

**Fishery Manuscript No. 06-05**

---

---

# **Review of Salmon Escapement Goals in Bristol Bay, Alaska, 2006**

by

**Timothy T. Baker,**

**Lowell F. Fair,**

**Robert A. Clark,**

and

**James J. Hasbrouck**

---

---

November 2006

Alaska Department of Fish and Game

Divisions of Sport Fish and Commercial Fisheries



## Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used without definition in the following reports by the Divisions of Sport Fish and of Commercial Fisheries: Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications. All others, including deviations from definitions listed below, are noted in the text at first mention, as well as in the titles or footnotes of tables, and in figure or figure captions.

| <b>Weights and measures (metric)</b> |    | <b>General</b>           |                                  | <b>Measures (fisheries)</b>      |                         |
|--------------------------------------|----|--------------------------|----------------------------------|----------------------------------|-------------------------|
| centimeter                           | cm | Alaska Administrative    |                                  | fork length                      | FL                      |
| deciliter                            | dL | Code                     | AAC                              | mid-eye-to-fork                  | MEF                     |
| gram                                 | g  | all commonly accepted    |                                  | mid-eye-to-tail-fork             | METF                    |
| hectare                              | ha | abbreviations            | e.g., Mr., Mrs.,<br>AM, PM, etc. | standard length                  | SL                      |
| kilogram                             | kg |                          |                                  | total length                     | TL                      |
| kilometer                            | km | all commonly accepted    |                                  |                                  |                         |
| liter                                | L  | professional titles      | e.g., Dr., Ph.D.,<br>R.N., etc.  |                                  |                         |
| meter                                | m  | at                       | @                                | <b>Mathematics, statistics</b>   |                         |
| milliliter                           | mL | compass directions:      |                                  | <i>all standard mathematical</i> |                         |
| millimeter                           | mm | east                     | E                                | <i>signs, symbols and</i>        |                         |
|                                      |    | north                    | N                                | <i>abbreviations</i>             |                         |
|                                      |    | south                    | S                                | alternate hypothesis             | H <sub>A</sub>          |
|                                      |    | west                     | W                                | base of natural logarithm        | <i>e</i>                |
|                                      |    | copyright                | ©                                | catch per unit effort            | CPUE                    |
|                                      |    | corporate suffixes:      |                                  | coefficient of variation         | CV                      |
|                                      |    | Company                  | Co.                              | common test statistics           | (F, t, $\chi^2$ , etc.) |
|                                      |    | Corporation              | Corp.                            | confidence interval              | CI                      |
|                                      |    | Incorporated             | Inc.                             | correlation coefficient          |                         |
|                                      |    | Limited                  | Ltd.                             | (multiple)                       | R                       |
|                                      |    | District of Columbia     | D.C.                             | correlation coefficient          |                         |
|                                      |    | et alii (and others)     | et al.                           | (simple)                         | r                       |
|                                      |    | et cetera (and so forth) | etc.                             | covariance                       | cov                     |
|                                      |    | exempli gratia           | e.g.                             | degree (angular)                 | °                       |
|                                      |    | (for example)            |                                  | degrees of freedom               | df                      |
|                                      |    | Federal Information      | FIC                              | expected value                   | <i>E</i>                |
|                                      |    | Code                     |                                  | greater than                     | >                       |
|                                      |    | id est (that is)         | i.e.                             | greater than or equal to         | ≥                       |
|                                      |    | latitude or longitude    | lat. or long.                    | harvest per unit effort          | HPUE                    |
|                                      |    | monetary symbols         |                                  | less than                        | <                       |
|                                      |    | (U.S.)                   | \$, ¢                            | less than or equal to            | ≤                       |
|                                      |    | months (tables and       |                                  | logarithm (natural)              | ln                      |
|                                      |    | figures): first three    |                                  | logarithm (base 10)              | log                     |
|                                      |    | letters                  | Jan, ..., Dec                    | logarithm (specify base)         | log <sub>2</sub> , etc. |
|                                      |    | registered trademark     | ®                                | minute (angular)                 | '                       |
|                                      |    | trademark                | ™                                | not significant                  | NS                      |
|                                      |    | United States            |                                  | null hypothesis                  | H <sub>0</sub>          |
|                                      |    | (adjective)              | U.S.                             | percent                          | %                       |
|                                      |    | United States of         |                                  | probability                      | P                       |
|                                      |    | America (noun)           | USA                              | probability of a type I error    |                         |
|                                      |    | U.S.C.                   | United States                    | (rejection of the null           |                         |
|                                      |    |                          | Code                             | hypothesis when true)            | α                       |
|                                      |    |                          |                                  | probability of a type II error   |                         |
|                                      |    |                          |                                  | (acceptance of the null          |                         |
|                                      |    |                          |                                  | hypothesis when false)           | β                       |
|                                      |    |                          |                                  | second (angular)                 | "                       |
|                                      |    |                          |                                  | standard deviation               | SD                      |
|                                      |    |                          |                                  | standard error                   | SE                      |
|                                      |    |                          |                                  | variance                         |                         |
|                                      |    |                          |                                  | population                       | Var                     |
|                                      |    |                          |                                  | sample                           | var                     |

### Weights and measures (English)

|                       |                    |
|-----------------------|--------------------|
| cubic feet per second | ft <sup>3</sup> /s |
| foot                  | ft                 |
| gallon                | gal                |
| inch                  | in                 |
| mile                  | mi                 |
| nautical mile         | nmi                |
| ounce                 | oz                 |
| pound                 | lb                 |
| quart                 | qt                 |
| yard                  | yd                 |

### Time and temperature

|                    |     |
|--------------------|-----|
| day                | d   |
| degrees Celsius    | °C  |
| degrees Fahrenheit | °F  |
| degrees kelvin     | K   |
| hour               | h   |
| minute             | min |
| second             | s   |

### Physics and chemistry

|                       |           |
|-----------------------|-----------|
| all atomic symbols    |           |
| alternating current   | AC        |
| ampere                | A         |
| calorie               | cal       |
| direct current        | DC        |
| hertz                 | Hz        |
| horsepower            | hp        |
| hydrogen ion activity | pH        |
| (negative log of)     |           |
| parts per million     | ppm       |
| parts per thousand    | ppt,<br>‰ |
| volts                 | V         |
| watts                 | W         |

***FISHERY MANUSCRIPT NO. 06-05***

**REVIEW OF SALMON ESCAPEMENT GOALS  
IN BRISTOL BAY, ALASKA, 2006**

by

Timothy T. Baker, Lowell F. Fair,  
Alaska Department of Fish and Game, Division of Commercial Fisheries, Anchorage

and

Robert A. Clark, and James J. Hasbrouck  
Alaska Department of Fish and Game, Division of Sport Fish, Anchorage

Alaska Department of Fish and Game  
Division of Sport Fish, Research and Technical Services  
333 Raspberry Road, Anchorage, Alaska, 99518-1565

November 2006

The Division of Sport Fish Fishery Manuscript series was established in 1987 for the publication of technically-oriented results of several years' work undertaken on a project to address common objectives, provide an overview of work undertaken through multiple projects to address specific research or management goal(s), or new and/or highly technical methods. Since 2004, the Division of Commercial Fisheries has also used the Fishery Manuscripts series. Fishery Manuscripts are intended for fishery and other technical professionals. Fishery Manuscripts are available through the Alaska State Library and on the Internet: <http://www.sf.adfg.state.ak.us/statewide/divreports/html/intersearch.cfm> This publication has undergone editorial and peer review.

*Timothy T. Baker, Lowell F. Fair,  
Alaska Department of Fish and Game, Division of Commercial Fisheries,  
333 Raspberry Road, Anchorage, AK 99518, USA*

*and*

*Robert A. Clark, and James J. Hasbrouck  
Alaska Department of Fish and Game, Division of Sport Fish,  
333 Raspberry Road, Anchorage, AK 99518, USA*

*This document should be cited as:*

*Baker, T. T., L. F. Fair, R. A. Clark, and J. J. Hasbrouck. 2006. Review of salmon escapement goals in Bristol Bay, Alaska, 2006. Alaska Department of Fish and Game, Fishery Manuscript No. 06-05, Anchorage.*

The Alaska Department of Fish and Game (ADF&G) administers all programs and activities free from discrimination based on race, color, national origin, age, sex, religion, marital status, pregnancy, parenthood, or disability. The department administers all programs and activities in compliance with Title VI of the Civil Rights Act of 1964, Section 504 of the Rehabilitation Act of 1973, Title II of the Americans with Disabilities Act (ADA) of 1990, the Age Discrimination Act of 1975, and Title IX of the Education Amendments of 1972.

**If you believe you have been discriminated against in any program, activity, or facility please write:**

ADF&G ADA Coordinator, P.O. Box 115526, Juneau AK 99811-5526

U.S. Fish and Wildlife Service, 4040 N. Fairfax Drive, Suite 300 Webb, Arlington VA 22203

Office of Equal Opportunity, U.S. Department of the Interior, Washington DC 20240

**The department's ADA Coordinator can be reached via phone at the following numbers:**

(VOICE) 907-465-6077, (Statewide Telecommunication Device for the Deaf) 1-800-478-3648, (Juneau TDD) 907-465-3646, or (FAX) 907-465-6078

**For information on alternative formats and questions on this publication, please contact:**

ADF&G, Sport Fish Division, Research and Technical Services, 333 Raspberry Road, Anchorage AK 99518 (907)267-2375.

# TABLE OF CONTENTS

|                                     | <b>Page</b> |
|-------------------------------------|-------------|
| LIST OF TABLES.....                 | ii          |
| LIST OF FIGURES.....                | ii          |
| LIST OF APPENDICES.....             | ii          |
| ABSTRACT.....                       | 1           |
| INTRODUCTION.....                   | 1           |
| METHODS.....                        | 2           |
| Escapement Goal Recommendation..... | 3           |
| Spawner-return Data.....            | 3           |
| Yield Analysis.....                 | 4           |
| Smolt Information.....              | 4           |
| Risk Analysis.....                  | 4           |
| RESULTS.....                        | 5           |
| Sockeye Salmon.....                 | 6           |
| Alagnak River.....                  | 6           |
| Togiak River.....                   | 6           |
| Kulukak River.....                  | 7           |
| Chinook Salmon.....                 | 7           |
| Nushagak River.....                 | 7           |
| Togiak River.....                   | 7           |
| Naknek River.....                   | 8           |
| Alagnak River.....                  | 8           |
| Egegik River.....                   | 8           |
| Chum Salmon.....                    | 9           |
| Nushagak River.....                 | 9           |
| Coho Salmon.....                    | 9           |
| Pink Salmon.....                    | 9           |
| Nushagak River.....                 | 9           |
| DISCUSSION.....                     | 9           |
| REFERENCES CITED.....               | 11          |
| TABLES AND FIGURES.....             | 13          |
| APPENDIX A.....                     | 19          |
| APPENDIX B.....                     | 39          |

## LIST OF TABLES

| <b>Table</b>   | <b>Page</b> |
|--|-------------|
| 1. Bristol Bay sockeye salmon runs by system, 1996–2005 (in thousands of fish).....                                    | 14          |
| 2. List of members on the Alaska Department of Fish and Game (ADF&G) Bristol Bay salmon escapement goal committee..... | 15          |
| 3. Summary of current escapement goals and recommended escapement goals for salmon stocks in Bristol Bay. ....         | 16          |

## LIST OF FIGURES

| <b>Figure</b>   | <b>Page</b> |
|---|-------------|
| 1. Bristol Bay area showing major salmon river locations..... | 17          |

## LIST OF APPENDICES

| <b>Appendix</b>   | <b>Page</b> |
|---|-------------|
| A1. Ugashik River data available for analysis of sockeye salmon escapement goal (in thousands of fish).....   | 20          |
| A2. Egegik River data available for analysis of sockeye salmon escapement goal (in thousands of fish).....    | 21          |
| A3. Naknek River data available for analysis of sockeye salmon escapement goal (in thousands of fish).....    | 22          |
| A4. Kvichak River data available for analysis of sockeye salmon escapement goal (in thousands of fish). ....  | 23          |
| A5. Wood River data available for analysis of sockeye salmon escapement goal (in thousands of fish). ....     | 24          |
| A6. Nushagak River data available for analysis of sockeye salmon escapement goal (in thousands of fish). .... | 25          |
| A7. Igushik River data available for analysis of sockeye salmon escapement goal (in thousands of fish). ....  | 26          |
| A8. Togiak River data available for analysis of sockeye salmon escapement goal (in thousands of fish).....    | 27          |
| A9. Kulukak River data available for analysis of sockeye salmon escapement goal. ....                         | 28          |
| A10. Nushagak River data available for analysis of Chinook salmon escapement goal. ....                       | 29          |
| A11. Togiak River data available for analysis of Chinook salmon escapement goal.....                          | 30          |
| A12. Naknek River data available for analysis of Chinook salmon escapement goal. ....                         | 31          |
| A13. Alagnak River data available for analysis of Chinook salmon escapement goal. ....                        | 32          |
| A14. Egegik River data available for analysis of Chinook salmon escapement goal.....                          | 33          |
| A15. Nushagak River data available for analysis of chum salmon escapement goal.....                           | 34          |
| A16. Nushagak River data available for analysis of coho salmon escapement goal.....                           | 35          |
| A17. Togiak River data available for analysis of coho salmon escapement goal.....                             | 36          |
| A18. Kulukak River data available for analysis of coho salmon escapement goal. ....                           | 37          |
| A19. Nushagak River data available for analysis of pink salmon escapement goal.....                           | 38          |
| B1. Escapement goal for Alagnak River sockeye salmon.....   | 40          |

## ABSTRACT

The Alaska Department of Fish and Game escapement goal review committee reviewed Pacific salmon *Oncorhynchus* spp. escapement goals for the major river systems in Bristol Bay. Spawner-return data were evaluated for: sockeye salmon *O. nerka* in the Ugashik, Egegik, Kvichak, Naknek, Alagnak, Wood, Nushagak, Igushik, Togiak, and Kulukak Rivers; Chinook salmon *O. tshawytscha* in the Nushagak, Togiak, Alagnak, Naknek, and Egegik Rivers; chum salmon *O. keta* in the Nushagak River; coho salmon *O. kisutch* in the Togiak, Nushagak, and Kulukak Rivers; and pink salmon *O. gorbuscha* in the Nushagak River. The committee recommended that the majority of the escapement goals in Bristol Bay be defined as sustainable escapement goals (SEGs) instead of biological escapement goals (BEGs). The only exception was sockeye salmon in the Togiak River that would remain a BEG. The committee also recommended that no changes be made to the majority of the escapement goals for sockeye salmon in Bristol Bay. The only exceptions were for the Alagnak and Kulukak Rivers. The committee recommended setting a minimum threshold SEG of 320,000 sockeye salmon in the Alagnak River and creating an 8,000 minimum threshold SEG for sockeye salmon in the Kulukak River. The committee recommended changes to all of the escapement goals for Chinook salmon in Bristol Bay. Chinook salmon in the Nushagak River was recommended for change from a point goal of 65,000 to a BEG range of 40,000–80,000, while SEG thresholds were recommended for the Togiak (9,300) and Naknek (5,000) rivers. New SEG thresholds were recommended for Chinook salmon in the Egegik (450) and Alagnak (2,700) rivers. The committee recommended setting a SEG threshold of 190,000 chum salmon in the Nushagak River. Finally, the committee recommended that escapement goals be dropped for coho salmon in the Togiak, Nushagak and Kulukak Rivers and pink salmon in the Nushagak River.

Key words: Pacific salmon, *Oncorhynchus*, sockeye salmon, *O. nerka*, Chinook salmon, *O. tshawytscha*, chum salmon, *O. keta*, coho salmon, *O. kisutch*, pink salmon, *O. gorbuscha*, Bristol Bay, Kvichak River, Alagnak River, Naknek River, Egegik River, Ugashik River, Wood River, Igushik River, Nushagak River, Kulukak River, Togiak River, spawning escapement goal, Ricker stock-recruitment model, smolt, Alaska Board of Fisheries.

## INTRODUCTION

Bristol Bay, Alaska, supports some of the largest sockeye salmon *Oncorhynchus nerka* runs in the world. Combined sockeye salmon runs to Bristol Bay have averaged 33 million fish for the last 10 years with nine major river systems producing more than 99% of the returning sockeye salmon (Ugashik, Egegik, Naknek, Kvichak, Alagnak, Wood, Nushagak, Igushik, and Togiak Rivers; Table 1; Figure 1). Management of these sockeye salmon runs is based on achieving spawning escapements for each river within a specific escapement goal range. Individual escapement goals for sockeye salmon have been in place for the major river systems since the early 1960s. Bristol Bay also supports one of the largest runs of Chinook salmon in Alaska. The Chinook salmon run in the Nushagak River has averaged 150,000 since the 1990's. Smaller runs of Chinook *O. tshawytscha*, chum *O. keta*, coho *O. kisutch*, and pink *O. gorbuscha* salmon are also found in the many rivers of Bristol Bay.

Escapement goals were reviewed based on the Policy for the Management of Sustainable Salmon Fisheries (SSFP; 5 AAC 39.222) and the Policy for Statewide Salmon Escapement Goals (EGP; 5 AAC 39.223). The Alaska Board of Fisheries (BOF) adopted these policies into regulation during the winter of 2000–2001 to ensure that the state's salmon stocks are conserved, managed, and developed using the sustained yield principle. Two important terms defined in the SSFP were:

“*Biological Escapement Goal* (BEG): the escapement that provides the greatest potential for maximum sustained yield (MSY)” and

“*Sustainable Escapement Goal* (SEG): a level of escapement, indicated by an index or an escapement estimate, that is known to provide for sustained yield over a 5 to 10 year period, used in situations where a BEG cannot be estimated due to the absence of a stock specific catch estimate.”

The Alaska Department of Fish and Game (ADF&G) reviews the escapement goals for Bristol Bay rivers on a schedule that corresponds to the Alaska Board of Fisheries 3-year cycle for considering area regulatory proposals. This report describes the Bristol Bay salmon escapement goals that were reviewed in 2003 and presents information from the subsequent 3 years in the context of these goals. Bristol Bay escapement goals were thoroughly reviewed during the previous 2003–2004 BOF cycle (Fair et al. 2004). Due to the thoroughness of the previous analysis by Fair et al. (2004), this review re-analyzed only those goals with recent (2003–2005) data that substantially changed findings from the 2003 review. In addition, the basis for deciding goal type (BEG, SEG) has evolved since the 2003 review. Because of this, the goal type (BEG, SEG) was reviewed for all stocks in Bristol Bay.

During the 2006 review process, escapement goals for the following stocks were evaluated:

- Sockeye salmon: Ugashik, Egegik, Kvichak (pre-peak/peak and off-cycle), Naknek, Alagnak, Wood, Nushagak, Igushik, Togiak, and Kulukak rivers;
- Chinook salmon: Nushagak, Togiak, Naknek, Alagnak, and Egegik rivers;
- Chum salmon: Nushagak River;
- Coho salmon: Nushagak, Togiak, and Kulukak rivers;
- Pink salmon: Nushagak River.

During spring of 2006, ADF&G established an escapement goal review committee (hereafter referred to as the committee). The committee consisted of four Division of Commercial Fisheries and three Division of Sport Fish personnel (Table 2). The committee was formed to recommend the appropriate type of escapement goal (BEG or SEG) and provide an analysis for recommending an escapement goal for each stock.

The committee formally met 13 April, 2006 to review escapement goals and develop recommendations. The committee also communicated by email. All committee recommendations were reviewed by ADF&G regional and headquarters staff prior to being adopted by ADF&G as escapement goals per the SSFP and EGP.

## **METHODS**

Available escapement, catch, and age data for each stock were compiled from research reports, management reports, and unpublished historical databases. The committee evaluated the type, quality, and quantity of data for each stock. This evaluation was used to determine the appropriate type of escapement goal as defined in regulation. Generally speaking, an escapement goal for a stock should provide escapement that produces sustainable yields. An escapement goal for a stock was defined as a BEG if a sufficiently long time series of escapement, catch, and age estimates were available; the estimates were sufficiently accurate and precise; and the data were considered sufficient to estimate MSY (as per rules and methods in Chinook Technical Committee 1999; Hilborn and Walters 1992; Quinn and Deriso 1999). An escapement goal for a stock was defined as an SEG if a sufficiently long time series of escapement estimates were available, but there was concern about the spawner-return data (lack of age composition estimates and/or concern with stock-specific catch allocation) or there was a lack of information on stock productivity.

The committee considered visual counts from towers as “good” estimates of escapement and sonar counts as “fair” estimates of escapement. Total return and spawner-return data were considered “good” if the escapement quality was “good” and there were no concerns with estimates of stock-specific harvest. Total return and spawner-return data was considered “fair” if the quality of the escapement data was “fair” or if there were concerns with estimates of stock-specific harvest.

