .82$ ;  $F_{2,5} = 12.1$        $Y = .36 + 46.22(\text{age } 2.1) + .021(\text{age } 2 \text{ smolt})$
- 2) 95 forecast of age 2.3 from recent 5-year average (1.44)

Table 13. Sockeye salmon escapements and returns to the Wood and Igushik rivers.

## Wood River

| Brood year | Escapement      |                | Fry on 9/1 (yr+1) |             | Adult return (millions) |             |            |             |            |       | Mean length of 1.2 |
|------------|-----------------|----------------|-------------------|-------------|-------------------------|-------------|------------|-------------|------------|-------|--------------------|
|            | Number millions | Percent age .2 | Index catch       | Mean length | 1.1                     | 1.2         | 2.2        | 1.3         | 2.3        | Total |                    |
| 81         | 1.23            | 37             | 52                | 53          | .000                    | .60         | .08        | 1.14        | .09        | 1.91  | 490                |
| 82         | .98             | 34             | 10                | 61          | .003                    | .50         | .13        | .90         | .02        | 1.55  | 501                |
| 83         | 1.36            | 75             | 4                 | 63          | .001                    | 1.91        | .02        | 1.23        | .07        | 3.23  | 495                |
| 84         | 1.00            | 22             | 38                | 55          | .000                    | .52         | .03        | 1.32        | .02        | 1.89  | 502                |
| 85         | .94             | 49             | 11                | 55          | .003                    | 1.11        | .03        | 1.37        | .01        | 2.52  | 501                |
| 86         | .82             | 36             | 9                 | 55          | .002                    | 1.16        | .07        | 1.94        | .06        | 3.23  | 480                |
| 87         | 1.34            | 82             | 4                 | 57          | .000                    | 1.36        | .09        | .74         | .09        | 2.28  | 486                |
| 88         | .87             | 37             | 11                | 56          | .001                    | 1.59        | .09        | 1.39        | .03        | 3.10  | 482                |
| 89         | 1.19            | 49             | 9                 | 58          | .004                    | 2.17        | .01        | 1.82        | <b>.04</b> | 4.04  | 496                |
| 90         | 1.07            | 50             | 23                | 57          | .001                    | 1.08        | <b>.06</b> | <b>1.45</b> |            |       | 477                |
| 91         | 1.16            | 36             | 22                | 49          | .012                    | <b>1.02</b> |            |             |            |       |                    |

- 1) 95 return of age 1.2 from age .2% in escapement and regression of 1.2 on % age .2.  
R<sup>2</sup>=.33; F1,8=4.0      Y= .37 + .018 (% age .2)
- 2) Other 95 forecasts from recent 5-year averages (smolts and spawner distribution not available)

## Igushik

| Brood Year | Escapement      |               | Mean air temp. for: |               | Adult return (millions) |            |             |            |       | Mean length of 1.2 |
|------------|-----------------|---------------|---------------------|---------------|-------------------------|------------|-------------|------------|-------|--------------------|
|            | Number millions | Percent age.2 | Fry Apr-Oct         | Smolt Apr-May | 1.2                     | 2.2        | 1.3         | 2.3        | Total |                    |
| 81         | .59             | 24            | 5.8                 | 4.7           | .15                     | .00        | .83         | .05        | 1.03  | 512                |
| 82         | .42             | 5             | 7.6                 | 1.9           | .05                     | .01        | .48         | .01        | .55   | 548                |
| 83         | .18             | 73            | 6.8                 | -1.6          | .15                     | .01        | .33         | .03        | .52   | 508                |
| 84         | .19             | 9             | 5.0                 | 1.6           | .03                     | .05        | .63         | .03        | .74   | 525                |
| 85         | .21             | 37            | 6.7                 | 2.5           | .51                     | .08        | .90         | .08        | 1.57  | 525                |
| 86         | .31             | 7             | 7.5                 | 2.4           | .23                     | .03        | 2.20        | .03        | 2.49  | 494                |
| 87         | .17             | 40            | 6.9                 | 3.7           | .16                     | .01        | .57         | .03        | .77   | 516                |
| 88         | .17             | 12            | 8.3                 | 5.0           | .19                     | .04        | 1.02        | .04        | 1.29  | 503                |
| 89         | .46             | 49            | 7.8                 | 4.1           | .48                     | .06        | 1.05        | <b>.05</b> | 1.64  | 519                |
| 90         | .37             | 25            | 8.0                 | 2.7           | .16                     | <b>.05</b> | <b>1.37</b> |            |       | 494                |
| 91         | .76             | 6             | 6.5                 | 6.6           | <b>.24</b>              |            |             |            |       |                    |