The majority of the large salmon stocks in Bristol Bay have “good” escapement and age data, and in some cases smolt data. Escapement was sampled by beach seine and visually counted using towers at Ugashik, Egegik, Naknek, Kvichak, Alagnak, Wood, Nushagak, Igushik, and Togiak rivers. Escapement was sampled by gillnet or beach seine and estimated using hydroacoustics (sonar) for Nushagak River salmon. Age data have been collected from both the escapement and harvest for all of these stocks. Harvest allocation for each stock was estimated by harvest location and age composition. Stock contributions for multi-stock fisheries (Naknek-Kvichak and Nushagak Districts) were estimated based on age composition and run timing of each stock (West 2003).

## **ESCAPEMENT GOAL RECOMMENDATION**

Escapement goals were evaluated for Bristol Bay stocks using the following methods: (1) Spawner-return data; (2) Yield Analysis; (3) Smolt Information; and (4) Risk Analysis. Spawner-return data was used to estimate escapement goals when the committee determined it had “good” estimates of total return (escapement and stock-specific harvest) for a stock. When “good” spawner-return data was available, escapement goals were estimated based on: (1) escapements producing average yields that were 90–100% of MSY ( $S_{MSY}$ ) from a stock-recruitment model, and 2) the Yield Analysis, explained below, which also estimates MSY with corresponding 90–100% yield range. Smolt information, when available, was used to aid in the estimation of escapement goals for stocks. When the harvest of a stock was deemed coincidental to harvests and management of primary stocks (e.g., chum harvests are coincidental to the directed harvests of sockeye and Chinook salmon in the Nushagak River), the risk analysis approach was used to determine SEG thresholds for these non-targeted stocks.

### **Spawner-return Data**

Salmon spawner-return data were analyzed for all available brood years. Annual runs were the sum of escapements and harvests. Methods used to estimate total runs (harvest plus escapement) are described in Bernard (1983). Sport and subsistence harvests were only included in total return estimates for the Nushagak River, and are considered minor components for the other systems.

Spawner-return data were analyzed using a Ricker (1954) stock-recruitment model to estimate MSY and the escapement goal range. Results were not used if the model fit the data poorly ( $P \geq 0.20$ ) or model assumptions were violated. The Chinook Technical Committee (1999), Hilborn and Walters (1992), and Quinn and Deriso (1999) provide good descriptions of the Ricker model and diagnostics to assess model fit. All stock-recruitment models were tested and corrected for serial correlation of residuals when necessary. Additionally, the Ricker alpha parameter was corrected for the logarithm transformation bias induced into the model as described in Hilborn and Walters (1992) from fitting a regression line to  $\ln(\text{recruits/spawners})$  versus spawners.

## Yield Analysis

In previous reviews (Cross et al. 1997; Fair 2000), an empirical approach was used to examine stock-recruitment yield relationships. This approach arranged spawning escapements into intervals. For each escapement interval, we calculated the average escapement and average surplus yield,  $ASY$ , for each interval, where yield is recruitment minus parental spawning escapement and

$$ASY = \frac{\sum_{i=1}^n y_i}{n}. \quad (1)$$

The problem with this approach is that the arrangement of spawning intervals is highly subjective and often results in large perceived changes in categorical yield.

As an alternative empirical stock-yield approach, yields were first plotted against spawning escapements. Second, the yield and escapement time series were sorted in ascending order by escapement. Next, a running average of  $n$  observations of yield,  $s_i$ , ( $i = 1, \dots, N-n+1$ ) is defined by

$$s_i = \frac{1}{n} \sum_{j=i}^{i+n-1} a_j, \quad (2)$$

where  $a_j = j$ th lowest value of yield ( $j = 1, \dots, N$ ).

Lastly, these new series averages were fit using a nonlinear polynomial of order 2 to approximate a theoretical yield curve. In this approach, the value of  $i$  is dependent on the property of the data. In practice, a running average that gives a smooth fit with a parabolic shape is ideal. The advantage of this approach is that the spawner-recruit function does not strictly assume a Ricker form, however, the underlying theory of stock-recruitment relations remains.

## Smolt Information

Smolt production was examined in systems for which this information had been collected. Passage of sockeye salmon smolt was estimated with hydroacoustic equipment in the Kvichak River from 1971–2002, Egegik River from 1982–2002, and Ugashik River from 1983–2002, accompanied with age and size data collected from fyke net samples (Crawford and Fair 2003). Relationships between the number of smolt produced (recruitment) and number of spawners were examined using a Ricker stock-recruitment model. If marine survival is assumed to be largely density independent, a smolt production model provides improved estimates of yield related to spawners by eliminating marine environmental influences on survival.

## Risk Analysis

For stocks that are passively managed and coincidentally harvested, SEG thresholds were estimated. The six stocks selected for this procedure were Alagnak, Egegik, Naknek, and Togiak river Chinook salmon, Nushagak River chum salmon, and Kulukak River sockeye salmon.

All escapement time series except for Egegik River Chinook salmon were composed of a single aggregate count or survey. For Egegik River Chinook salmon there were aerial survey data from the mainstem and five tributaries (Sands et al. 2003). Correlation in log-transformed escapements among the six aerial survey areas was not high, but Gertrude, Kaye's, and Takayoto creeks all exhibited positive correlations that exceeded 0.5 and are proximate to each other in the

King Salmon River drainage, so that these three systems were combined into one index of escapement for use in the SEG analysis. Counts in these three surveys represent approximately 65% of enumerated Chinook salmon in Egegik River surveys.

The method used to develop SEG thresholds followed that of Bernard et al. (*Unpublished*). Escapement time series were first log-transformed and tested for deviations from normality using a one-sample Kolmogorov-Smirnov test. The log-transformed escapement time series were then tested for serial correlation using diagnostics in Abraham and Ledolter (1983). Residuals of the four autoregressive models had no significant serial correlation, so no further modeling was necessary.

For Nushagak River chum salmon, and the Egegik and Naknek River Chinook salmon stocks, risk of an unwarranted restriction due to a management concern ( $\pi_k$ ) was estimated directly from the log transformed mean ( $\mu$ ), standard deviation ( $\sigma$ ), and number of consecutive years to warrant a management concern ( $k$ ) for various values of an escapement threshold ( $X$ ) as per Bernard et al. (*Unpublished*):

$$\hat{\pi}_k = \left\{ pr \left[ (N : \hat{\mu}, \hat{\sigma}^2) \leq \ln X \right] \right\}^k, \text{ where } k = 3. \quad (3)$$

For Alagnak and Kulukak river sockeye salmon, and Alagnak and Togiak river Chinook salmon, direct calculation of risk of unwarranted restriction was not possible due to serial correlation in escapements, so that simulation was required. A long escapement time series was simulated using the original escapements and the appropriate autoregressive model. Simulated escapements were appended onto the original escapement time series, so that a large number of (>1,000) escapements were available. This allowed for a large number of possible sets of 3 consecutive years for tabulation of estimated risk. Risk was then estimated by summing the number of times 3 consecutive years of escapements were below various escapement thresholds dividing by the number of simulated escapements minus four.

Risk of detecting a drop in mean escapement was calculated in the same way as risk of an unwarranted concern, except that the risk of not detecting ( $1 - \hat{\pi}_k$ ) was estimated and the mean escapement ( $\hat{\mu}$ ) was changed by the desired percentage drop in mean to be detected with the threshold. Risk was estimated for drops of 95 to 25% of the mean escapement depending on the stock. The maximum percentage drop in mean escapement was based on the observed percent difference between the mean escapement and the minimum escapement for each stock (95% for Kulukak River sockeye salmon; 85% for Alagnak River sockeye salmon; 80% for Alagnak River Chinook salmon; 70% for Nushagak River chum and Egegik River Chinook salmon; 55% for Naknek River Chinook salmon; and 40% for Togiak River Chinook salmon). Recommended escapement thresholds were chosen based on an estimated risk of 15% or less for triggering an unwarranted management concern and an approximately equal risk of failing to detect the maximum percentage drop in mean escapement as noted above (Bernard et al. *Unpublished*).

## RESULTS

There were 21 escapement goals evaluated for 20 stocks in Bristol Bay (Table 3). There were 17 existing escapement goals (all BEGs) and 4 new goals for stocks that previously did not have goals. This resulted in 17 proposed goals, all but one of which was changed from BEG to SEG status. The recommendation for each escapement goal follows by species and river. The

detailed information for each escapement goal can be found in the previous review report (Fair et al. 2004). Recent and historical data used for each escapement goal analysis is located in Appendix A. For Alagnak River sockeye salmon, which underwent an updated review (see also Clark 2005), detailed information is located in Appendix B.

## **SOCKEYE SALMON**

The committee recommended that escapement goals for sockeye salmon in the Ugashik, Egegik, Naknek, Kvichak (off cycle and peak/pre-peak years), Wood, Nushagak, and Igushik rivers be defined as an SEG instead of a BEG. The current escapement goal ranges would remain unchanged from the 2000 review (Fair 2000; see also Table 3). No new escapement goal analyses were completed for these stocks in 2006. The latest escapement goal analyses for these stocks were completed in 2003 by Fair et al. (2004).

### **Alagnak River**

The committee recommended that the BEG of 170,000 to 200,000 aerial survey counts be changed to a lower bound SEG of 320,000 tower counts with no upper bound since this stock is not actively managed. The goal was estimated using the risk analysis approach with escapement data beginning in 1956 (Appendix B1). An escapement threshold of 320,000 sockeye resulted in a 7% estimated risk of an unwarranted concern, with a 7% estimated risk that a drop in mean escapement of 90% would not be detected in 3 years. The desire is to maintain the median escapement at 500,000 tower units.

Although the quality of the tower data collected from 1956–1976 is questionable due to the tower's location in the intertidal zone with frequent murky water conditions, we felt the data was sufficient for this analysis since the Alagnak productivity closely matched other Bristol Bay stock productivity changes during the period of the data set. The general trend was an increasing shift in productivity during the mid to late 1970s.

### **Togiak River**

The committee recommended the escapement goal for sockeye salmon in the Togiak River continue to be defined as a BEG since the accuracy of catch allocation of the harvest is not a perceived problem in the Togiak District. Additionally it was recommended that the current escapement goal range of 100,000 to 200,000 sockeye salmon be changed to a range of 120,000 to 270,000 based on an escapement goal analysis for this stock that was completed in 2003 by Fair et al. (2004). The analysis conducted by Fair et al. (2004) has been provided below because there was a recommendation to change the escapement goal for this stock.

Fair et al. (2004) recommended to change the BEG range of 100,000 to 200,000 spawners to a range of 100,000 to 250,000 spawners. A Ricker stock-recruitment model fit to the data for 1956–1997 brood years had autocorrelation of lag-1 and estimated  $S_{MSY}$  at 187,000 spawners with a 90–100% MSY escapement range of 119,000 to 267,000 (Table 5; Appendix B6 in Fair et al. 2004). The stock-yield model estimated  $S_{MSY}$  at 206,000 spawners with a 90–100% MSY escapement range of 151,000 to 262,000 spawners.

Both the Ricker and stock-yield models estimated that  $S_{MSY}$  is near the upper end of the current goal, prompting us to raise the upper range. An upper range of 250,000 was chosen because it closely matches the upper 90–100% MSY escapement range from both approaches. Because the aerial survey escapement component is considered additional to the Togiak River tower counts,

and annually averages 20,000 expanded counts, it was added to the river BEG of 100,000 to 250,000 spawners for a total Togiak River system goal of 120,000 to 270,000 spawners.

### **Kulukak River**

The committee recommended establishing an escapement goal for sockeye salmon in the Kulukak River based on an escapement goal analysis for this stock that was completed in 2003 by Fair et al. (2004). The analysis conducted by Fair et al. (2004) has been provided below because there was a recommendation to change the escapement goal for this stock.

Fair et al. (2004) recommended establishing a lower bound SEG of 8,000 aerial survey counts with no upper bound using the risk analysis approach with escapement data beginning in 1961 (Table 6; Appendix B10 in Fair et al. 2004). An escapement threshold of 8,000 sockeye resulted in a 5% estimated risk of an unwarranted concern, with a 5% estimated risk that a drop in mean escapement of 90% would not be detected in 3 years. The desire is to maintain the median escapement at 17,300 aerial survey units.

## **CHINOOK SALMON**

### **Nushagak River**

The committee recommended the escapement goal for Chinook salmon in the Nushagak River be defined as an SEG instead of a BEG. Additionally, the committee recommended that the current escapement goal of 65,000 Chinook salmon counted by sonar changed to a range of 40,000 to 80,000 Chinook salmon, based on an escapement goal analysis for this stock that was completed in 2003 by Fair et al. (2004). The analysis conducted by Fair et al. (2004) has been provided below because there was a recommendation to change the escapement goal for this stock.

Ricker stock-recruitment models were fit with two data sets of escapement: (1) sonar data from 1980 to present, and (2) a full data set that includes expanded aerial surveys (1966–1979) and sonar. Because the results from both models were nearly identical, we used the full data set in our final analysis to better encompass long-term variability. The full model fit to the data for 1966–1996 brood years had autocorrelation of lag-1 and estimated escapement that produced MSY ( $S_{MSY}$ ) at 50,000 spawners with a 90–100% MSY escapement range of 32,000 to 71,000 (Table 5; Appendix A1 in Fair et al. 2004). The stock-yield model estimated  $S_{MSY}$  at 85,000 spawners with a 90–100% MSY escapement range of 58,000 to 112,000 spawners. The recommended range was based on the combined results from the Ricker and stock-yield models.

The trend towards younger fish in Chinook salmon spawning escapements from 1995–1997 previously raised concerns about the quality of Chinook salmon escapements into the Nushagak River. Chinook salmon size and sex composition varies greatly among years with the smaller 3 and 4-year-old Chinook salmon returning to spawn primarily as males. The age-5 through age-7 Ricker stock-recruitment model estimated that 41,000 age-5 through age-7 spawners would produce MSY. Based on this, a SEG of 40,000 to 80,000 should address spawner quality adequately.

### **Togiak River**

The committee recommended the escapement goal for Chinook salmon in the Togiak River be defined as an SEG instead of a BEG. Additionally, it was recommended that the current escapement goal of 10,000 Chinook salmon be changed to a lower bound of 9,300 Chinook salmon with no upper bound based on an escapement goal analysis for this stock that was

completed in 2003 by Fair et al. (2004). The analysis conducted by Fair et al. (2004) has been provided below because there was a recommendation to change the escapement goal for this stock.

The BEG of 10,000 spawners changed to a lower bound SEG of 9,300 spawners with no upper bound. The goal was estimated using the risk analysis approach with escapement data beginning in 1980. An escapement threshold of 9,300 Chinook resulted in a 15% estimated risk of an unwarranted concern, with a 15% estimated risk that a drop in mean escapement of 40% would not be detected over 3 years (Table 6; Appendix A5 in Fair et al. 2004). The desire is to maintain the median escapement at 9,900 fish assessed by aerial survey. Although this system has escapement and harvest information, it is inadequate for a BEG because the escapement data has a low contrast and there are large measurement errors associated with the aerial surveys (Fair et al. 2004).

### **Naknek River**

The committee recommended the escapement goal for Chinook salmon in the Naknek River be defined as an SEG instead of a BEG. Additionally, the current escapement goal of 5,000 Chinook salmon was changed to a lower bound of 5,000 Chinook salmon with no upper bound based on an escapement goal analysis for this stock completed in 2003 by Fair et al. (2004). The analysis conducted by Fair et al. (2004) has been provided below because there was a recommendation to change the escapement goal for this stock.

The escapement goals for Chinook salmon in the Naknek River were based on aerial survey estimates. The goal was estimated using the risk analysis approach with escapement data beginning in 1971. An escapement threshold of 4,900 Chinook resulted in a 10% estimated risk of an unwarranted concern, with a 9% estimated risk that a drop in mean escapement of 60% would not be detected across 3 years (Table 6; Appendix A4 in Fair et al. 2004). These threshold values are very near to and encompass the current escapement goal of 5,000. The desire is to maintain the median escapement at 5,000 aerial survey units.

### **Alagnak River**

The committee recommended establishing a lower bound SEG of 2,700 Chinook salmon with no upper bound based on an escapement goal analysis for this stock that was completed in 2003 by Fair et al. (2004). The analysis conducted by Fair et al. (2004) has been provided below because there was a recommendation to establish an escapement goal for this stock.

The escapement goals for Chinook salmon in the Alagnak River were based on aerial survey estimates and were established using the risk analysis approach. Using escapement data since 1970, an escapement threshold of 2,700 Chinook resulted in a 10% estimated risk of an unwarranted concern, with a 9% estimated risk that a drop in mean escapement of 80% would not be detected for 3 years (Table 6; Appendix A2 in Fair et al. 2004). The desire is to maintain the median escapement at 3,900 aerial survey units.

### **Egegik River**

The committee recommended establishing a lower bound SEG of 450 Chinook salmon with no upper bound based on an escapement goal analysis for this stock that was completed in 2003 by Fair et al. (2004). The analysis conducted by Fair et al. (2004) has been provided below because there was a recommendation to establish an escapement goal for this stock.

The escapement goals for Chinook salmon in the Egegik River were based on aerial survey estimates and were established using the risk analysis approach. Escapement data of Egegik River Chinook salmon beginning in 1985 are the sum of aerial surveys from Gertrude, Kaye's, and Takayoto creeks only. An escapement threshold of 450 Chinook resulted in a 4% estimated risk of an unwarranted concern, with a 4% estimated risk that a drop in mean escapement of 70% would not be detected for 3 years (Table 6; Appendix A3 in Fair et al. 2004). The desire is to maintain the median escapement at 600 Chinook salmon (based on aerial surveys).

## **CHUM SALMON**

### **Nushagak River**

The committee recommended establishing a lower bound SEG of 190,000 Chinook salmon with no upper bound based on an escapement goal analysis for this stock that was completed in 2003 by Fair et al. (2004). The analysis conducted by Fair et al. (2004) has been provided below because there was a recommendation to establish an escapement goal for this stock.

The escapement goals for Chum salmon in the Nushagak River were based on sonar counts and were established using the risk analysis approach. This goal applies to escapement estimates through July 20, the final day that the sonar will be in operation in future years. Using escapement data since 1979, an escapement threshold of 190,000 chum resulted in a 6% estimated risk of an unwarranted concern, with a 6% estimated risk that a drop in mean escapement of 70% would not be detected over 3 years (Table 6; Appendix C1 in Fair et al. 2004). The desire is to maintain the median escapement at 248,000 sonar counts. Although the data for this system is similar to that of Nushagak River Chinook and sockeye salmon, the difference is that chum salmon are not actively managed in the Nushagak District. For this reason, the goal was set using an SEG risk analysis approach.

## **COHO SALMON**

The committee recommended that all three escapement goals for coho salmon in Bristol Bay be dropped. There are currently escapement goals for coho salmon on the Nushagak River (50,000-100,000); Togiak River (25,000–75,000) and Kulukak (15,000). The escapement goals for coho salmon on the Nushagak, Togiak, and Kulukak River were based on sonar counts, tower counts and aerial surveys, respectively. ADF&G no longer estimates coho salmon escapement in these three rivers.

## **PINK SALMON**

### **Nushagak River**

The committee recommended that the escapement goal for pink salmon in the Nushagak River be dropped. The escapement goal for pink salmon in the Nushagak River was 600,000-1,100,000. The escapement goal for pink salmon was based on sonar counts. ADF&G no longer estimates pink salmon escapement in the Nushagak River.

## **DISCUSSION**

In this review, the committee recommended the majority of the escapement goals in Bristol Bay be changed from BEGs to SEGs. The primary reason for this recommendation is because of

concerns with accurately estimating the stock composition of the harvest in Bristol Bay. This is not a new concern.

Accurately estimating the stock composition of a mixed-stock harvest is critical to estimating the total run of each of stock, especially when sockeye salmon stocks in Bristol Bay are exploited at rates of up to 70%. It has been assumed that sockeye salmon harvested in each fishing district originated from rivers within that district. Estimates of interceptions of stocks outside their district of origin, based on differences in scale growth, have shown that this was probably not true. However, use of interception estimates obtained during 1983–1994 did not substantially change spawner-return relationships (Menard and Miller 1997). Estimates of interception have not been obtained since 1995. There were also concerns about correctly allocating the harvest of fish within a district when there was more than one stock within that district. Naknek-Kvichak and Nushagak Districts each have three stocks. ADF&G currently uses age composition estimates from harvest and escapement, and run timing to allocate the harvest to each stock. The current method assumes that the stocks present in a district are equally exploited. This is a big assumption that is probably incorrect. The current method probably underestimates the productivity of some stocks and overestimates the productivity of other stocks.

A secondary reason for recommending the majority of escapement goals in Bristol Bay be defined as SEGs instead of BEGs is because the majority of the current escapement goals in Bristol Bay are providing levels of escapement that have been sustainable for at least 10 years or longer and meet the definition of an SEG. An SEG is supposed to provide a level of escapement that is known to provide for sustainable yield over a 5 to 10 year period. In addition, the majority of the current escapement goals are likely not providing levels of escapement that will lead to MSY. A BEG is supposed to represent escapements that provide the greatest potential for maximum sustained yield (MSY) of a stock and we are unsure if the current goals actually provide this potential.

The committee also recommended the majority of current escapement goals for sockeye salmon in Bristol Bay remain unchanged. Current spawner-recruit data and analyses (Fair et al. 2004) suggest that the current escapement goals should be increased for many stocks in Bristol Bay. There has been evidence to raise the goals of many stocks for 10–15 years. In this review, the committee did not want to change the escapement goals for many stocks when the underlying spawner-recruit data may be changed in the relatively near future using new information to allocate harvests.

ADF&G has recently developed new genetics techniques to estimate the stock composition of sockeye salmon in Bristol Bay. It is anticipated that the results from the genetics analyses will provide estimates of stock composition in each of the districts and will ultimately change the estimates of total run for most of the stocks in Bristol Bay. ADF&G has received general fund monies to allow for the analysis of genetics samples each year. ADF&G plans to estimate the stock composition of the harvest of sockeye salmon in Bristol Bay during 2006. The first genetics results from the 2006 season should be available during the winter of 2006–2007. As time and money allow, it is anticipated that select historical harvests will be genetically tested for stock composition and in conjunction with run strength, age composition, and run timing, modeled to re-estimate historical harvest composition by stock.

## REFERENCES CITED

- Abraham, B., and J. Ledolter. 1983. *Statistical methods for forecasting*. John Wiley and Sons, New York, NY. 445 p.
- Bernard, D. R., J. J. Hasbrouck, and B. G. Bue. *Unpublished*. Using risk of management error to set precautionary reference points (PRPs) for non-targeted salmon stocks. Located at: Alaska Department of Fish and Game, 333 Raspberry Road, Anchorage, Alaska.
- Bernard, D. R. 1983. Variance and bias of catch allocations that use the age composition of escapements. Alaska Department of Fish and Game, Division of Commercial Fisheries, Informational Leaflet No. 227, Anchorage.
- CTC (Chinook Technical Committee). 1999. Maximum sustained yield of biologically based escapement goals for selected Chinook salmon stocks used by the Pacific Salmon Commission's Chinook Technical Committee for escapement assessment, Volume I. Pacific Salmon Commission Joint Chinook Technical Committee Report No. TCHINOOK (99)-3, Vancouver, British Columbia, Canada.
- Clark, J. H. 2005. Abundance of sockeye salmon in the Alagnak River system of Bristol Bay Alaska. Alaska Department of Fish and Game, Fishery Manuscript No. 05-01, Anchorage. <http://www.sf.adfg.state.ak.us/FedAidPDFs/fm05-01.pdf>
- Crawford, D. L., and L. F. Fair. 2003. Bristol Bay sockeye salmon smolt studies using upward-looking sonar, 2002. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 2A03-17, Anchorage.
- Cross, B. A., D. C. Gray, and D. L. Crawford. 1997. Report to the Alaska Board of Fisheries on spawning escapement goal evaluations for Bristol Bay salmon. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 2A97-30, Anchorage.
- Fair, L. F. 2000. Report to the Alaska Board of Fisheries on spawning escapement goal evaluations for Bristol Bay salmon. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 2A00-38, Anchorage.
- Fair, L. F., B. G. Bue, R. A. Clark, and J. J. Hasbrouck. 2004. Spawning escapement goal review of Bristol Bay salmon stocks. Alaska Department of Fish and Game, Division Commercial Fisheries, Regional Information Report No. 2A04-17, Anchorage.
- Hilborn, R., and C. J. Walters. 1992. *Quantitative fisheries stock assessment choice, dynamics and uncertainty*. Chapman and Hall, New York.
- Menard, J. and J. D. Miller. 1997. Report to the Alaska Board of Fisheries on the stock composition of sockeye salmon catches within east side Bristol Bay fishing districts, 1983-1995. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 2A97-31, Anchorage.
- Quinn II, T. J. and R. B. Deriso. 1999. *Quantitative fish dynamics*. Oxford University Press. New York, NY.
- Ricker, W. E. 1954. Stock and recruitment. *Journal of the Fisheries Research Board of Canada*, 11:559-623.
- Sands, T., S. Morstad, and K. Weiland. 2003. Salmon spawning ground surveys in the Bristol Bay area, Alaska, 2002. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 2A03-07, Anchorage.
- West, F. W. 2003. Abundance, age, sex, and size statistics for Pacific salmon in Bristol Bay, 2002. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report No. 2A03-23, Anchorage.



## **TABLES AND FIGURES**

**Table 1.**—Bristol Bay sockeye salmon runs by system, 1996–2005 (in thousands of fish).

| <b>Year</b> | <b>Alagnak</b> | <b>Egegik</b> | <b>Igushik</b> | <b>Kvichak</b> | <b>Naknek</b> | <b>Nushagak</b> | <b>Togiak</b> | <b>Ugashik</b> | <b>Wood</b> | <b>Total</b> |
|-------------|----------------|---------------|----------------|----------------|---------------|-----------------|---------------|----------------|-------------|--------------|
| 1996        | 724            | 12,253        | 1,514          | 3,538          | 7,076         | 1,804           | 586           | 5,237          | 5,159       | 37,893       |
| 1997        | 266            | 9,363         | 314            | 1,828          | 1,515         | 930             | 264           | 2,239          | 3,631       | 20,350       |
| 1998        | 412            | 5,090         | 614            | 3,554          | 2,747         | 941             | 314           | 1,786          | 4,143       | 19,602       |
| 1999        | 1,079          | 9,407         | 1,627          | 13,308         | 3,970         | 992             | 565           | 4,060          | 6,160       | 41,167       |
| 2000        | 774            | 8,403         | 1,813          | 3,031          | 4,935         | 1,529           | 1,127         | 2,300          | 5,544       | 29,456       |
| 2001        | 411            | 3,868         | 1,324          | 1,436          | 6,684         | 2,126           | 1,109         | 1,356          | 4,014       | 22,328       |
| 2002        | 793            | 5,840         | 214            | 728            | 2,775         | 663             | 406           | 2,564          | 3,842       | 17,825       |
| 2003        | 3,790          | 3,503         | 1,036          | 1,751          | 5,184         | 2,274           | 898           | 2,583          | 5,744       | 26,761       |
| 2004        | 6,667          | 12,865        | 524            | 7,901          | 3,949         | 2,228           | 508           | 4,160          | 5,948       | 44,751       |
| 2005        | 5,437          | 9,872         | 1,926          | 2,951          | 8,006         | 3,530           | 579           | 3,078          | 4,893       | 39,269       |
| Average     | 1,912          | 8,788         | 1,172          | 6,214          | 4,595         | 1,619           | 648           | 3,219          | 4,843       | 32,918       |

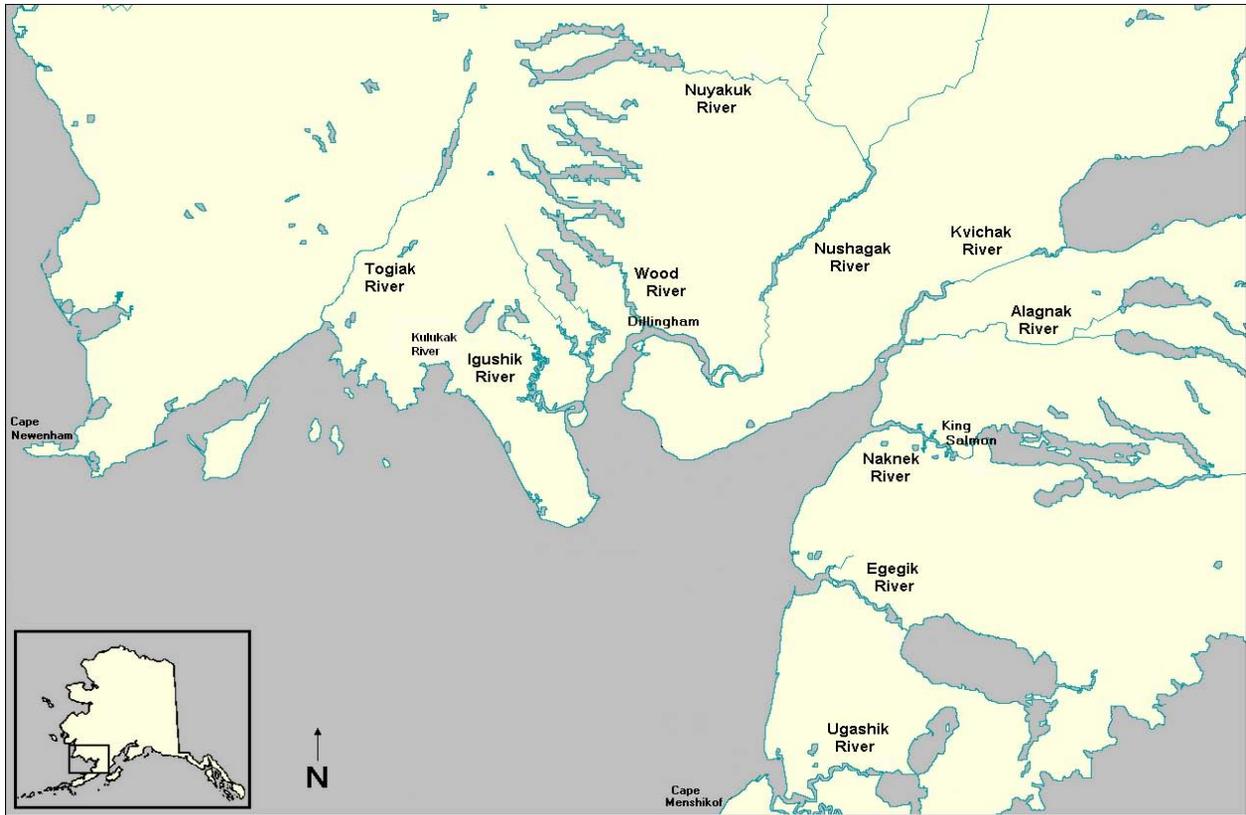
**Table 2.**—List of members on the Alaska Department of Fish and Game (ADF&G) Bristol Bay salmon escapement goal committee.

| <b>Name</b>                       | <b>Affiliation</b>                         |
|-----------------------------------|--|
| <b>Escapement Goal Committee:</b> |  |
| Timothy Baker                     | ADF&G, Division of Commercial Fisheries    |
| Lowell Fair                       | ADF&G, Division of Commercial Fisheries    |
| Scott Raborn                      | ADF&G, Division of Commercial Fisheries    |
| Dan Gray                          | ADF&G, Division of Commercial Fisheries    |
| Robert Clark                      | ADF&G, Sport Fish Division                 |
| James Hasbrouck                   | ADF&G, Sport Fish Division                 |
| Craig Schwanke                    | ADF&G, Sport Fish Division                 |
| <b>Other Participants:</b>        |  |
| John Clark                        | ADF&G, Division of Commercial Fisheries    |
| Doug Eggers                       | ADF&G, Division of Commercial Fisheries    |
| Jeff Regnart                      | ADF&G, Division of Commercial Fisheries    |
| Slim Morstad                      | ADF&G, Division of Commercial Fisheries    |
| Tim Sands                         | ADF&G, Division of Commercial Fisheries    |
| Paul Salomone                     | ADF&G, Division of Commercial Fisheries    |
| Charlotte Westing                 | ADF&G, Division of Commercial Fisheries    |
| Fred West                         | ADF&G, Division of Commercial Fisheries    |
| Chuck Brazil                      | ADF&G, Division of Commercial Fisheries    |
| Dan Sharp                         | ADF&G, Sport Fish Division                 |
| Jason Dye                         | ADF&G, Sport Fish Division                 |
| Steve Fleischman                  | ADF&G, Sport Fish Division                 |
| Michael Link                      | Bristol Bay Science and Research Institute |
| Michael Daigneault                | Bristol Bay Science and Research Institute |

*Note:* Also provided is a list of other participants who assisted with the escapement goal review.

**Table 3.**—Summary of current escapement goals and recommended escapement goals for salmon stocks in Bristol Bay.

| System                 | Current Escapement Goal |              | Recommended Escapement Goal |                      |                 |               |
|------------------------|-------------------------|--------------|-----------------------------|----------------------|-----------------|---------------|
|                        | Goal                    | Year Adopted | Type                        | Range                | Escapement Data | Action        |
| <b>Sockeye Salmon</b>  |                         |              |                             |                      |                 |               |
| Ugashik                | 500,000–1,200,000       | 1997         | SEG                         | 500,000–1,200,000    | Tower Count     | Change to SEG |
| Egegik                 | 800,000–1,400,000       | 1997         | SEG                         | 800,000–1,400,000    | Tower Count     | Change to SEG |
| Naknek                 | 800,000–1,400,000       | 1984         | SEG                         | 800,000–1,400,000    | Tower Count     | Change to SEG |
| Kvichak (off-cycle)    | 2,000,000–10,000,000    | 1997         | SEG                         | 2,000,000–10,000,000 | Tower Count     | Change to SEG |
| Kvichak (pre and peak) | 6,000,000–10,000,000    | 1997         | SEG                         | 6,000,000–10,000,000 | Tower Count     | Change to SEG |
| Alagnak                | 170,000–200,000         | 1973         | SEG                         | 320,000 minimum      | Tower Count     | Change        |
| Wood                   | 700,000–1,500,000       | 2000         | SEG                         | 700,000–1,500,000    | Tower Count     | Change to SEG |
| Nushagak               | 340,000–760,000         | 1997         | SEG                         | 340,000–760,000      | Sonar Count     | Change to SEG |
| Igushik                | 150,000–300,000         | 2000         | SEG                         | 150,000–300,000      | Tower Count     | Change to SEG |
| Togiak                 | 100,000–200,000         | 1997         | BEG                         | 120,000–270,000      | Tower Count     | Change        |
| Kulukak Bay            |                         |              | SEG                         | 8,000 minimum        | Aerial Survey   | New Goal      |
| <b>Chinook Salmon</b>  |                         |              |                             |                      |                 |               |
| Nushagak               | 65,000                  | 1992         | SEG                         | 40,000–80,000        | Sonar Count     | Change        |
| Togiak                 | 10,000                  | 1991         | SEG                         | 9,300 minimum        | Aerial Survey   | Change        |
| Naknek                 | 5,000                   | 1994         | SEG                         | 5,000 minimum        | Aerial Survey   | Change        |
| Alagnak                |                         |              | SEG                         | 2,700 minimum        | Aerial Survey   | New Goal      |
| Egegik                 |                         |              | SEG                         | 450 minimum          | Aerial Survey   | New Goal      |
| <b>Chum Salmon</b>     |                         |              |                             |                      |                 |               |
| Nushagak               |                         |              | SEG                         | 190,000 minimum      | Sonar count     | New Goal      |
| <b>Coho Salmon</b>     |                         |              |                             |                      |                 |               |
| Nushagak               | 50,000–100,000          | 1992         |                             |                      | Sonar Count     | Dropped       |
| Togiak                 | 25,000–75,000           | 1986         |                             |                      | Aerial Survey   | Dropped       |
| Kulukak                | 15,000                  | 1986         |                             |                      | Aerial Count    | Dropped       |
| <b>Pink Salmon</b>     |                         |              |                             |                      |                 |               |
| Nushagak               | 600,000–1,100,000       | 1992         |                             |                      | Sonar Count     | Dropped       |



**Figure 1.**–Bristol Bay area showing major salmon river locations.



## **APPENDIX A.**

**Appendix A1.**–Ugashik River data available for analysis of sockeye salmon escapement goal (in thousands of fish).

| Brood |            | Return by Age Class |     |     |       |     |     |       |       |     |     |       |     |     |     | Total |       |
|-------|------------|---------------------|-----|-----|-------|-----|-----|-------|-------|-----|-----|-------|-----|-----|-----|-------|-------|
| Year  | Escapement | 0.2                 | 1.1 | 0.3 | 1.2   | 2.1 | 0.4 | 1.3   | 2.2   | 3.1 | 1.4 | 2.3   | 3.2 | 2.4 | 3.3 |       | 3.4   |
| 1956  | 425        | 1                   | 12  | 0   | 3,165 | 0   | 0   | 837   | 80    | 0   | 2   | 35    | 0   | 0   | 0   | 0     | 4,132 |
| 1957  | 215        | 0                   | 0   | 1   | 35    | 0   | 0   | 105   | 354   | 0   | 2   | 100   | 4   | 0   | 2   | 0     | 603   |
| 1958  | 280        | 0                   | 0   | 0   | 63    | 0   | 0   | 105   | 444   | 0   | 0   | 66    | 0   | 0   | 0   | 0     | 678   |
| 1959  | 219        | 0                   | 0   | 0   | 18    | 0   | 0   | 38    | 310   | 0   | 0   | 132   | 0   | 0   | 1   | 0     | 499   |
| 1960  | 2,304      | 0                   | 0   | 0   | 674   | 11  | 0   | 296   | 1,563 | 0   | 0   | 487   | 0   | 0   | 0   | 0     | 3,031 |
| 1961  | 349        | 0                   | 0   | 3   | 240   | 2   | 0   | 500   | 247   | 0   | 1   | 120   | 0   | 0   | 0   | 0     | 1,113 |
| 1962  | 255        | 0                   | 0   | 2   | 77    | 2   | 0   | 130   | 185   | 0   | 0   | 27    | 0   | 0   | 0   | 0     | 423   |
| 1963  | 388        | 0                   | 0   | 0   | 13    | 0   | 0   | 21    | 91    | 0   | 0   | 23    | 0   | 0   | 0   | 0     | 148   |
| 1964  | 473        | 0                   | 0   | 0   | 31    | 9   | 0   | 16    | 245   | 0   | 0   | 18    | 0   | 0   | 2   | 0     | 321   |
| 1965  | 997        | 0                   | 0   | 0   | 86    | 2   | 0   | 38    | 249   | 0   | 1   | 162   | 1   | 0   | 0   | 0     | 539   |
| 1966  | 704        | 1                   | 0   | 2   | 723   | 0   | 0   | 1,478 | 90    | 0   | 0   | 21    | 0   | 0   | 0   | 0     | 2,315 |
| 1967  | 239        | 0                   | 0   | 0   | 56    | 0   | 0   | 50    | 44    | 0   | 0   | 34    | 0   | 0   | 0   | 0     | 184   |
| 1968  | 71         | 0                   | 0   | 0   | 14    | 0   | 0   | 7     | 15    | 0   | 0   | 3     | 0   | 0   | 0   | 0     | 39    |
| 1969  | 160        | 0                   | 0   | 0   | 4     | 0   | 0   | 5     | 53    | 0   | 0   | 26    | 2   | 0   | 2   | 0     | 92    |
| 1970  | 735        | 0                   | 0   | 0   | 4     | 1   | 0   | 2     | 256   | 0   | 1   | 28    | 2   | 0   | 1   | 0     | 295   |
| 1971  | 530        | 0                   | 0   | 0   | 178   | 0   | 0   | 236   | 290   | 0   | 0   | 130   | 0   | 0   | 1   | 0     | 835   |
| 1972  | 79         | 0                   | 0   | 0   | 35    | 0   | 0   | 58    | 119   | 0   | 0   | 41    | 2   | 0   | 3   | 0     | 258   |
| 1973  | 39         | 0                   | 0   | 1   | 16    | 0   | 0   | 8     | 17    | 0   | 0   | 46    | 4   | 0   | 0   | 0     | 92    |
| 1974  | 62         | 0                   | 0   | 0   | 13    | 10  | 0   | 15    | 602   | 0   | 0   | 83    | 2   | 0   | 0   | 0     | 725   |
| 1975  | 429        | 0                   | 3   | 0   | 1,484 | 4   | 0   | 575   | 1,721 | 0   | 0   | 325   | 2   | 1   | 0   | 0     | 4,115 |
| 1976  | 356        | 0                   | 0   | 2   | 2,027 | 58  | 0   | 1,527 | 1,248 | 0   | 7   | 437   | 0   | 0   | 3   | 0     | 5,309 |
| 1977  | 202        | 0                   | 2   | 18  | 585   | 0   | 0   | 1,614 | 266   | 0   | 10  | 186   | 6   | 1   | 4   | 0     | 2,692 |
| 1978  | 82         | 0                   | 0   | 5   | 247   | 7   | 0   | 413   | 863   | 0   | 6   | 523   | 1   | 0   | 0   | 0     | 2,065 |
| 1979  | 1,707      | 0                   | 20  | 0   | 3,076 | 8   | 0   | 851   | 1,471 | 0   | 14  | 562   | 0   | 5   | 0   | 0     | 6,007 |
| 1980  | 3,335      | 0                   | 1   | 13  | 1,183 | 39  | 0   | 2,309 | 3,371 | 0   | 10  | 850   | 3   | 2   | 0   | 0     | 7,781 |
| 1981  | 1,328      | 0                   | 2   | 10  | 1,603 | 4   | 0   | 2,632 | 2,278 | 0   | 4   | 933   | 1   | 1   | 0   | 0     | 7,468 |
| 1982  | 1,186      | 0                   | 1   | 15  | 423   | 1   | 1   | 713   | 606   | 0   | 9   | 737   | 0   | 2   | 0   | 0     | 2,508 |
| 1983  | 1,001      | 0                   | 0   | 10  | 650   | 6   | 1   | 342   | 632   | 0   | 3   | 319   | 1   | 1   | 0   | 0     | 1,965 |
| 1984  | 1,270      | 0                   | 0   | 5   | 472   | 55  | 0   | 568   | 3,635 | 0   | 13  | 709   | 3   | 0   | 4   | 0     | 5,464 |
| 1985  | 1,006      | 2                   | 1   | 6   | 508   | 2   | 0   | 721   | 978   | 0   | 4   | 469   | 0   | 5   | 0   | 0     | 2,695 |
| 1986  | 1,016      | 5                   | 1   | 46  | 503   | 1   | 0   | 2,427 | 1,874 | 0   | 71  | 1,750 | 4   | 15  | 0   | 0     | 6,696 |
| 1987  | 687        | 7                   | 1   | 9   | 828   | 11  | 0   | 1,626 | 1,875 | 0   | 25  | 2,310 | 10  | 20  | 24  | 0     | 6,745 |
| 1988  | 654        | 1                   | 2   | 1   | 463   | 27  | 0   | 692   | 2,144 | 0   | 37  | 2,252 | 22  | 3   | 7   | 0     | 5,650 |
| 1989  | 1,713      | 3                   | 7   | 7   | 694   | 14  | 0   | 391   | 2,479 | 0   | 12  | 955   | 6   | 1   | 4   | 0     | 4,573 |
| 1990  | 749        | 0                   | 1   | 13  | 345   | 15  | 2   | 709   | 2,302 | 0   | 2   | 1,218 | 2   | 2   | 0   | 0     | 4,611 |
| 1991  | 2,482      | 1                   | 6   | 0   | 2,034 | 1   | 0   | 3,167 | 597   | 0   | 14  | 326   | 0   | 4   | 0   | 0     | 6,151 |
| 1992  | 2,195      | 6                   | 3   | 49  | 191   | 4   | 1   | 597   | 1,013 | 0   | 1   | 827   | 0   | 10  | 1   | 0     | 2,703 |
| 1993  | 1,413      | 1                   | 2   | 2   | 265   | 7   | 0   | 352   | 241   | 0   | 17  | 198   | 0   | 0   | 1   | 0     | 1,086 |
| 1994  | 1,095      | 0                   | 12  | 4   | 333   | 12  | 0   | 327   | 689   | 0   | 6   | 274   | 1   | 2   | 0   | 0     | 1,660 |
| 1995  | 1,321      | 3                   | 18  | 7   | 2,808 | 1   | 0   | 1,562 | 185   | 0   | 19  | 82    | 0   | 1   | 0   | 0     | 4,686 |
| 1996  | 692        | 0                   | 0   | 40  | 231   | 0   | 3   | 978   | 36    | 0   | 16  | 81    | 1   | 0   | 1   | 0     | 1,388 |
| 1997  | 657        | 1                   | 0   | 2   | 234   | 0   | 0   | 701   | 1553  | 0   | 11  | 534   | 23  | 0   | 2   | 0     | 3,061 |
| 1998  | 925        | 0                   | 1   | 0   | 204   | 1   | 0   | 292   | 603   | 0   | 5   | 241   | 2   | 0   | 0   | 0     | 1,349 |
| 1999  | 1,662      | 0                   | 6   | 3   | 1,088 | 25  | 0   | 769   | 1425  | 0   | 7   | 397   | 0   |     |     |       | 3,720 |
| 2000  | 638        | 0                   | 3   | 2   | 1,711 | 0   | 0   | 2177  | 90    | 0   |     |       |     |     |     |       | 3,983 |
| 2001  | 866        | 1                   | 2   | 8   | 380   | 2   |     |       |       |     |     |       |     |     |     |       |       |
| 2002  | 892        | 9                   | 8   |     |       |     |     |       |       |     |     |       |     |     |     |       |       |
| 2003  | 790        |                     |     |     |       |     |     |       |       |     |     |       |     |     |     |       |       |
| 2004  | 815        |                     |     |     |       |     |     |       |       |     |     |       |     |     |     |       |       |
| 2005  | 800        |                     |     |     |       |     |     |       |       |     |     |       |     |     |     |       |       |