- 1) 95 return of age 1.2 from recent 5-year average
- 2) 95 return of age 2.2 from return of 1.2 (.16) and regression of 2.2 on 1.2 return  
R<sup>2</sup>=.19; F1,14= 3.3      Y= .02 + .184(age 1.2)
- 3) 95 return of age 1.3 from return of age 1.2 (.16), % age 2 in escape. (25) and length of 1.2 (494)  
R<sup>2</sup>= .90; F3,5=7.3      Y= 12.68 + 1.62 (age 1.2) - .0164(% .2 Esc) - .0226(Length 1.2)
- 4) 95 return of age 2.3 from return of age 2.2 and regression of age 2.3 on age 2.2  
R<sup>2</sup>= .41; F1,6=4.1      Y= .024 + .486 (age 2.2)

Table 14. Sockeye salmon escapements and returns to the Nushagak and Togiak rivers.

| Nushagak/Nuyakuk |                 |                |                         |            |            |            |             |            |       |             |     |
|------------------|-----------------|----------------|-------------------------|------------|------------|------------|-------------|------------|-------|-------------|-----|
| Brood year       | Escapement      |                | Adult return (millions) |            |            |            |             |            |       | Mean length |     |
|                  | Number millions | Percent age .2 | 0.2                     | 0.3        | 0.4        | 1.2        | 1.3         | 1.4        | Total | 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         | <b>.08</b> | 1.43  | 480         |     |
| 90               | .67             | 22             | .05                     | .75        | <b>.13</b> | .04        | <b>0.36</b> |            |       |             |     |
| 91               | .50             | 5              | .01                     | <b>.26</b> |            | <b>.15</b> |             |            |       |             |     |
| 92               | .70             | 31             | <b>.05</b>              |            |            |            |             |            |       |             |     |

- 1) 95 forecast for age 0.2 from escapement (.70) and regression of age 0.2 on escapement.  
R<sup>2</sup>=.38; F1,8=4.9    Y = .127 - .1082(Escapement)
- 2) 95 forecast of age 0.3 from age 0.2 return (.05) and regression of 0.3 on 0.2 return  
R<sup>2</sup>= .60; F1,8=11.8    Y = .21 + 5.11(0.2 return)
- 3) 95 forecast of age 0.4 from return of 0.3 (.75) and regression of 0.4 on 0.3 return  
R<sup>2</sup>=.57; F1,7= 9.1    Y = .213(age 0.3 return) - .025
- 4) 95 forecast of age 1.2 from percent age .2 in escapement (5) and regression of 1.2 on % .2  
R<sup>2</sup>=.31; F1,8= 3.5    Y = .161 - .0023(Esc. % age .2)
- 5) 95 forecast of age 1.3 from return of age 1.2 (.75) and regression of 1.3 on 1.2 return  
R<sup>2</sup>=.65; F1,7= 13.1    Y = .14 + 5.51(age1.2 return)
- 6) 95 forecast of age 1.4 from recent 5-year average (.08).

| Togiak     |                 |                |                         |     |            |            |            |            |       |             |     |
|------------|-----------------|----------------|-------------------------|-----|------------|------------|------------|------------|-------|-------------|-----|
| Brood year | Escapement      |                | Adult return (millions) |     |            |            |            |            |       | Mean length |     |
|            | Number millions | Percent age .2 | 0.2                     | 0.3 | 1.2        | 1.3        | 2.2        | 2.3        | Total | 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        | <b>.03</b> | .51   | 522         | 561 |
| 90         | .19             | 24             | .001                    | .02 | .10        | <b>.35</b> | <b>.04</b> |            |       | 495         |     |
| 91         | .28             | 41             | .001                    |     | <b>.12</b> |            |            |            |       |             |     |

- 1) 95 forecasts of ages 1.2 and 2.2 from recent 5-year averages
- 2) 95 forecast of age 1.3 from return of 1.2 (.10) and regression of age 1.3 on 1.2 returns  
R<sup>2</sup>= .86; F1,7=44.5    Y = .08 + 2.682(age 1.2 return)
- 4) 95 forecast of age 2.3 from return of 2.2 (.01) and regression of 2.3 on 2.2 returns  
R<sup>2</sup>= .87; F1,6=40.9    Y= .016 + 1.308(age 2.2 return)