**Appendix A2.**—Egegik River data available for analysis of sockeye salmon escapement goal (in thousands of fish).

| Brood<br>Year | Escapement | Return by Age Class |     |     |       |     |     |       |        |     |     |        |     |     |     | Total |        |
|---------------|------------|---------------------|-----|-----|-------|-----|-----|-------|--------|-----|-----|--------|-----|-----|-----|-------|--------|
|               |            | 0.2                 | 1.1 | 0.3 | 1.2   | 2.1 | 0.4 | 1.3   | 2.2    | 3.1 | 1.4 | 2.3    | 3.2 | 2.4 | 3.3 |       | 3.4    |
| 1956          | 1,104      | 0                   | 6   | 0   | 2,025 | 0   | 0   | 3,190 | 925    | 0   | 2   | 685    | 1   | 0   | 12  | 0     | 6,846  |
| 1957          | 391        | 0                   | 0   | 0   | 37    | 0   | 0   | 43    | 1,096  | 0   | 0   | 927    | 70  | 0   | 62  | 0     | 2,235  |
| 1958          | 246        | 0                   | 0   | 0   | 42    | 2   | 0   | 73    | 817    | 0   | 0   | 308    | 16  | 0   | 3   | 0     | 1,261  |
| 1959          | 1,072      | 0                   | 0   | 0   | 73    | 2   | 0   | 164   | 1,037  | 0   | 0   | 467    | 14  | 0   | 24  | 0     | 1,781  |
| 1960          | 1,799      | 8                   | 0   | 0   | 447   | 21  | 0   | 328   | 4,447  | 0   | 1   | 2,560  | 49  | 0   | 50  | 0     | 7,911  |
| 1961          | 702        | 0                   | 0   | 3   | 82    | 0   | 0   | 229   | 446    | 0   | 1   | 791    | 28  | 0   | 10  | 0     | 1,590  |
| 1962          | 1,027      | 0                   | 0   | 0   | 22    | 0   | 0   | 69    | 950    | 0   | 0   | 375    | 28  | 0   | 30  | 0     | 1,474  |
| 1963          | 998        | 0                   | 0   | 1   | 16    | 2   | 0   | 112   | 538    | 1   | 1   | 506    | 74  | 0   | 7   | 0     | 1,258  |
| 1964          | 850        | 0                   | 1   | 0   | 126   | 6   | 0   | 69    | 1,454  | 1   | 0   | 242    | 73  | 0   | 12  | 0     | 1,984  |
| 1965          | 1,445      | 0                   | 0   | 0   | 104   | 35  | 0   | 72    | 2,016  | 0   | 4   | 845    | 6   | 2   | 20  | 0     | 3,104  |
| 1966          | 804        | 0                   | 0   | 1   | 249   | 0   | 0   | 752   | 600    | 0   | 2   | 890    | 7   | 0   | 10  | 0     | 2,511  |
| 1967          | 637        | 0                   | 0   | 2   | 60    | 2   | 0   | 257   | 665    | 0   | 0   | 622    | 1   | 1   | 2   | 0     | 1,612  |
| 1968          | 339        | 0                   | 0   | 0   | 41    | 0   | 0   | 56    | 87     | 0   | 0   | 258    | 3   | 5   | 9   | 0     | 459    |
| 1969          | 1,016      | 0                   | 0   | 0   | 12    | 1   | 0   | 111   | 1,096  | 0   | 0   | 1,141  | 279 | 2   | 113 | 0     | 2,755  |
| 1970          | 920        | 0                   | 0   | 0   | 59    | 0   | 0   | 89    | 796    | 0   | 1   | 175    | 95  | 0   | 25  | 0     | 1,240  |
| 1971          | 634        | 0                   | 0   | 0   | 45    | 2   | 0   | 109   | 1,477  | 0   | 0   | 970    | 74  | 1   | 55  | 0     | 2,733  |
| 1972          | 546        | 0                   | 0   | 1   | 57    | 2   | 0   | 61    | 1,508  | 0   | 0   | 1,264  | 48  | 0   | 18  | 0     | 2,959  |
| 1973          | 329        | 0                   | 0   | 0   | 76    | 0   | 0   | 135   | 578    | 0   | 0   | 851    | 35  | 0   | 4   | 0     | 1,679  |
| 1974          | 1,276      | 0                   | 0   | 0   | 131   | 18  | 0   | 99    | 2,224  | 0   | 0   | 496    | 54  | 0   | 3   | 0     | 3,025  |
| 1975          | 1,174      | 0                   | 0   | 0   | 148   | 9   | 0   | 241   | 2,449  | 2   | 0   | 797    | 14  | 2   | 1   | 0     | 3,663  |
| 1976          | 509        | 1                   | 1   | 2   | 612   | 59  | 0   | 789   | 3,003  | 0   | 4   | 846    | 0   | 0   | 0   | 0     | 5,317  |
| 1977          | 693        | 0                   | 2   | 0   | 823   | 1   | 0   | 1,969 | 688    | 0   | 14  | 655    | 52  | 0   | 13  | 0     | 4,217  |
| 1978          | 896        | 0                   | 0   | 2   | 398   | 6   | 0   | 510   | 6,071  | 0   | 0   | 2,184  | 25  | 4   | 8   | 0     | 9,208  |
| 1979          | 1,032      | 0                   | 3   | 0   | 712   | 9   | 3   | 520   | 3,036  | 0   | 4   | 1,659  | 0   | 0   | 0   | 0     | 5,946  |
| 1980          | 1,061      | 0                   | 1   | 13  | 803   | 26  | 0   | 2,225 | 4,576  | 0   | 6   | 917    | 7   | 0   | 0   | 0     | 8,574  |
| 1981          | 695        | 0                   | 0   | 6   | 544   | 64  | 0   | 953   | 3,284  | 0   | 11  | 1,438  | 9   | 0   | 7   | 0     | 6,316  |
| 1982          | 1,035      | 2                   | 2   | 4   | 988   | 12  | 0   | 1,874 | 1,796  | 0   | 9   | 1,638  | 11  | 2   | 2   | 0     | 6,340  |
| 1983          | 792        | 0                   | 3   | 0   | 1,748 | 7   | 1   | 2,763 | 3,235  | 0   | 7   | 2,822  | 21  | 23  | 16  | 0     | 10,646 |
| 1984          | 1,165      | 0                   | 1   | 8   | 608   | 85  | 0   | 978   | 6,539  | 3   | 10  | 5,029  | 215 | 13  | 39  | 0     | 13,528 |
| 1985          | 1,095      | 4                   | 0   | 9   | 567   | 32  | 0   | 1,404 | 4,358  | 0   | 9   | 1,262  | 8   | 0   | 18  | 0     | 7,671  |
| 1986          | 1,152      | 0                   | 2   | 14  | 1,850 | 10  | 0   | 3,733 | 3,912  | 0   | 92  | 4,515  | 86  | 83  | 34  | 0     | 14,331 |
| 1987          | 1,274      | 2                   | 0   | 9   | 886   | 66  | 0   | 4,561 | 8,863  | 3   | 101 | 11,239 | 133 | 31  | 57  | 0     | 25,951 |
| 1988          | 1,599      | 0                   | 1   | 0   | 413   | 62  | 0   | 1,278 | 11,061 | 0   | 4   | 5,650  | 261 | 3   | 152 | 0     | 18,885 |
| 1989          | 1,612      | 1                   | 0   | 6   | 513   | 34  | 0   | 456   | 6,063  | 1   | 6   | 3,979  | 170 | 1   | 31  | 0     | 11,261 |
| 1990          | 2,192      | 0                   | 0   | 2   | 403   | 66  | 0   | 867   | 9,598  | 1   | 3   | 4,721  | 21  | 28  | 30  | 0     | 15,739 |
| 1991          | 2,787      | 4                   | 1   | 3   | 1,397 | 20  | 2   | 3,939 | 3,113  | 0   | 47  | 2,607  | 19  | 2   | 9   | 0     | 11,163 |
| 1992          | 1,946      | 5                   | 0   | 32  | 335   | 54  | 3   | 1,117 | 4,963  | 2   | 4   | 3,099  | 53  | 16  | 17  | 0     | 9,701  |
| 1993          | 1,517      | 0                   | 2   | 10  | 497   | 31  | 0   | 573   | 880    | 0   | 11  | 992    | 6   | 0   | 1   | 0     | 3,002  |
| 1994          | 1,898      | 1                   | 8   | 0   | 368   | 65  | 0   | 982   | 4,228  | 0   | 0   | 3,071  | 11  | 15  | 9   | 0     | 8,758  |
| 1995          | 1,267      | 0                   | 7   | 0   | 3,151 | 4   | 0   | 3,175 | 1,644  | 0   | 16  | 1,455  | 10  | 11  | 12  | 0     | 9,485  |
| 1996          | 1,076      | 0                   | 1   | 0   | 497   | 5   | 0   | 1,791 | 515    | 3   | 40  | 1,727  | 28  | 0   | 7   | 0     | 4,617  |
| 1997          | 1,104      | 0                   | 0   | 0   | 34    | 19  | 0   | 322   | 3,572  | 9   | 3   | 1,971  | 246 | 4   | 38  | 0     | 6,674  |
| 1998          | 1,111      | 0                   | 0   | 0   | 104   | 13  | 0   | 206   | 602    | 1   | 2   | 684    | 22  | 3   | 0   |       | 1,637  |
| 1999          | 1,728      | 1                   | 0   | 0   | 249   | 213 | 0   | 676   | 9,686  | 0   | 6   | 3,008  | 22  |     |     |       | 13,861 |
| 2000          | 1,032      | 0                   | 2   | 0   | 1,726 | 27  | 0   | 2,903 | 3,549  | 0   |     |        |     |     |     |       | 8,207  |
| 2001          | 969        | 0                   | 0   | 0   | 294   | 58  |     |       |        |     |     |        |     |     |     |       |        |
| 2002          | 1,036      | 0                   | 30  |     |       |     |     |       |        |     |     |        |     |     |     |       |        |
| 2003          | 1,152      |                     |     |     |       |     |     |       |        |     |     |        |     |     |     |       |        |
| 2004          | 1,290      |                     |     |     |       |     |     |       |        |     |     |        |     |     |     |       |        |
| 2005          | 1,622      |                     |     |     |       |     |     |       |        |     |     |        |     |     |     |       |        |

**Appendix A3.**–Naknek River data available for analysis of sockeye salmon escapement goal (in thousands of fish).

| Brood<br>Year | Escapement | Return by Age Class |     |     |       |     |     |       |       |     |     |       |     |     |     | Total |        |
|---------------|------------|---------------------|-----|-----|-------|-----|-----|-------|-------|-----|-----|-------|-----|-----|-----|-------|--------|
|               |            | 0.2                 | 1.1 | 0.3 | 1.2   | 2.1 | 0.4 | 1.3   | 2.2   | 3.1 | 1.4 | 2.3   | 3.2 | 2.4 | 3.3 |       | 3.4    |
| 1956          | 1,773      | 0                   | 1   | 0   | 473   | 0   | 0   | 1,701 | 3     | 0   | 17  | 304   | 0   | 0   | 0   | 0     | 2,499  |
| 1957          | 635        | 0                   | 0   | 0   | 53    | 2   | 0   | 329   | 505   | 0   | 1   | 674   | 5   | 0   | 3   | 0     | 1,572  |
| 1958          | 278        | 0                   | 0   | 0   | 112   | 4   | 0   | 211   | 539   | 0   | 0   | 168   | 3   | 0   | 2   | 0     | 1,039  |
| 1959          | 2,232      | 0                   | 0   | 0   | 349   | 7   | 0   | 351   | 742   | 0   | 0   | 705   | 0   | 0   | 0   | 0     | 2,154  |
| 1960          | 828        | 0                   | 1   | 1   | 1,408 | 9   | 0   | 625   | 696   | 0   | 0   | 1,278 | 1   | 1   | 2   | 0     | 4,022  |
| 1961          | 351        | 0                   | 0   | 0   | 239   | 3   | 0   | 744   | 315   | 0   | 3   | 640   | 0   | 0   | 8   | 0     | 1,952  |
| 1962          | 723        | 0                   | 0   | 0   | 76    | 4   | 0   | 230   | 351   | 0   | 2   | 397   | 13  | 0   | 1   | 0     | 1,074  |
| 1963          | 905        | 0                   | 0   | 0   | 136   | 8   | 0   | 390   | 833   | 0   | 0   | 627   | 7   | 0   | 1   | 0     | 2,002  |
| 1964          | 1,350      | 0                   | 1   | 0   | 447   | 24  | 0   | 264   | 1,135 | 0   | 0   | 177   | 11  | 0   | 1   | 0     | 2,060  |
| 1965          | 718        | 0                   | 5   | 0   | 540   | 44  | 0   | 360   | 732   | 0   | 0   | 437   | 1   | 0   | 1   | 0     | 2,120  |
| 1966          | 1,016      | 1                   | 4   | 0   | 728   | 2   | 0   | 2,304 | 167   | 0   | 1   | 630   | 0   | 1   | 0   | 0     | 3,838  |
| 1967          | 756        | 0                   | 0   | 2   | 326   | 6   | 0   | 625   | 401   | 0   | 0   | 356   | 0   | 1   | 0   | 0     | 1,717  |
| 1968          | 1,023      | 0                   | 3   | 0   | 152   | 0   | 0   | 234   | 83    | 0   | 0   | 269   | 2   | 0   | 2   | 0     | 745    |
| 1969          | 1,331      | 0                   | 0   | 0   | 47    | 3   | 0   | 307   | 976   | 0   | 0   | 1,211 | 5   | 0   | 3   | 0     | 2,552  |
| 1970          | 733        | 0                   | 1   | 0   | 154   | 19  | 0   | 318   | 1,845 | 0   | 0   | 370   | 12  | 0   | 0   | 0     | 2,719  |
| 1971          | 936        | 0                   | 1   | 0   | 397   | 24  | 0   | 559   | 1,428 | 0   | 0   | 1,844 | 3   | 9   | 8   | 0     | 4,273  |
| 1972          | 587        | 0                   | 3   | 0   | 245   | 3   | 0   | 241   | 161   | 0   | 3   | 599   | 9   | 0   | 1   | 0     | 1,265  |
| 1973          | 357        | 0                   | 0   | 0   | 494   | 0   | 0   | 618   | 524   | 0   | 0   | 598   | 0   | 0   | 0   | 0     | 2,234  |
| 1974          | 1,241      | 0                   | 2   | 0   | 232   | 3   | 0   | 228   | 1,026 | 0   | 1   | 783   | 5   | 0   | 5   | 0     | 2,285  |
| 1975          | 2,027      | 0                   | 1   | 0   | 425   | 11  | 0   | 1,746 | 1,393 | 0   | 0   | 1,641 | 1   | 8   | 0   | 0     | 5,226  |
| 1976          | 1,321      | 0                   | 4   | 0   | 1,084 | 3   | 0   | 4,048 | 1,575 | 0   | 21  | 1,491 | 0   | 28  | 1   | 0     | 8,255  |
| 1977          | 1,086      | 2                   | 10  | 7   | 635   | 0   | 0   | 2,272 | 95    | 0   | 64  | 401   | 0   | 1   | 5   | 0     | 3,492  |
| 1978          | 813        | 0                   | 1   | 0   | 331   | 4   | 0   | 1,695 | 1,121 | 0   | 11  | 530   | 2   | 0   | 0   | 0     | 3,695  |
| 1979          | 925        | 0                   | 4   | 1   | 2,438 | 4   | 0   | 973   | 792   | 0   | 9   | 408   | 4   | 0   | 3   | 0     | 4,636  |
| 1980          | 2,645      | 0                   | 1   | 1   | 723   | 14  | 0   | 1,505 | 1,192 | 0   | 9   | 828   | 0   | 2   | 0   | 0     | 4,275  |
| 1981          | 1,796      | 0                   | 4   | 0   | 782   | 9   | 0   | 2,568 | 473   | 0   | 12  | 937   | 0   | 3   | 0   | 0     | 4,788  |
| 1982          | 1,156      | 0                   | 3   | 3   | 185   | 0   | 0   | 1,172 | 191   | 0   | 23  | 457   | 0   | 9   | 0   | 0     | 2,043  |
| 1983          | 888        | 0                   | 0   | 1   | 163   | 7   | 0   | 484   | 336   | 0   | 5   | 480   | 0   | 0   | 1   | 0     | 1,477  |
| 1984          | 1,242      | 0                   | 1   | 0   | 469   | 23  | 0   | 911   | 1,214 | 0   | 21  | 1,828 | 5   | 1   | 4   | 0     | 4,477  |
| 1985          | 1,850      | 0                   | 2   | 6   | 656   | 20  | 1   | 3,533 | 1,293 | 0   | 44  | 1,441 | 0   | 28  | 10  | 0     | 7,034  |
| 1986          | 1,978      | 0                   | 3   | 6   | 1,981 | 6   | 1   | 7,167 | 1,276 | 0   | 367 | 2,817 | 1   | 38  | 2   | 0     | 13,665 |
| 1987          | 1,062      | 3                   | 0   | 12  | 336   | 4   | 1   | 1,251 | 565   | 0   | 95  | 3,225 | 2   | 12  | 0   | 0     | 5,506  |
| 1988          | 1,038      | 0                   | 0   | 0   | 273   | 13  | 0   | 796   | 516   | 0   | 37  | 544   | 2   | 2   | 1   | 0     | 2,184  |
| 1989          | 1,162      | 0                   | 1   | 0   | 226   | 5   | 0   | 930   | 1,154 | 0   | 0   | 566   | 4   | 0   | 1   | 0     | 2,887  |
| 1990          | 2,093      | 0                   | 0   | 0   | 405   | 46  | 0   | 1,236 | 1,345 | 0   | 12  | 1,316 | 3   | 12  | 0   | 0     | 4,375  |
| 1991          | 3,579      | 1                   | 13  | 0   | 546   | 1   | 0   | 5,209 | 250   | 0   | 45  | 343   | 0   | 1   | 0   | 0     | 6,408  |
| 1992          | 1,607      | 0                   | 0   | 16  | 268   | 1   | 0   | 552   | 250   | 1   | 10  | 379   | 5   | 2   | 0   | 0     | 1,484  |
| 1993          | 1,536      | 0                   | 0   | 2   | 293   | 12  | 0   | 1,390 | 473   | 0   | 23  | 692   | 0   | 0   | 0   | 0     | 2,885  |
| 1994          | 991        | 0                   | 6   | 0   | 503   | 15  | 0   | 631   | 553   | 0   | 7   | 526   | 4   | 7   | 0   | 0     | 2,251  |
| 1995          | 1,111      | 0                   | 9   | 0   | 2,067 | 1   | 1   | 3,896 | 156   | 0   | 65  | 280   | 0   | 5   | 0   | 0     | 6,479  |
| 1996          | 1,078      | 1                   | 1   | 0   | 345   | 0   | 0   | 6,117 | 83    | 0   | 109 | 354   | 1   | 2   | 0   | 0     | 7,013  |
| 1997          | 1,026      | 0                   | 0   | 2   | 119   | 9   | 0   | 854   | 824   | 0   | 19  | 1596  | 5   | 7   | 0   | 0     | 3,435  |
| 1998          | 1,202      | 0                   | 1   | 0   | 625   | 3   | 0   | 2,099 | 598   | 0   | 16  | 689   | 0   | 0   | 0   |       | 4,031  |
| 1999          | 1,625      | 0                   | 0   | 0   | 854   | 7   | 0   | 1,356 | 610   | 0   | 14  | 997   | 0   |     |     |       | 3,838  |
| 2000          | 1,375      | 0                   | 3   | 0   | 1,035 | 0   | 0   | 6,066 | 464   | 0   |     |       |     |     |     |       | 7,568  |
| 2001          | 1,830      | 0                   | 0   | 0   | 398   | 12  |     |       |       |     |     |       |     |     |     |       |        |
| 2002          | 1,264      | 0                   | 53  |     |       |     |     |       |       |     |     |       |     |     |     |       |        |
| 2003          | 1,831      |                     |     |     |       |     |     |       |       |     |     |       |     |     |     |       |        |
| 2004          | 1,939      |                     |     |     |       |     |     |       |       |     |     |       |     |     |     |       |        |
| 2005          | 2,745      |                     |     |     |       |     |     |       |       |     |     |       |     |     |     |       |        |

**Appendix A4.**–Kvichak River data available for analysis of sockeye salmon escapement goal (in thousands of fish).

| Brood<br>Year | Escapement | Return by Age Class |     |     |        |     |     |       |        |     |     |       |     |     |     | Total |        |
|---------------|------------|---------------------|-----|-----|--------|-----|-----|-------|--------|-----|-----|-------|-----|-----|-----|-------|--------|
|               |            | 0.2                 | 1.1 | 0.3 | 1.2    | 2.1 | 0.4 | 1.3   | 2.2    | 3.1 | 1.4 | 2.3   | 3.2 | 2.4 | 3.3 |       | 3.4    |
| 1956          | 9,443      | 0                   | 14  | 0   | 24,273 | 0   | 0   | 6,968 | 6,472  | 0   | 0   | 1,308 | 0   | 0   | 0   | 0     | 39,035 |
| 1957          | 2,843      | 8                   | 0   | 0   | 243    | 0   | 0   | 244   | 3,333  | 0   | 2   | 259   | 0   | 0   | 2   | 0     | 4,091  |
| 1958          | 535        | 0                   | 0   | 0   | 76     | 0   | 0   | 48    | 135    | 0   | 0   | 26    | 0   | 0   | 3   | 0     | 288    |
| 1959          | 680        | 0                   | 0   | 0   | 212    | 1   | 0   | 117   | 206    | 0   | 0   | 11    | 0   | 0   | 0   | 0     | 547    |
| 1960          | 14,630     | 0                   | 0   | 1   | 1,314  | 134 | 0   | 563   | 46,746 | 0   | 0   | 6,485 | 10  | 0   | 6   | 0     | 55,259 |
| 1961          | 3,706      | 1                   | 0   | 0   | 334    | 0   | 0   | 190   | 2,293  | 0   | 0   | 679   | 5   | 0   | 0   | 0     | 3,502  |
| 1962          | 2,581      | 0                   | 0   | 0   | 104    | 2   | 0   | 152   | 4,675  | 0   | 0   | 408   | 12  | 0   | 4   | 0     | 5,357  |
| 1963          | 339        | 0                   | 0   | 0   | 49     | 3   | 0   | 50    | 639    | 0   | 0   | 366   | 3   | 0   | 9   | 0     | 1,119  |
| 1964          | 957        | 0                   | 8   | 0   | 2,232  | 105 | 0   | 407   | 2,341  | 0   | 0   | 647   | 8   | 0   | 3   | 0     | 5,751  |
| 1965          | 24,326     | 0                   | 25  | 0   | 9,853  | 484 | 0   | 471   | 32,951 | 0   | 0   | 1,239 | 2   | 0   | 1   | 0     | 45,026 |
| 1966          | 3,775      | 4                   | 11  | 6   | 497    | 11  | 0   | 1,086 | 4,262  | 0   | 0   | 385   | 0   | 1   | 0   | 0     | 6,263  |
| 1967          | 3,216      | 0                   | 0   | 5   | 349    | 2   | 0   | 272   | 812    | 0   | 0   | 86    | 0   | 0   | 0   | 0     | 1,526  |
| 1968          | 2,557      | 0                   | 0   | 0   | 293    | 0   | 0   | 34    | 77     | 0   | 5   | 132   | 0   | 0   | 2   | 0     | 543    |
| 1969          | 8,394      | 0                   | 0   | 1   | 129    | 7   | 0   | 321   | 4,221  | 0   | 0   | 595   | 19  | 0   | 11  | 0     | 5,304  |
| 1970          | 13,935     | 0                   | 1   | 0   | 43     | 40  | 0   | 13    | 14,463 | 6   | 0   | 848   | 412 | 0   | 7   | 0     | 15,833 |
| 1971          | 2,387      | 0                   | 0   | 0   | 244    | 18  | 0   | 93    | 2,169  | 0   | 0   | 303   | 2   | 0   | 0   | 0     | 2,829  |
| 1972          | 1,010      | 0                   | 0   | 0   | 255    | 1   | 0   | 159   | 1,206  | 0   | 22  | 297   | 0   | 0   | 0   | 0     | 1,940  |
| 1973          | 227        | 0                   | 0   | 2   | 576    | 2   | 2   | 1,028 | 274    | 0   | 3   | 543   | 28  | 0   | 0   | 0     | 2,458  |
| 1974          | 4,434      | 0                   | 9   | 1   | 6,328  | 309 | 0   | 2,009 | 16,725 | 0   | 8   | 763   | 23  | 0   | 5   | 0     | 26,180 |
| 1975          | 13,140     | 0                   | 5   | 0   | 5,683  | 302 | 0   | 1,232 | 30,263 | 0   | 0   | 599   | 2   | 0   | 0   | 0     | 38,086 |
| 1976          | 1,965      | 0                   | 5   | 11  | 5,298  | 43  | 0   | 826   | 4,115  | 0   | 4   | 273   | 0   | 0   | 0   | 0     | 10,575 |
| 1977          | 1,341      | 11                  | 43  | 6   | 1,934  | 2   | 0   | 935   | 208    | 0   | 0   | 99    | 0   | 0   | 0   | 0     | 3,238  |
| 1978          | 4,149      | 0                   | 0   | 0   | 1,835  | 16  | 0   | 1,157 | 1,318  | 0   | 0   | 817   | 11  | 0   | 6   | 0     | 5,160  |
| 1979          | 11,218     | 1                   | 57  | 3   | 18,331 | 73  | 0   | 2,234 | 17,931 | 0   | 0   | 3,512 | 0   | 0   | 0   | 0     | 42,142 |
| 1980          | 17,505     | 0                   | 2   | 5   | 2,889  | 20  | 0   | 1,641 | 8,076  | 0   | 2   | 413   | 0   | 0   | 0   | 0     | 13,048 |
| 1981          | 1,754      | 0                   | 0   | 12  | 789    | 0   | 0   | 231   | 931    | 0   | 0   | 167   | 0   | 0   | 0   | 0     | 2,130  |
| 1982          | 1,135      | 25                  | 0   | 2   | 445    | 1   | 0   | 544   | 524    | 0   | 6   | 139   | 0   | 0   | 0   | 0     | 1,686  |
| 1983          | 3,570      | 0                   | 1   | 5   | 8,596  | 3   | 0   | 3,010 | 1,195  | 0   | 5   | 573   | 0   | 2   | 1   | 0     | 13,391 |
| 1984          | 10,491     | 0                   | 0   | 4   | 2,532  | 44  | 1   | 1,924 | 16,952 | 0   | 0   | 2,483 | 8   | 0   | 2   | 0     | 23,950 |
| 1985          | 7,211      | 4                   | 7   | 30  | 1,024  | 29  | 0   | 1,282 | 13,465 | 0   | 2   | 1,560 | 1   | 15  | 2   | 0     | 17,421 |
| 1986          | 1,179      | 10                  | 0   | 27  | 688    | 0   | 1   | 1,079 | 1,390  | 0   | 25  | 1,332 | 2   | 0   | 4   | 0     | 4,558  |
| 1987          | 6,066      | 29                  | 4   | 69  | 4,179  | 31  | 4   | 2,519 | 4,499  | 0   | 5   | 700   | 4   | 0   | 2   | 0     | 12,045 |
| 1988          | 4,065      | 11                  | 5   | 19  | 2,503  | 19  | 1   | 2,470 | 4,385  | 0   | 5   | 557   | 11  | 0   | 6   | 0     | 9,991  |
| 1989          | 8,318      | 29                  | 2   | 54  | 2,147  | 117 | 2   | 1,678 | 18,826 | 0   | 2   | 3,316 | 13  | 1   | 0   | 0     | 26,187 |
| 1990          | 6,970      | 6                   | 8   | 11  | 1,541  | 83  | 0   | 1,192 | 21,105 | 0   | 0   | 1,162 | 0   | 1   | 0   | 0     | 25,109 |
| 1991          | 4,223      | 0                   | 1   | 4   | 2,688  | 2   | 0   | 1,232 | 699    | 0   | 6   | 170   | 0   | 0   | 0   | 0     | 4,802  |
| 1992          | 4,726      | 2                   | 0   | 13  | 429    | 2   | 0   | 226   | 567    | 0   | 0   | 175   | 0   | 0   | 6   | 0     | 1,420  |
| 1993          | 4,025      | 0                   | 0.9 | 1   | 852    | 1   | 4   | 890   | 624    | 0   | 8   | 574   | 0   | 0   | 0   | 0     | 2,955  |
| 1994          | 8,338      | 0                   | 3   | 0   | 1,811  | 29  | 0   | 1,204 | 3,777  | 0   | 1   | 250   | 1   | 0   | 0   | 0     | 7,076  |
| 1995          | 10,039     | 0                   | 17  | 0   | 7736   | 0   | 0   | 1810  | 600    | 0   | 5   | 76    | 0   | 0   | 0   | 0     | 10,244 |
| 1996          | 1,451      | 4                   | 0   | 0   | 369    | 0   | 0   | 1,202 | 19     | 0   | 9   | 16    | 0   | 0   | 0   | 0     | 1,619  |
| 1997          | 1,504      | 0                   | 0   | 4   | 130    | 0   | 1   | 107   | 263    | 0   | 0   | 75    | 0   | 5   | 0   | 0     | 585    |
| 1998          | 2,296      | 0                   | 0   | 2   | 323    | 1   | 4   | 278   | 245    | 0   | 8   | 54    | 1   | 0   | 0   |       | 916    |
| 1999          | 6,197      | 4                   | 1   | 0   | 1,070  | 78  | 0   | 224   | 5,794  | 0   | 5   | 265   | 2   |     |     |       | 7,443  |
| 2000          | 1,828      | 0                   | 0   | 13  | 1,856  | 0   | 0   | 1,163 | 940    | 0   |     |       |     |     |     |       | 3,972  |
| 2001          | 1,095      | 0                   | 0   | 33  | 532    | 2   |     |       |        |     |     |       |     |     |     |       |        |
| 2002          | 704        | 2                   | 7   |     |        |     |     |       |        |     |     |       |     |     |     |       |        |
| 2003          | 1,687      |                     |     |     |        |     |     |       |        |     |     |       |     |     |     |       |        |
| 2004          | 5,500      |                     |     |     |        |     |     |       |        |     |     |       |     |     |     |       |        |
| 2005          | 2,320      |                     |     |     |        |     |     |       |        |     |     |       |     |     |     |       |        |

**Appendix A5.**–Wood River data available for analysis of sockeye salmon escapement goal (in thousands of fish).

| Brood<br>Year | Escapement | Return by Age Class |     |     |       |     |     |       |     |     |     |     |     |     |     | Total |       |
|---------------|------------|---------------------|-----|-----|-------|-----|-----|-------|-----|-----|-----|-----|-----|-----|-----|-------|-------|
|               |            | 0.2                 | 1.1 | 0.3 | 1.2   | 2.1 | 0.4 | 1.3   | 2.2 | 3.1 | 1.4 | 2.3 | 3.2 | 2.4 | 3.3 |       | 3.4   |
| 1956          | 773        | 0                   | 0   | 48  | 774   | 0   | 0   | 627   | 24  | 0   | 0   | 0   | 0   | 0   | 0   | 0     | 1,473 |
| 1957          | 289        | 0                   | 0   | 21  | 136   | 0   | 0   | 257   | 35  | 0   | 0   | 0   | 0   | 0   | 0   | 0     | 449   |
| 1958          | 960        | 0                   | 1   | 0   | 2,145 | 1   | 0   | 389   | 75  | 0   | 0   | 32  | 0   | 0   | 0   | 0     | 2,643 |
| 1959          | 2,209      | 0                   | 0   | 1   | 979   | 10  | 0   | 398   | 359 | 0   | 1   | 55  | 0   | 0   | 2   | 0     | 1,805 |
| 1960          | 1,016      | 0                   | 6   | 0   | 1,474 | 0   | 0   | 1,039 | 106 | 0   | 2   | 105 | 1   | 0   | 0   | 0     | 2,733 |
| 1961          | 461        | 0                   | 0   | 10  | 255   | 0   | 0   | 1,183 | 24  | 0   | 2   | 20  | 0   | 1   | 1   | 0     | 1,496 |
| 1962          | 874        | 1                   | 2   | 0   | 992   | 1   | 2   | 340   | 116 | 0   | 6   | 43  | 0   | 0   | 0   | 0     | 1,503 |
| 1963          | 721        | 0                   | 0   | 0   | 536   | 1   | 0   | 769   | 76  | 0   | 0   | 46  | 0   | 0   | 0   | 0     | 1,428 |
| 1964          | 1,076      | 0                   | 1   | 6   | 452   | 0   | 0   | 347   | 338 | 0   | 0   | 74  | 0   | 0   | 2   | 0     | 1,220 |
| 1965          | 675        | 2                   | 1   | 8   | 472   | 1   | 0   | 999   | 90  | 0   | 0   | 213 | 0   | 0   | 1   | 0     | 1,787 |
| 1966          | 1,209      | 0                   | 7   | 29  | 974   | 0   | 0   | 988   | 46  | 0   | 7   | 69  | 0   | 0   | 1   | 0     | 2,121 |
| 1967          | 516        | 0                   | 3   | 21  | 642   | 0   | 0   | 269   | 75  | 0   | 2   | 80  | 0   | 0   | 0   | 0     | 1,092 |
| 1968          | 649        | 0                   | 1   | 0   | 514   | 0   | 0   | 565   | 5   | 0   | 4   | 19  | 0   | 0   | 0   | 0     | 1,108 |
| 1969          | 604        | 0                   | 0   | 4   | 57    | 0   | 0   | 445   | 201 | 0   | 10  | 116 | 0   | 0   | 0   | 0     | 833   |
| 1970          | 1,162      | 0                   | 2   | 0   | 1,539 | 0   | 0   | 1,002 | 231 | 0   | 0   | 26  | 0   | 0   | 0   | 0     | 2,800 |
| 1971          | 851        | 3                   | 0   | 18  | 456   | 0   | 0   | 576   | 198 | 0   | 1   | 49  | 0   | 0   | 0   | 0     | 1,301 |
| 1972          | 431        | 2                   | 1   | 22  | 779   | 0   | 0   | 631   | 32  | 0   | 20  | 27  | 0   | 0   | 0   | 0     | 1,514 |
| 1973          | 330        | 1                   | 1   | 0   | 213   | 0   | 0   | 1,148 | 74  | 0   | 3   | 44  | 0   | 0   | 0   | 0     | 1,484 |
| 1974          | 1,709      | 0                   | 3   | 6   | 2,956 | 4   | 0   | 1,698 | 421 | 0   | 5   | 71  | 0   | 0   | 0   | 0     | 5,164 |
| 1975          | 1,270      | 13                  | 47  | 12  | 1,592 | 2   | 0   | 1,977 | 406 | 0   | 2   | 734 | 0   | 0   | 0   | 0     | 4,785 |
| 1976          | 817        | 0                   | 3   | 0   | 2,278 | 3   | 0   | 2,589 | 572 | 0   | 10  | 265 | 0   | 0   | 0   | 0     | 5,720 |
| 1977          | 562        | 0                   | 20  | 0   | 1,029 | 0   | 0   | 2,173 | 40  | 0   | 0   | 26  | 2   | 0   | 0   | 0     | 3,290 |
| 1978          | 2,267      | 0                   | 0   | 0   | 1,364 | 3   | 0   | 1,029 | 784 | 0   | 12  | 96  | 0   | 0   | 0   | 0     | 3,288 |
| 1979          | 1,706      | 0                   | 10  | 0   | 2,643 | 0   | 0   | 1,491 | 24  | 0   | 1   | 13  | 0   | 0   | 0   | 0     | 4,182 |
| 1980          | 2,969      | 0                   | 0   | 0   | 453   | 0   | 0   | 978   | 72  | 0   | 1   | 101 | 0   | 0   | 0   | 0     | 1,605 |
| 1981          | 1,233      | 0                   | 0   | 0   | 626   | 0   | 0   | 1,137 | 60  | 0   | 0   | 86  | 0   | 0   | 0   | 0     | 1,909 |
| 1982          | 976        | 0                   | 4   | 0   | 522   | 0   | 0   | 765   | 121 | 0   | 12  | 14  | 0   | 0   | 0   | 0     | 1,438 |
| 1983          | 1,361      | 0                   | 1   | 5   | 1,940 | 0   | 2   | 1,154 | 15  | 0   | 2   | 75  | 0   | 0   | 0   | 0     | 3,194 |
| 1984          | 1,003      | 0                   | 0   | 0   | 586   | 0   | 2   | 1,340 | 32  | 0   | 15  | 23  | 0   | 0   | 0   | 0     | 1,998 |
| 1985          | 939        | 8                   | 3   | 15  | 1,127 | 0   | 1   | 1,390 | 29  | 0   | 2   | 12  | 0   | 1   | 0   | 0     | 2,588 |
| 1986          | 819        | 7                   | 2   | 25  | 1,179 | 0   | 1   | 1,970 | 70  | 0   | 12  | 64  | 0   | 0   | 0   | 0     | 3,330 |
| 1987          | 1,337      | 25                  | 0   | 30  | 1,334 | 0   | 14  | 756   | 98  | 0   | 8   | 92  | 0   | 1   | 0   | 0     | 2,358 |
| 1988          | 867        | 4                   | 1   | 8   | 1,613 | 0   | 3   | 1,425 | 90  | 0   | 15  | 34  | 0   | 0   | 0   | 0     | 3,193 |
| 1989          | 1,186      | 1                   | 4   | 16  | 2,293 | 0   | 0   | 1,922 | 13  | 0   | 2   | 39  | 0   | 0   | 0   | 0     | 4,290 |
| 1990          | 1,069      | 10                  | 1   | 10  | 1,104 | 1   | 3   | 1,208 | 286 | 0   | 2   | 169 | 0   | 0   | 0   | 0     | 2,794 |
| 1991          | 1,160      | 0                   | 12  | 9   | 2,633 | 0   | 0   | 2,466 | 54  | 0   | 65  | 71  | 0   | 0   | 0   | 0     | 5,310 |
| 1992          | 1,286      | 10                  | 1   | 57  | 2,398 | 0   | 2   | 1,674 | 90  | 0   | 0   | 49  | 0   | 0   | 1   | 0     | 4,282 |
| 1993          | 1,176      | 14                  | 0   | 3   | 1,715 | 0   | 9   | 1,161 | 129 | 0   | 3   | 191 | 0   | 0   | 0   | 0     | 3,225 |
| 1994          | 1,472      | 0                   | 10  | 0   | 2,747 | 1   | 0   | 1,993 | 448 | 0   | 2   | 91  | 0   | 0   | 0   | 0     | 5,292 |
| 1995          | 1,482      | 1                   | 5   | 0   | 3,524 | 0   | 0   | 2,594 | 149 | 0   | 61  | 35  | 0   | 0   | 0   | 0     | 6,369 |
| 1996          | 1,650      | 0                   | 0   | 0   | 2,705 | 0   | 0   | 3,675 | 3   | 0   | 58  | 13  | 0   | 0   | 0   | 0     | 6,454 |
| 1997          | 1,512      | 4                   | 0   | 63  | 174   | 0   | 4   | 675   | 164 | 0   | 25  | 203 | 0   | 0   | 0   | 0     | 1,312 |
| 1998          | 1,756      | 0                   | 3   | 11  | 2,910 | 1   | 0   | 3,516 | 176 | 0   | 9   | 105 | 0   | 1   | 0   |       | 6,731 |
| 1999          | 1,512      | 4                   | 2   | 42  | 1,778 | 1   | 0   | 2,236 | 405 | 0   | 7   | 184 | 0   |     |     |       | 4,659 |
| 2000          | 1,300      | 0                   | 3   | 5   | 3,177 | 0   | 0   | 2,250 | 132 | 0   |     |     |     |     |     |       | 5,567 |
| 2001          | 1,459      | 4                   | 0   | 29  | 2,218 | 0   |     |       |     |     |     |     |     |     |     |       | 2,251 |
| 2002          | 1,284      | 28                  | 44  |     |       |     |     |       |     |     |     |     |     |     |     |       |       |
| 2003          | 1,460      |                     |     |     |       |     |     |       |     |     |     |     |     |     |     |       |       |
| 2004          | 1,543      |                     |     |     |       |     |     |       |     |     |     |     |     |     |     |       |       |
| 2005          | 1,497      |                     |     |     |       |     |     |       |     |     |     |     |     |     |     |       |       |

**Appendix A6.**–Nushagak River data available for analysis of sockeye salmon escapement goal (in thousands of fish).

| <b>Brood</b> |                   | <b>Return by Age Class</b> |            |            |            |            |            |            |            |            |            |            |            |            |            | <b>Total</b> |            |
|--------------|-------------------|----------------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|--------------|------------|
| <b>Year</b>  | <b>Escapement</b> | <b>0.2</b>                 | <b>1.1</b> | <b>0.3</b> | <b>1.2</b> | <b>2.1</b> | <b>0.4</b> | <b>1.3</b> | <b>2.2</b> | <b>3.1</b> | <b>1.4</b> | <b>2.3</b> | <b>3.2</b> | <b>2.4</b> | <b>3.3</b> |              | <b>3.4</b> |
| 1978         | 664               |                            |            | 436        | 100        | 0          | 149        | 779        | 20         | 0          | 1          | 6          | 0          | 1          | 0          | 0            | 1,491      |
| 1979         | 499               | 18                         | 1          | 466        | 494        | 0          | 16         | 854        | 6          | 0          | 42         | 5          | 0          | 0          | 0          | 0            | 1,902      |
| 1980         | 3,317             | 19                         | 0          | 447        | 84         | 0          | 67         | 344        | 162        | 0          | 4          | 156        | 0          | 0          | 0          | 0            | 1,284      |
| 1981         | 1,012             | 9                          | 0          | 137        | 170        | 0          | 14         | 1,476      | 2          | 0          | 86         | 32         | 0          | 0          | 0          | 0            | 1,926      |
| 1982         | 601               | 35                         | 0          | 351        | 164        | 0          | 49         | 894        | 2          | 0          | 62         | 7          | 0          | 0          | 0          | 0            | 1,563      |
| 1983         | 404               | 100                        | 0          | 608        | 114        | 0          | 122        | 553        | 6          | 0          | 16         | 3          | 0          | 0          | 0          | 0            | 1,521      |
| 1984         | 593               | 10                         | 0          | 226        | 51         | 0          | 32         | 566        | 2          | 0          | 20         | 6          | 0          | 0          | 0          | 0            | 912        |
| 1985         | 498               | 68                         | 0          | 510        | 64         | 0          | 62         | 612        | 6          | 0          | 13         | 16         | 0          | 1          | 0          | 0            | 1,351      |
| 1986         | 990               | 68                         | 0          | 837        | 114        | 0          | 58         | 676        | 0          | 0          | 182        | 64         | 0          | 0          | 0          | 0            | 1,999      |
| 1987         | 388               | 140                        | 0          | 933        | 36         | 0          | 253        | 535        | 36         | 0          | 101        | 10         | 0          | 1          | 0          | 0            | 2,047      |
| 1988         | 483               | 68                         | 0          | 546        | 214        | 0          | 120        | 1,426      | 12         | 0          | 62         | 8          | 0          | 0          | 0          | 0            | 2,457      |
| 1989         | 513               | 68                         | 0          | 483        | 124        | 0          | 35         | 703        | 1          | 0          | 18         | 4          | 0          | 0          | 0          | 0            | 1,436      |
| 1990         | 680               | 53                         | 0          | 761        | 36         | 0          | 104        | 253        | 18         | 0          | 11         | 7          | 0          | 4          | 0          | 0            | 1,247      |
| 1991         | 493               | 10                         | 1          | 137        | 172        | 0          | 6          | 1,010      | 3          | 0          | 131        | 19         | 0          | 0          | 0          | 0            | 1,491      |
| 1992         | 695               | 85                         | 0          | 496        | 228        | 0          | 11         | 650        | 9          | 0          | 63         | 11         | 0          | 0          | 0          | 0            | 1,551      |
| 1993         | 715               | 43                         | 0          | 43         | 63         | 0          | 2          | 803        | 1          | 0          | 119        | 49         | 0          | 0          | 0          | 0            | 1,124      |
| 1994         | 509               | 0                          | 0          | 55         | 81         | 0          | 2          | 665        | 6          | 0          | 9          | 53         | 0          | 0          | 0          | 0            | 872        |
| 1995         | 281               | 5                          | 1          | 8          | 143        | 0          | 0          | 923        | 34         | 0          | 109        | 15         | 0          | 0          | 0          | 0            | 1,239      |
| 1996         | 504               | 0                          | 0          | 6          | 502        | 0          | 5          | 1,795      | 3          | 0          | 58         | 5          | 0          | 0          | 0          | 0            | 2,374      |
| 1997         | 373               | 0                          | 0          | 129        | 71         | 0          | 6          | 254        | 14         | 0          | 19         | 86         | 0          | 0          | 0          | 0            | 583        |
| 1998         | 459               | 2                          | 0          | 10         | 312        | 0          | 3          | 1,633      | 64         | 0          | 183        | 82         | 0          | 0          | 0          |              | 2,289      |
| 1999         | 312               | 4                          | 0          | 40         | 421        | 0          | 5          | 1,602      | 25         | 0          | 70         | 24         | 0          |            |            |              | 2,192      |
| 2000         | 404               | 7                          | 0          | 87         | 231        | 0          | 15         | 2,806      | 14         | 0          |            |            |            |            |            |              | 3,160      |
| 2001         | 811               | 11                         | 0          | 253        | 340        | 0          |            |            |            |            |            |            |            |            |            |              | 604        |
| 2002         | 316               | 7                          | 0          |            |            |            |            |            |            |            |            |            |            |            |            |              |            |
| 2003         | 581               |                            |            |            |            |            |            |            |            |            |            |            |            |            |            |              |            |
| 2004         | 492               |                            |            |            |            |            |            |            |            |            |            |            |            |            |            |              |            |
| 2005         | 1,096             |                            |            |            |            |            |            |            |            |            |            |            |            |            |            |              |            |

**Appendix A7.**–Igushik River data available for analysis of sockeye salmon escapement goal (in thousands of fish).

| Brood<br>Year | Escapement | Return by Age Class |     |     |     |     |     |       |     |     |     |     |     |     |     | Total |       |
|---------------|------------|---------------------|-----|-----|-----|-----|-----|-------|-----|-----|-----|-----|-----|-----|-----|-------|-------|
|               |            | 0.2                 | 1.1 | 0.3 | 1.2 | 2.1 | 0.4 | 1.3   | 2.2 | 3.1 | 1.4 | 2.3 | 3.2 | 2.4 | 3.3 |       | 3.4   |
| 1956          | 400        | 0                   | 0   | 0   | 169 | 0   | 0   | 523   | 12  | 0   | 3   | 36  | 0   | 0   | 0   | 0     | 743   |
| 1957          | 130        | 0                   | 0   | 0   | 2   | 0   | 0   | 35    | 19  | 0   | 0   | 20  | 0   | 0   | 0   | 0     | 76    |
| 1958          | 107        | 0                   | 0   | 0   | 14  | 0   | 0   | 71    | 20  | 0   | 0   | 28  | 0   | 0   | 0   | 0     | 133   |
| 1959          | 644        | 0                   | 0   | 0   | 101 | 0   | 0   | 155   | 93  | 0   | 0   | 22  | 0   | 0   | 0   | 0     | 371   |
| 1960          | 495        | 0                   | 0   | 1   | 61  | 0   | 0   | 310   | 44  | 0   | 0   | 57  | 0   | 0   | 0   | 0     | 473   |
| 1961          | 294        | 0                   | 0   | 1   | 33  | 0   | 1   | 364   | 20  | 0   | 0   | 17  | 0   | 0   | 0   | 0     | 436   |
| 1962          | 16         | 0                   | 0   | 8   | 20  | 0   | 0   | 280   | 9   | 0   | 0   | 9   | 0   | 0   | 0   | 0     | 326   |
| 1963          | 92         | 0                   | 0   | 3   | 254 | 0   | 0   | 190   | 36  | 0   | 0   | 25  | 0   | 0   | 0   | 0     | 508   |
| 1964          | 129        | 0                   | 0   | 1   | 162 | 0   | 0   | 585   | 133 | 0   | 0   | 49  | 0   | 0   | 0   | 0     | 930   |
| 1965          | 181        | 0                   | 0   | 0   | 371 | 0   | 0   | 436   | 203 | 0   | 0   | 80  | 0   | 0   | 0   | 0     | 1,090 |
| 1966          | 206        | 0                   | 0   | 0   | 66  | 0   | 0   | 383   | 6   | 0   | 0   | 15  | 0   | 0   | 0   | 0     | 470   |
| 1967          | 282        | 0                   | 0   | 3   | 57  | 0   | 0   | 90    | 13  | 0   | 0   | 12  | 0   | 0   | 0   | 0     | 175   |
| 1968          | 195        | 0                   | 0   | 0   | 43  | 0   | 0   | 120   | 0   | 0   | 2   | 10  | 0   | 0   | 0   | 0     | 175   |
| 1969          | 512        | 0                   | 0   | 0   | 1   | 0   | 0   | 131   | 301 | 0   | 2   | 103 | 0   | 0   | 0   | 0     | 538   |
| 1970          | 371        | 0                   | 0   | 1   | 26  | 0   | 0   | 170   | 41  | 0   | 0   | 71  | 0   | 0   | 0   | 0     | 309   |
| 1971          | 211        | 0                   | 0   | 1   | 48  | 0   | 0   | 164   | 60  | 0   | 0   | 30  | 0   | 0   | 0   | 0     | 303   |
| 1972          | 60         | 0                   | 0   | 4   | 89  | 0   | 0   | 109   | 6   | 0   | 8   | 13  | 0   | 0   | 0   | 0     | 229   |
| 1973          | 60         | 0                   | 0   | 0   | 19  | 0   | 0   | 650   | 25  | 0   | 2   | 29  | 0   | 0   | 0   | 0     | 725   |
| 1974          | 359        | 0                   | 0   | 7   | 441 | 1   | 0   | 750   | 346 | 0   | 4   | 25  | 0   | 0   | 0   | 0     | 1,574 |
| 1975          | 241        | 0                   | 0   | 0   | 783 | 0   | 0   | 2,556 | 137 | 0   | 2   | 503 | 0   | 0   | 0   | 0     | 3,981 |
| 1976          | 186        | 0                   | 0   | 0   | 551 | 3   | 0   | 1,411 | 194 | 0   | 20  | 215 | 0   | 0   | 0   | 0     | 2,394 |
| 1977          | 96         | 0                   | 0   | 6   | 294 | 0   | 0   | 1,689 | 9   | 0   | 8   | 9   | 0   | 0   | 0   | 0     | 2,015 |
| 1978          | 536        | 0                   | 0   | 0   | 96  | 0   | 0   | 330   | 84  | 0   | 1   | 15  | 0   | 0   | 0   | 0     | 526   |
| 1979          | 860        | 0                   | 0   | 0   | 422 | 0   | 0   | 406   | 13  | 0   | 0   | 5   | 0   | 0   | 0   | 0     | 846   |
| 1980          | 1,988      | 0                   | 0   | 0   | 20  | 0   | 0   | 271   | 25  | 0   | 0   | 56  | 0   | 0   | 0   | 0     | 372   |
| 1981          | 591        | 0                   | 0   | 0   | 188 | 0   | 0   | 779   | 8   | 0   | 1   | 49  | 0   | 0   | 0   | 0     | 1,025 |
| 1982          | 424        | 0                   | 0   | 7   | 57  | 0   | 0   | 434   | 9   | 0   | 2   | 10  | 0   | 0   | 0   | 0     | 519   |
| 1983          | 180        | 1                   | 0   | 0   | 151 | 0   | 0   | 353   | 8   | 0   | 2   | 29  | 0   | 0   | 0   | 0     | 544   |
| 1984          | 185        | 0                   | 0   | 0   | 41  | 0   | 0   | 641   | 56  | 0   | 5   | 36  | 0   | 1   | 0   | 0     | 780   |
| 1985          | 212        | 0                   | 0   | 7   | 515 | 0   | 0   | 938   | 86  | 0   | 7   | 79  | 0   | 1   | 0   | 0     | 1,633 |
| 1986          | 308        | 3                   | 0   | 14  | 236 | 0   | 1   | 2,231 | 27  | 0   | 15  | 30  | 0   | 0   | 0   | 0     | 2,557 |
| 1987          | 169        | 2                   | 0   | 11  | 158 | 0   | 0   | 587   | 7   | 0   | 12  | 29  | 0   | 0   | 0   | 0     | 806   |
| 1988          | 170        | 0                   | 0   | 1   | 189 | 0   | 1   | 1,056 | 41  | 0   | 3   | 36  | 0   | 0   | 0   | 0     | 1,327 |
| 1989          | 462        | 0                   | 0   | 15  | 508 | 0   | 0   | 1,119 | 59  | 0   | 7   | 53  | 0   | 0   | 0   | 0     | 1,761 |
| 1990          | 366        | 1                   | 0   | 3   | 159 | 0   | 0   | 1,429 | 183 | 0   | 4   | 146 | 0   | 0   | 0   | 0     | 1,925 |
| 1991          | 756        | 0                   | 0   | 1   | 318 | 0   | 0   | 1,314 | 3   | 0   | 5   | 20  | 0   | 0   | 0   | 0     | 1,661 |
| 1992          | 305        | 0                   | 0   | 3   | 44  | 0   | 0   | 148   | 8   | 0   | 0   | 26  | 0   | 0   | 0   | 0     | 229   |
| 1993          | 406        | 0                   | 0   | 1   | 132 | 0   | 2   | 316   | 20  | 0   | 0   | 35  | 0   | 0   | 0   | 0     | 506   |
| 1994          | 446        | 0                   | 0   | 0   | 238 | 0   | 0   | 846   | 92  | 0   | 1   | 26  | 0   | 0   | 0   | 0     | 1,203 |
| 1995          | 473        | 0                   | 0   | 0   | 653 | 0   | 0   | 1,599 | 15  | 0   | 21  | 13  | 0   | 0   | 0   | 0     | 2,301 |
| 1996          | 401        | 0                   | 0   | 0   | 171 | 0   | 0   | 1,237 | 1   | 0   | 4   | 4   | 0   | 0   | 0   | 0     | 1,417 |
| 1997          | 128        | 0                   | 0   | 19  | 34  | 0   | 0   | 52    | 10  | 0   | 5   | 58  | 0   | 0   | 0   | 0     | 178   |
| 1998          | 216        | 0                   | 0   | 0   | 143 | 0   | 0   | 732   | 28  | 0   | 8   | 31  | 0   | 0   | 0   |       | 942   |
| 1999          | 446        | 0                   | 0   | 7   | 206 | 0   | 0   | 317   | 70  | 0   | 0   | 222 | 0   |     |     |       | 822   |
| 2000          | 413        | 0                   | 0   | 0   | 103 | 0   | 0   | 1556  | 67  | 0   |     |     |     |     |     |       | 1,726 |
| 2001          | 410        | 0                   | 0   | 0   | 82  | 0   |     |       |     |     |     |     |     |     |     |       |       |
| 2002          | 123        | 0                   | 0   |     |     |     |     |       |     |     |     |     |     |     |     |       |       |
| 2003          | 194        |                     |     |     |     |     |     |       |     |     |     |     |     |     |     |       |       |
| 2004          | 110        |                     |     |     |     |     |     |       |     |     |     |     |     |     |     |       |       |
| 2005          | 366        |                     |     |     |     |     |     |       |     |     |     |     |     |     |     |       |       |

**Appendix A8.**–Togiak River data available for analysis of sockeye salmon escapement goal (in thousands of fish).

| Brood<br>Year | Escapement | Return by Age Class |     |     |     |     |     |      |     |     |     |     |     |     |     |     | Total |
|---------------|------------|---------------------|-----|-----|-----|-----|-----|------|-----|-----|-----|-----|-----|-----|-----|-----|-------|
|               |            | 0.2                 | 1.1 | 0.3 | 1.2 | 2.1 | 0.4 | 1.3  | 2.2 | 3.1 | 1.4 | 2.3 | 3.2 | 2.4 | 3.3 | 3.4 |       |
| 1956          | 225        | 0                   | 0   | 4   | 114 | 0   | 0   | 306  | 22  | 0   | 1   | 13  | 0   | 0   | 0   | 0   | 460   |
| 1957          | 25         | 2                   | 0   | 5   | 48  | 0   | 0   | 70   | 20  | 0   | 0   | 36  | 1   | 0   | 0   | 0   | 182   |
| 1958          | 72         | 0                   | 1   | 2   | 68  | 0   | 0   | 115  | 59  | 0   | 0   | 25  | 0   | 0   | 0   | 0   | 270   |
| 1959          | 210        | 0                   | 0   | 0   | 141 | 0   | 0   | 92   | 56  | 0   | 0   | 7   | 0   | 0   | 0   | 0   | 296   |
| 1960          | 163        | 0                   | 0   | 2   | 191 | 0   | 0   | 274  | 22  | 0   | 0   | 52  | 0   | 0   | 0   | 0   | 541   |
| 1961          | 122        | 1                   | 0   | 3   | 85  | 0   | 0   | 216  | 15  | 0   | 1   | 19  | 0   | 0   | 0   | 0   | 340   |
| 1962          | 62         | 0                   | 0   | 7   | 48  | 0   | 0   | 102  | 4   | 0   | 0   | 8   | 0   | 0   | 0   | 0   | 169   |
| 1963          | 116        | 0                   | 0   | 2   | 43  | 0   | 0   | 65   | 18  | 0   | 0   | 24  | 0   | 0   | 0   | 0   | 152   |
| 1964          | 105        | 0                   | 0   | 1   | 43  | 0   | 0   | 84   | 41  | 0   | 0   | 6   | 0   | 0   | 0   | 0   | 175   |
| 1965          | 96         | 0                   | 0   | 2   | 154 | 0   | 0   | 181  | 31  | 0   | 0   | 37  | 0   | 0   | 0   | 0   | 405   |
| 1966          | 104        | 1                   | 0   | 6   | 200 | 0   | 0   | 419  | 4   | 0   | 1   | 9   | 0   | 0   | 0   | 0   | 640   |
| 1967          | 81         | 1                   | 0   | 6   | 18  | 0   | 0   | 99   | 16  | 0   | 1   | 40  | 0   | 0   | 0   | 0   | 181   |
| 1968          | 50         | 0                   | 0   | 1   | 49  | 0   | 0   | 190  | 6   | 0   | 3   | 13  | 0   | 0   | 0   | 0   | 262   |
| 1969          | 117        | 0                   | 0   | 5   | 28  | 0   | 0   | 142  | 25  | 0   | 3   | 13  | 0   | 0   | 0   | 0   | 216   |
| 1970          | 203        | 0                   | 0   | 1   | 54  | 0   | 0   | 226  | 55  | 0   | 1   | 70  | 0   | 0   | 0   | 0   | 407   |
| 1971          | 200        | 0                   | 0   | 4   | 106 | 0   | 0   | 317  | 62  | 0   | 1   | 68  | 0   | 0   | 0   | 0   | 558   |
| 1972          | 79         | 0                   | 0   | 2   | 93  | 0   | 0   | 150  | 21  | 0   | 2   | 34  | 0   | 0   | 0   | 0   | 302   |
| 1973          | 107        | 1                   | 0   | 10  | 151 | 0   | 0   | 442  | 18  | 0   | 1   | 31  | 0   | 0   | 0   | 0   | 654   |
| 1974          | 104        | 0                   | 0   | 2   | 271 | 0   | 0   | 307  | 73  | 0   | 3   | 45  | 0   | 1   | 0   | 0   | 702   |
| 1975          | 181        | 1                   | 0   | 7   | 195 | 0   | 0   | 848  | 87  | 0   | 2   | 59  | 0   | 0   | 0   | 0   | 1,199 |
| 1976          | 189        | 0                   | 0   | 1   | 189 | 0   | 0   | 558  | 142 | 0   | 4   | 175 | 0   | 0   | 0   | 0   | 1,069 |
| 1977          | 163        | 0                   | 0   | 5   | 232 | 0   | 0   | 617  | 14  | 0   | 4   | 14  | 0   | 0   | 0   | 0   | 886   |
| 1978          | 306        | 0                   | 0   | 12  | 149 | 0   | 0   | 430  | 65  | 0   | 1   | 25  | 0   | 0   | 0   | 0   | 682   |
| 1979          | 198        | 1                   | 0   | 1   | 270 | 0   | 0   | 293  | 12  | 0   | 2   | 5   | 0   | 0   | 0   | 0   | 584   |
| 1980          | 527        | 0                   | 0   | 5   | 45  | 0   | 1   | 224  | 10  | 0   | 0   | 19  | 0   | 0   | 0   | 0   | 304   |
| 1981          | 307        | 2                   | 0   | 11  | 53  | 0   | 0   | 245  | 15  | 0   | 1   | 16  | 0   | 0   | 0   | 0   | 343   |
| 1982          | 289        | 0                   | 0   | 16  | 109 | 0   | 0   | 255  | 14  | 0   | 5   | 26  | 0   | 0   | 0   | 0   | 425   |
| 1983          | 213        | 1                   | 0   | 3   | 285 | 0   | 2   | 924  | 9   | 0   | 2   | 21  | 0   | 0   | 0   | 0   | 1,247 |
| 1984          | 151        | 0                   | 0   | 14  | 21  | 0   | 0   | 109  | 4   | 0   | 1   | 17  | 0   | 0   | 0   | 0   | 166   |
| 1985          | 153        | 0                   | 0   | 7   | 35  | 0   | 0   | 194  | 35  | 0   | 1   | 77  | 0   | 1   | 0   | 0   | 350   |
| 1986          | 203        | 0                   | 0   | 18  | 77  | 0   | 1   | 445  | 83  | 0   | 14  | 121 | 0   | 0   | 0   | 0   | 759   |
| 1987          | 278        | 0                   | 0   | 7   | 190 | 0   | 1   | 575  | 31  | 0   | 7   | 81  | 0   | 0   | 0   | 0   | 892   |
| 1988          | 309        | 1                   | 0   | 9   | 111 | 0   | 3   | 403  | 34  | 0   | 3   | 53  | 0   | 0   | 0   | 0   | 617   |
| 1989          | 104        | 0                   | 0   | 36  | 132 | 0   | 1   | 328  | 7   | 0   | 1   | 41  | 0   | 0   | 0   | 0   | 546   |
| 1990          | 166        | 1                   | 0   | 23  | 101 | 0   | 1   | 460  | 75  | 0   | 5   | 37  | 0   | 0   | 0   | 0   | 703   |
| 1991          | 254        | 1                   | 3.2 | 3   | 189 | 0   | 1   | 429  | 28  | 0   | 8   | 29  | 0   | 0   | 0   | 0   | 691   |
| 1992          | 210        | 1                   | 0   | 35  | 50  | 0   | 1   | 124  | 33  | 0   | 1   | 30  | 0   | 0   | 0   | 0   | 275   |
| 1993          | 189        | 0                   | 0.3 | 4   | 64  | 0   | 0   | 229  | 6   | 0   | 4   | 15  | 0   | 0   | 0   | 0   | 322   |
| 1994          | 174        | 1                   | 0.2 | 3   | 43  | 0   | 0   | 167  | 31  | 0   | 1   | 8   | 0   | 0   | 0   | 0   | 254   |
| 1995          | 211        | 0                   | 0.6 | 6   | 341 | 0   | 1   | 1010 | 11  | 0   | 5   | 66  | 0   | 0   | 0   | 0   | 1,441 |
| 1996          | 187        | 1                   | 0.3 | 9   | 87  | 0   | 326 | 987  | 4   | 0   | 8   | 21  | 1   | 0   | 0   | 0   | 1,444 |
| 1997          | 152        | 0                   | 0   | 5   | 43  | 0   | 0   | 305  | 16  | 0   | 5   | 87  | 0   | 2   | 0   | 0   | 463   |
| 1998          | 175        | 0                   | 0   | 1   | 54  | 0   | 0   | 633  | 24  | 0   | 5   | 91  | 0   | 0   | 0   |     | 808   |
| 1999          | 196        | 0                   | 0   | 11  | 137 | 0   | 0   | 290  | 29  | 0   | 1   | 50  | 0   |     |     |     | 518   |
| 2000          | 352        | 0                   | 0   | 4   | 87  | 0   | 0   | 317  | 141 | 0   |     |     |     |     |     |     | 549   |
| 2001          | 303        | 0                   | 0   | 7   | 63  | 0   |     |      |     |     |     |     |     |     |     |     |       |
| 2002          | 162        | 0                   | 0   |     |     |     |     |      |     |     |     |     |     |     |     |     |       |
| 2003          | 232        |                     |     |     |     |     |     |      |     |     |     |     |     |     |     |     |       |
| 2004          | 136        |                     |     |     |     |     |     |      |     |     |     |     |     |     |     |     |       |
| 2005          | 156        |                     |     |     |     |     |     |      |     |     |     |     |     |     |     |     |       |

**Appendix A9.**—Kulukak River data available for analysis of sockeye salmon escapement goal.

| <b>Year</b> | <b>Escapement</b> | <b>ln(Escapement)</b> | <b>Harvest</b> |
|-------------|-------------------|-----------------------|----------------|
| 1961        | 5,200             | 8.56                  | 3,373          |
| 1962        | 9,600             | 9.17                  | 672            |
| 1963        | 11,400            | 9.34                  | 554            |
| 1964        | 9,800             | 9.19                  | 8,286          |
| 1965        | 16,300            | 9.70                  | 3,265          |
| 1966        | 18,800            | 9.84                  | 7,263          |
| 1967        | 10,000            | 9.21                  | 24,379         |
| 1968        | 6,500             | 8.78                  | 2,618          |
| 1969        | 8,400             | 9.04                  | 3,411          |
| 1970        | 10,000            | 9.21                  |                |
| 1971        | 13,000            | 9.47                  | 7,927          |
| 1972        | 3,400             | 8.13                  | 17,244         |
| 1973        | 800               | 6.68                  | 15,551         |
| 1974        | 4,900             | 8.50                  | 13,615         |
| 1975        | 8,600             | 9.06                  | 3,821          |
| 1976        | 11,200            | 9.32                  | 4,822          |
| 1977        | 40,100            | 10.60                 | 16,252         |
| 1978        | 33,900            | 10.43                 | 29,668         |
| 1979        | 26,600            | 10.19                 | 66,629         |
| 1980        | 45,700            | 10.73                 | 42,811         |
| 1981        | 58,780            | 10.98                 | 19,246         |
| 1982        | 52,750            | 10.87                 | 13,952         |
| 1983        | 26,970            | 10.20                 | 55,906         |
| 1984        | 49,800            | 10.82                 | 96,709         |
| 1985        | 36,600            | 10.51                 | 44,120         |
| 1986        | 42,800            | 10.66                 | 100,466        |
| 1987        | 37,800            | 10.54                 | 45,401         |
| 1988        | 31,700            | 10.36                 | 143,112        |
| 1989        | 20,840            | 9.94                  | 14,116         |
| 1990        | 49,600            | 10.81                 | 27,311         |
| 1991        | 23,900            | 10.08                 | 33,425         |
| 1992        | 26,440            | 10.18                 | 108,358        |
| 1993        | 31,800            | 10.37                 | 58,616         |
| 1994        | 29,740            | 10.30                 | 76,781         |
| 1995        | 14,620            | 9.59                  | 76,056         |
| 1996        | 18,980            | 9.85                  | 76,833         |
| 1997        | 7,950             | 8.98                  | 49,277         |
| 1998        | 12,950            | 9.47                  | 76,332         |
| 1999        | 12,300            | 9.42                  | 38,662         |
| 2000        | 22,350            | 10.01                 | 67,612         |
| 2001        | 17,280            | 9.76                  | 9,762          |
| 2002        | 8,500             | 9.05                  | 19,112         |
| 2003        | 8,004             | 8.99                  | 55,081         |
| 2004        |                   |                       | 80,204         |
| 2005        |                   |                       | 53,774         |
| Mean        | 21,783            | 9.70                  | 37,581         |
| SD          | 15,301            | 0.87                  | 34,902         |
| Median      | 17,280            | 9.76                  | 25,845         |

*Note:* Harvest includes commercial, sport, and subsistence. Years with no data indicate years when no escapement estimates were made.

**Appendix A10.**–Nushagak River data available for analysis of Chinook salmon escapement goal.

| Brood<br>Year | Escapement | Return by Age Class |       |       |        |     |       |         |       |     |         |       |        |       |       |     | Total<br>Return |
|---------------|------------|---------------------|-------|-------|--------|-----|-------|---------|-------|-----|---------|-------|--------|-------|-------|-----|-----------------|
|               |            | 0.2                 | 1.1   | 0.3   | 1.2    | 2.1 | 0.4   | 1.3     | 2.2   | 0.5 | 1.4     | 2.3   | 1.5    | 2.4   | 1.6   | 2.5 |                 |
| 1966          | 40,000     | 149                 | 62    | 7,406 | 13,979 | 0   | 4,668 | 27,454  | 0     | 0   | 38,557  | 130   | 5,044  | 376   | 1,043 | 342 | 99,210          |
| 1967          | 65,000     | 0                   | 0     | 283   | 9,795  | 0   | 1,575 | 16,353  | 76    | 188 | 46,066  | 380   | 24,552 | 342   | 275   | 0   | 99,885          |
| 1968          | 70,000     | 0                   | 0     | 834   | 13,485 | 0   | 376   | 18,291  | 0     | 0   | 67,765  |       | 8,368  | 542   | 0     | 0   | 109,661         |
| 1969          | 35,000     | 230                 | 0     | 384   | 965    | 0   | 0     | 14,524  | 0     | 0   | 29,429  | 808   | 2,430  | 268   | 0     | 0   | 49,038          |
| 1970          | 50,000     | 0                   | 0     | 0     | 1,385  | 0   | 0     | 56,699  | 0     | 0   | 73,517  | 1,323 | 4,043  | 874   | 0     | 847 | 138,688         |
| 1971          | 40,000     | 0                   | 0     | 0     | 2,433  | 0   | 389   | 55,755  | 501   | 0   | 94,828  | 1,266 | 12,572 | 6,976 | 0     | 0   | 174,720         |
| 1972          | 25,000     | 0                   | 0     | 137   | 33,264 | 0   | 686   | 52,295  | 0     | 0   | 125,392 | 2,842 | 7,275  | 7,489 | 0     | 0   | 229,380         |
| 1973          | 35,000     | 0                   | 0     | 0     | 2,204  | 0   | 0     | 82,126  | 0     | 0   | 105,777 |       | 13,089 | 0     | 0     | 0   | 203,196         |
| 1974          | 70,000     | 0                   | 0     | 431   | 23,817 | 0   | 0     | 42,053  | 2,175 | 0   | 51,264  |       | 2,174  | 3,078 | 0     | 0   | 124,992         |
| 1975          | 70,000     | 0                   | 587   | 0     | 95,530 | 0   | 0     | 146,534 | 0     | 0   | 137,063 | 3,614 | 9,963  | 7,149 | 0     | 0   | 400,440         |
| 1976          | 100,000    | 0                   | 1,576 | 0     | 7,628  | 0   | 0     | 111,415 | 839   | 0   | 143,981 | 8,701 | 6,052  | 1,171 | 116   | 0   | 281,479         |
| 1977          | 65,000     | 0                   | 0     | 0     | 96,260 | 0   | 0     | 152,290 | 3,400 | 0   | 208,444 | 231   | 14,837 | 0     | 74    | 0   | 475,536         |
| 1978          | 130,000    | 0                   | 1,738 | 0     | 27,569 | 0   | 0     | 46,773  | 402   | 0   | 56,434  |       | 22,029 | 0     | 0     | 73  | 155,018         |
| 1979          | 95,000     | 0                   | 3,137 | 0     | 49,377 | 0   | 0     | 70,843  | 0     | 0   | 87,467  |       | 8,654  | 454   | 0     | 0   | 219,932         |
| 1980          | 141,000    | 0                   | 205   | 0     | 11,241 | 0   | 0     | 48,427  | 0     | 0   | 59,449  | 290   | 4,149  | 0     | 0     | 0   | 123,760         |
| 1981          | 150,000    | 0                   | 967   | 0     | 33,684 | 37  | 0     | 45,923  | 145   | 0   | 82,252  | 0     | 7,492  | 509   | 0     | 0   | 171,010         |
| 1982          | 147,000    | 0                   | 1,494 | 0     | 2,486  | 0   | 0     | 38,490  | 174   | 0   | 32,237  | 224   | 5,849  | 0     | 0     | 0   | 80,954          |
| 1983          | 161,730    | 0                   | 77    | 0     | 12,320 | 0   | 317   | 19,887  | 0     | 0   | 51,467  | 0     | 1,389  | 0     | 0     | 0   | 85,458          |
| 1984          | 80,940     | 0                   | 174   | 0     | 16,772 | 0   | 0     | 27,073  | 0     | 0   | 27,812  | 0     | 1,814  | 181   | 0     | 0   | 73,826          |
| 1985          | 115,720    | 0                   | 3,012 | 0     | 17,797 | 0   | 0     | 32,570  | 0     | 0   | 44,474  | 0     | 2,069  | 134   | 0     | 0   | 100,056         |
| 1986          | 33,854     | 0                   | 37    | 0     | 23,962 | 0   | 0     | 50,682  | 0     | 0   | 45,265  | 268   | 1,883  | 111   | 0     | 0   | 122,208         |
| 1987          | 75,891     | 0                   | 497   | 0     | 35,777 | 0   | 0     | 54,006  | 86    | 0   | 67,881  | 0     | 4,954  | 90    | 0     | 0   | 163,292         |
| 1988          | 50,946     | 0                   | 701   | 31    | 35,795 | 0   | 0     | 61,412  | 0     | 0   | 105,130 | 0     | 2,074  | 179   | 0     | 0   | 205,323         |
| 1989          | 72,601     | 134                 | 2,213 | 0     | 41,446 | 0   | 0     | 84,987  | 0     | 0   | 85,188  | 0     | 3,771  | 138   | 0     | 0   | 217,876         |
| 1990          | 55,931     | 0                   | 556   | 0     | 32,125 | 0   | 0     | 34,731  | 0     | 0   | 26,640  | 0     | 611    | 0     | 0     | 0   | 94,662          |
| 1991          | 94,733     | 0                   | 1,413 | 213   | 52,358 | 0   | 0     | 73,593  | 0     | 0   | 58,708  | 0     | 3,896  | 0     | 0     | 0   | 190,182         |
| 1992          | 74,094     | 0                   | 869   | 138   | 26,244 | 0   | 0     | 52,044  | 0     | 0   | 89,432  | 0     | 683    | 0     | 0     | 0   | 169,408         |
| 1993          | 86,706     | 0                   | 1,802 | 0     | 51,538 | 0   | 0     | 128,688 | 91    | 0   | 40,891  | 41    | 2,121  | 0     | 0     | 0   | 225,172         |
| 1994          | 83,103     | 0                   | 1,110 | 0     | 20,082 | 0   | 0     | 24,841  | 0     | 0   | 32,379  | 0     | 2,936  | 0     | 0     | 0   | 81,348          |
| 1995          | 77,018     | 0                   | 1,013 | 0     | 12,937 | 0   | 0     | 23,326  | 0     | 0   | 49,599  | 152   | 2,794  | 0     | 102   | 0   | 89,923          |
| 1996          | 42,228     | 0                   | 499   | 0     | 17,105 | 0   | 0     | 32,167  | 0     | 0   | 51,496  | 0     | 1,618  | 0     | 0     | 0   | 102,885         |
| 1997          | 82,000     | 0                   | 284   | 36    | 27,109 | 0   | 0     | 44,954  | 0     | 0   | 35,580  | 112   | 1,151  | 0     | 0     | 0   | 109,227         |
| 1998          | 108,037    | 0                   | 500   | 0     | 34,299 | 0   | 0     | 61,337  | 0     | 0   | 68,225  | 77    | 2,135  | 104   |       |     | 166,677         |
| 1999          | 54,703     | 0                   | 693   | 0     | 34,992 | 0   | 0     | 104,194 | 0     | 0   | 95,045  | 0     |        |       |       |     | 234,924         |
| 2000          | 47,674     | 0                   | 552   | 0     | 55,694 | 0   | 0     | 117,180 | 132   |     |         |       |        |       |       |     | 173,558         |
| 2001          | 47,674     | 0                   | 86    | 0     | 45,783 | 0   |       |         |       |     |         |       |        |       |       |     |                 |
| 2002          | 83,272     | 0                   | 274   |       |        |     |       |         |       |     |         |       |        |       |       |     |                 |
| 2003          | 79,790     |                     |       |       |        |     |       |         |       |     |         |       |        |       |       |     |                 |
| 2004          | 103,800    |                     |       |       |        |     |       |         |       |     |         |       |        |       |       |     |                 |
| 2005          | 173,095    |                     |       |       |        |     |       |         |       |     |         |       |        |       |       |     |                 |

Note: Years with no data indicate years when no age composition data were collected.

**Appendix A11.**—Togiak River data available for analysis of Chinook salmon escapement goal.

| <b>Year</b> | <b>Escapement</b> | <b>ln(Escapement)</b> | <b>Commercial Harvest</b> | <b>Subsistence Harvest</b> | <b>Sport Harvest</b> |
|-------------|-------------------|-----------------------|---------------------------|----------------------------|----------------------|
| 1980        | 8,045             | 8.99                  | 10,858                    | 900                        | 34                   |
| 1981        | 12,435            | 9.43                  | 22,744                    | 400                        | 0                    |
| 1982        | 6,800             | 8.82                  | 33,607                    | 400                        | 231                  |
| 1983        | 10,975            | 9.30                  | 35,669                    | 700                        | 535                  |
| 1984        | 19,085            | 9.86                  | 19,958                    | 600                        | 46                   |
| 1985        | 12,010            | 9.39                  | 33,110                    | 600                        | 925                  |
| 1986        |                   |                       | 16,267                    | 700                        | 618                  |
| 1987        | 7,170             | 8.88                  | 14,555                    | 700                        | 338                  |
| 1988        | 6,390             | 8.76                  | 13,205                    | 429                        | 0                    |
| 1989        | 6,640             | 8.80                  | 9,049                     | 551                        | 234                  |
| 1990        | 6,475             | 8.78                  | 9,651                     | 480                        | 445                  |
| 1991        | 8,380             | 9.03                  | 6,472                     | 470                        | 284                  |
| 1992        | 7,410             | 8.91                  | 11,764                    | 1,361                      | 271                  |
| 1993        | 10,210            | 9.23                  | 10,769                    | 749                        | 225                  |
| 1994        | 15,115            | 9.62                  | 9,492                     | 904                        | 663                  |
| 1995        | 12,600            | 9.44                  | 10,736                    | 448                        | 581                  |
| 1996        | 8,299             | 9.02                  | 8,281                     | 471                        | 790                  |
| 1997        | 10,300            | 9.24                  | 5,381                     | 667                        | 1,165                |
| 1998        | 9,856             | 9.20                  | 12,878                    | 782                        | 763                  |
| 1999        | 9,520             | 9.16                  | 10,668                    | 1,244                      | 644                  |
| 2000        | 11,813            | 9.38                  | 7,258                     | 1,116                      | 470                  |
| 2001        | 13,110            | 9.48                  | 9,518                     | 1,612                      | 1006                 |
| 2002        | 9,515             | 9.16                  | 2,682                     | 703                        | 76                   |
| 2003        | 3,050             | 8.02                  | 3,078                     | 1,208                      | 706                  |
| 2004        | 12,324            | 9.42                  | 7,673                     | 1,094                      | 1388                 |
| 2005        | 10,188            | 9.23                  | 10,125                    | 1,147                      | 729                  |
| Mean        | 9,909             | 9.14                  | 13,286                    | 786                        | 506                  |
| SD          | 3,320             | 0.37                  | 8,872                     | 332                        | 371                  |
| Median      | 9,856             | 9.20                  | 10,702                    | 700                        | 503                  |

*Note:* Years with no data indicate years when no escapement estimates were made.

**Appendix A12.**—Naknek River data available for analysis of Chinook salmon escapement goal.

| <b>Year</b> | <b>Escapement</b> | <b>ln(Escapement)</b> |
|-------------|-------------------|-----------------------|
| 1971        | 2,885             | 7.97                  |
| 1972        | 2,791             | 7.93                  |
| 1973        | 2,536             | 7.84                  |
| 1974        |                   |                       |
| 1975        | 3,452             | 8.15                  |
| 1976        | 7,131             | 8.87                  |
| 1977        |                   |                       |
| 1978        |                   |                       |
| 1979        |                   |                       |
| 1980        |                   |                       |
| 1981        | 4,271             | 8.36                  |
| 1982        | 8,610             | 9.06                  |
| 1983        | 7,830             | 8.97                  |
| 1984        | 4,995             | 8.52                  |
| 1985        |                   |                       |
| 1986        | 3,917             | 8.27                  |
| 1987        | 4,450             | 8.40                  |
| 1988        | 11,730            | 9.37                  |
| 1989        | 2,710             | 7.90                  |
| 1990        | 7,000             | 8.85                  |
| 1991        | 4,391             | 8.39                  |
| 1992        | 2,691             | 7.90                  |
| 1993        | 8,016             | 8.99                  |
| 1994        | 9,678             | 9.18                  |
| 1995        | 4,960             | 8.51                  |
| 1996        | 5,010             | 8.52                  |
| 1997        | 10,453            | 9.25                  |
| 1998        | 5,505             | 8.61                  |
| 1999        |                   |                       |
| 2000        | 3,233             | 8.08                  |
| 2001        | 6,340             | 8.75                  |
| 2002        | 7,593             | 8.93                  |
| 2003        | 6,081             | 8.71                  |
| 2004        | 12,878            | 9.46                  |
| 2005        |                   |                       |
| Mean        | 5,968             | 8.58                  |
| SD          | 2,884             | 0.48                  |
| Median      | 5,010             | 8.52                  |

*Note:* Years with no data indicate years when no escapement estimates were made.

**Appendix A13.**–Alagnak River data available for analysis of Chinook salmon escapement goal.

| <b>Year</b> | <b>Escapement</b> | <b>ln(Escapement)</b> |
|-------------|-------------------|-----------------------|
| 1970        | 5,250             | 8.57                  |
| 1971        | 1,475             | 7.30                  |
| 1972        | 2,256             | 7.72                  |
| 1973        | 824               | 6.71                  |
| 1974        | 1,596             | 7.38                  |
| 1975        | 6,620             | 8.80                  |
| 1976        | 7,593             | 8.93                  |
| 1977        | 9,425             | 9.15                  |
| 1978        | 11,650            | 9.36                  |
| 1979        |                   |                       |
| 1980        | 2,930             | 7.98                  |
| 1981        | 2,430             | 7.80                  |
| 1982        | 3,400             | 8.13                  |
| 1983        | 2,980             | 8.00                  |
| 1984        | 6,090             | 8.71                  |
| 1985        | 3,920             | 8.27                  |
| 1986        | 3,090             | 8.04                  |
| 1987        | 2,420             | 7.79                  |
| 1988        | 4,600             | 8.43                  |
| 1989        | 3,650             | 8.20                  |
| 1990        | 1,720             | 7.45                  |
| 1991        | 2,531             | 7.84                  |
| 1992        | 3,042             | 8.02                  |
| 1993        | 10,170            | 9.23                  |
| 1994        | 8,480             | 9.05                  |
| 1995        | 6,860             | 8.83                  |
| 1996        | 9,885             | 9.20                  |
| 1997        | 15,210            | 9.63                  |
| 1998        | 4,148             | 8.33                  |
| 1999        | 2,178             | 7.69                  |
| 2000        | 2,220             | 7.71                  |
| 2001        | 5,458             | 8.60                  |
| 2002        | 3,765             | 8.23                  |
| 2003        | 8,209             | 9.01                  |
| 2004        | 6,755             | 8.82                  |
| 2005        | 5,084             | 8.53                  |
| Mean        | 5,083             | 8.33                  |
| SD          | 3,329             | 0.67                  |
| Median      | 3,920             | 8.27                  |

*Note:* Years with no data indicate years when no escapement estimates were made.

**Appendix A14.**–Egegik River data available for analysis of Chinook salmon escapement goal.

| <b>Year</b> | <b>Escapement</b> | <b>ln(Escapement)</b> |
|-------------|-------------------|-----------------------|
| 1985        | 805               | 6.69                  |
| 1986        | 236               | 6.83                  |
| 1987        | 924               | 6.3                   |
| 1988        | 545               | 6.59                  |
| 1989        | 730               | 6.41                  |
| 1990        | 610               | 6.41                  |
| 1991        | 295               | 5.69                  |
| 1992        | 926               | 6.83                  |
| 1993        | 720               | 6.58                  |
| 1994        | 1284              | 7.16                  |
| 1995        | 843               | 6.74                  |
| 1996        | 427               | 6.06                  |
| 1997        | 807               | 6.69                  |
| 1998        | 605               | 6.41                  |
| 1999        | 286               | 5.66                  |
| 2000        | 199               | 5.29                  |
| 2001        | 389               | 5.96                  |
| 2002        | 646               | 6.47                  |
| 2003        | 790               | 6.67                  |
| 2004        | 579               | 6.36                  |
| 2005        | 335               | 5.81                  |
| Mean        | 618               | 6.36                  |
| SD          | 276               | 0.46                  |
| Median      | 610               | 6.41                  |

**Appendix A15.**—Nushagak River data available for analysis of chum salmon escapement goal.

| <b>Brood</b> |                   |                       |
|--------------|-------------------|-----------------------|
| <b>Year</b>  | <b>Escapement</b> | <b>ln(Escapement)</b> |
| 1980         | 327,344           | 12.69877              |
| 1981         | 143,324           | 11.87286              |
| 1982         | 206,769           | 12.23936              |
| 1983         | 84,866            | 11.34883              |
| 1984         | 354,355           | 12.77805              |
| 1985         | 193,541           | 12.17324              |
| 1986         | 160,480           | 11.98592              |
| 1987         | 138,229           | 11.83667              |
| 1988         | 171,474           | 12.05219              |
| 1989         | 363,351           | 12.80312              |
| 1990         | 293,800           | 12.59065              |
| 1991         | 275,737           | 12.5272               |
| 1992         | 301,813           | 12.61756              |
| 1993         | 214,392           | 12.27556              |
| 1994         | 368,449           | 12.81706              |
| 1995         | 209,789           | 12.25386              |
| 1996         | 220,005           | 12.30141              |
| 1997         | 59,869            | 10.99991              |
| 1998         | 290,903           | 12.58075              |
| 1999         | 233,392           | 12.36047              |
| 2000         | 136,781           | 11.82614              |
| 2001         | 509,436           | 13.14106              |
| 2002         | 400,871           | 12.90139              |
| 2003         | 295,413           | 12.59613              |
| 2004         | 261,690           | 12.47492              |
| 2005         | 456,366           | 13.03105              |
| Mean         | 256,632           | 12.35                 |
| SD           | 110,961           | 0.50                  |
| Median       | 247,541           | 12.42                 |

**Appendix A16.**—Nushagak River data available for analysis of coho salmon escapement goal.

| Brood<br>Year     | Escapement <sup>a</sup> | Returns By Age Class |                     |                    |       |       | Total   |
|-------------------|-------------------------|----------------------|---------------------|--------------------|-------|-------|---------|
|                   |                         | 1.1                  | 2.1                 | 3.1                | 1.2   | 2.2   |         |
| 1980              | 95,411                  | 13,272               | 389,742             | 0                  | 1,465 | 2,621 | 407,100 |
| 1981              | 141,468                 | 12,734               | 81,249              | 503                | 1,751 | 503   | 96,740  |
| 1982              | 294,151                 | 28,830               | 117,625             | 1,695              | 0     | 0     | 148,150 |
| 1983              | 36,885                  | 9,192                | 30,480              | 9,479              | 0     | 0     | 49,151  |
| 1984              | 140,804                 | 10,160               | 150,147             | 4,743              | 0     | 0     | 165,050 |
| 1985              | 82,258                  | 30,656               | 148,867             | 8,679              | 0     | 71    | 188,273 |
| 1986              | 45,483                  | 15,092               | 137,380             | 0                  | 0     | 0     | 152,472 |
| 1987              | 21,268                  | 7,876                | 50,387              | 4,811 <sup>b</sup> |       | 0     | 63,074  |
| 1988              | 130,171                 | 7,067                | 78,406 <sup>b</sup> | 1,380              | 0     | 0     | 86,853  |
| 1989              | 81,107                  | 8,108 <sup>b</sup>   | 60,069              | 9,003              | 0     | 173   | 77,353  |
| 1990              | 140,500                 | 0                    | 79,123              | 2,699              | 0     | 0     | 81,822  |
| 1991              | 37,584                  | 3,636                | 49,317              | 5,071              | 0     | 0     | 58,024  |
| 1992 <sup>b</sup> |                         | 2,453                | 185,627             | 1,533              | 0     | 0     | 189,613 |
| 1993              | 42,161                  | 11,334               | 46,925              | 3,360              | 0     | 0     | 61,619  |
| 1994              | 80,470                  | 2,454                | 118,710             | 4,575              | 0     | 0     | 125,739 |
| 1995              | 45,137                  | 5,206                | 32,900              | 5,571              | 0     | 0     | 43,677  |
| 1996              | 182,460                 | 3,268                | 296,295             | 6,369              | 0     | 0     | 305,932 |
| 1997              | 55,882 <sup>c</sup>     | 27,826               | 71,930              | 2,137              | 0     | 0     | 101,893 |
| 1998              | 103,194                 | 5,731                | 51,284              |                    | 0     |       | 57,015  |
| 1999              | 33,991                  | 3,422                |                     |                    |       |       | 3,422   |
| 2000              | 200,938                 |                      |                     |                    |       |       | 0       |
| 2001              | 72,388                  |                      |                     |                    |       |       |         |
| 2002              | 48,054                  |                      |                     |                    |       |       |         |
| 2003              |                         |                      |                     |                    |       |       |         |
| 2004              | 152,613                 |                      |                     |                    |       |       |         |
| 2005              |                         |                      |                     |                    |       |       |         |

*Note:* Years with no data indicate years when no age composition data were collected.

<sup>a</sup> Sonar counts were expanded in years that the sonar was terminated early.

<sup>b</sup> Coho escapement was not counted in 1992. Runs of age-1.1 and age-3.1 coho for 1992 were estimated from relationship of spawners to returns and sibling to returns.

<sup>c</sup> Base on offshore test netting sonar estimates of coho passage significantly too low. Estimate of total coho escapement not available. Based on sonar counts, test net results, and observations escapement was greater than 50,000 coho salmon.

**Appendix A17.**—Togiak River data available for analysis of coho salmon escapement goal.

| <b>Year</b> | <b>Escapement<sup>a</sup></b> | <b>ln(Escapement)</b> | <b>Harvest<sup>b</sup></b> |
|-------------|-------------------------------|-----------------------|----------------------------|
| 1980        | 65,130                        | 11.08                 | 113,287                    |
| 1981        | 43,500                        | 10.68                 | 21,823                     |
| 1982        | 69,900                        | 11.15                 | 109,824                    |
| 1983        |                               |                       | 6,606                      |
| 1984        | 60,840                        | 11.02                 | 116,585                    |
| 1985        | 33,210                        | 10.41                 | 37,265                     |
| 1986        | 21,400                        | 9.97                  | 31,381                     |
| 1987        | 16,000                        | 9.68                  | 3,067                      |
| 1988        | 25,770                        | 10.16                 | 10,774                     |
| 1989        |                               |                       | 37,206                     |
| 1990        | 21,390                        | 9.97                  | 3,774                      |
| 1991        | 25,260                        | 10.14                 | 5,587                      |
| 1992        | 80,100                        | 11.29                 | 5,400                      |
| 1993        |                               |                       | 13,686                     |
| 1994        |                               |                       | 89,963                     |
| 1995        |                               |                       | 10,021                     |
| 1996        | 64,980                        | 11.08                 | 59,950                     |
| 1997        | 20,625                        | 9.93                  | 4,016                      |
| 1998        | 25,335                        | 10.14                 | 53,793                     |
| 1999        | 3,855                         | 8.26                  | 3,979                      |
| 2000        |                               |                       | 3,940                      |
| 2001        |                               |                       | 4,510                      |
| 2002        |                               |                       | 2,470                      |
| 2003        | 6,900                         | 8.84                  | 3,930                      |
| 2004        |                               |                       | 17,988                     |
| 2005        | 24,339                        | 10.10                 | 16,492                     |
| Mean        | 35,796                        | 10                    | 30,281                     |
| SD          | 23,553                        | 1                     | 37,244                     |
| Median      | 25,335                        | 10                    | 12,230                     |

*Note:* Years with no data indicate years when no escapement estimates were made.

<sup>a</sup> Expanded aerial survey counts.

<sup>b</sup> Includes commercial, sport, and subsistence harvests.

**Appendix A18.**–Kulukak River data available for analysis of coho salmon escapement goal.

| <b>Year</b> | <b>Escapement</b> | <b>ln(Escapement)</b> |
|-------------|-------------------|-----------------------|
| 1980        | 30,900            | 10.34                 |
| 1981        | 11,370            | 9.34                  |
| 1982        | 10,140            | 9.22                  |
| 1983        |                   |                       |
| 1984        | 32,250            | 10.38                 |
| 1985        | 23,370            | 10.06                 |
| 1986        |                   |                       |
| 1987        | 2,730             | 7.91                  |
| 1988        | 5,520             | 8.62                  |
| 1989        |                   |                       |
| 1990        | 15,585            | 9.65                  |
| 1991        | 12,600            | 9.44                  |
| 1992        | 37,920            | 10.54                 |
| 1993        |                   |                       |
| 1994        |                   |                       |
| 1995        | 3,555             | 8.18                  |
| 1996        | 30,870            | 10.34                 |
| 1997        | 5,025             | 8.52                  |
| 1998        | 10,950            | 9.30                  |
| 1999        | 1,500             | 7.31                  |
| 2000        |                   |                       |
| 2001        | 2,205             | 7.70                  |
| 2002        |                   |                       |
| 2003        | 4,830             | 8.48                  |
| 2004        |                   |                       |
| 2005        |                   |                       |
| Mean        | 14,195            | 9.14                  |
| SD          | 12,161            | 1.02                  |
| Median      | 10,950            | 9.30                  |

*Note:* Years with no data indicate years when no escapement estimates were made.

**Appendix A19.**–Nushagak River data available for analysis of pink salmon escapement goal.

| <b>Year</b> | <b>Escapement</b> | <b>ln(Escapement)</b> | <b>Commercial Harvest</b> |
|-------------|-------------------|-----------------------|---------------------------|
| 1958        | 4,000,000         | 15.20                 | 1,100,000                 |
| 1960        | 100,000           | 11.51                 | 300,000                   |
| 1962        | 500,014           | 13.12                 | 880,424                   |
| 1964        | 908,500           | 13.72                 | 1,497,817                 |
| 1966        | 1,442,424         | 14.18                 | 2,337,066                 |
| 1968        | 2,161,116         | 14.59                 | 1,705,150                 |
| 1970        | 152,580           | 11.94                 | 417,834                   |
| 1972        | 58,536            | 10.98                 | 67,953                    |
| 1974        | 532,316           | 13.18                 | 413,613                   |
| 1976        | 836,278           | 13.64                 | 739,590                   |
| 1978        | 9,161,784         | 16.03                 | 4,348,336                 |
| 1980        | 2,749,746         | 14.83                 | 2,202,545                 |
| 1982        | 1,611,226         | 14.29                 | 1,339,272                 |
| 1984        | 2,833,362         | 14.86                 | 3,127,153                 |
| 1986        | 72,189            | 11.19                 | 267,117                   |
| 1988        | 494,610           | 13.11                 | 243,890                   |
| 1990        | 801,430           | 13.59                 | 54,127                    |
| 1992        |                   |                       | 190,102                   |
| 1994        | 191,772           | 12.16                 | 7,337                     |
| 1996        | 821,312           | 13.62                 | 2,681                     |
| 1998        | 132,402           | 11.79                 | 6,808                     |
| 2000        | 135,285           | 11.82                 | 38,309                    |
| 2002        | 317,661           | 12.67                 | 234                       |
| 2004        | 556,066           | 13.23                 | 26,187                    |
| Mean        | 1,329,157         | 13.27                 | 888,064                   |
| SD          | 2,004,376         | 1.36                  | 1,145,153                 |
| Median      | 556,066           | 13.23                 | 356,807                   |

*Note:* Years with no data indicate years when no escapement estimates were made.

## **APPENDIX B.**

---

**Appendix B1.**—Escapement goal for Alagnak River sockeye salmon.

---

The following pages contain tables and figures formatted the same as the 2003 BOF report that analyzed other Bristol Bay sockeye salmon goals using the same methodology. The first item is a table summary of the Alagnak River sockeye salmon goal and the data used for its development. The second item is a table of the recently revised brood table (Clark 2005), which significantly differs from the 2003 data set. The final item is a figure showing the risk of an unwarranted concern and the estimated risk that a drop in various levels of mean escapement would not be detected.

System: Alagnak River

Species: sockeye salmon

Description of stock and escapement goals.

---

|                                |   |
|--------------------------------|---|
| Management division:           | Commercial Fisheries  |
| Previous escapement goal:      | 170,000–200,000   |
| Inriver goal:                  | None  |
| Optimal escapement goal:       | None  |
| Recommended escapement goal:   | 320,000 minimum   |
| Escapement goal type:          | SEG   |
| Escapement estimation:         | Tower counts from 1956–1976; expanded aerial survey counts from 1977–2001. Tower counts from 2001–2005.   |
| Summary:                       |   |
| Data quality:                  | Fair to Excellent.  |
| Data type:                     | Tower counts; aerial surveys; commercial harvest; age data  |
| Methodology:                   | Risk analysis   |
| Autocorrelation:               | None  |
| Years within recommended goal: | Not applicable  |
| Comments:                      | This stock had SEG quality data for many years, and is passively managed and coincidentally harvested. Therefore, a risk analysis approach was taken to alert managers to potential changes in productivity when the escapement estimate falls below the SEG threshold for 3 consecutive years. |

---

**Appendix B1.**–Page 2 of 2.

System: Alagnak River

Species: sockeye salmon

Data available for analysis of escapement goals (in thousands of fish).

| Brood<br>Year | Escapement | Return by Age Class |     |     |       |     |     |       |     |     |     |     |     |     |     | Total |       |
|---------------|------------|---------------------|-----|-----|-------|-----|-----|-------|-----|-----|-----|-----|-----|-----|-----|-------|-------|
|               |            | 0.2                 | 1.1 | 0.3 | 1.2   | 2.1 | 0.4 | 1.3   | 2.2 | 3.1 | 1.4 | 2.3 | 3.2 | 2.4 | 3.3 |       | 3.4   |
| 1956          | 784        | 5                   | 0   | 0   | 1,885 | 0   | 0   | 459   | 0   | 0   | 0   | 38  | 3   | 0   | 0   | 0     | 2,390 |
| 1957          | 127        | 0                   | 0   | 0   | 5     | 0   | 0   | 23    | 43  | 0   | 0   | 13  | 0   | 0   | 1   | 0     | 85    |
| 1958          | 95         | 0                   | 0   | 0   | 43    | 0   | 0   | 26    | 27  | 0   | 0   | 52  | 0   | 0   | 0   | 0     | 148   |
| 1959          | 825        | 0                   | 0   | 0   | 302   | 0   | 0   | 265   | 122 | 0   | 0   | 76  | 1   | 0   | 2   | 0     | 768   |
| 1960          | 1,241      | 0                   | 0   | 0   | 105   | 0   | 0   | 185   | 135 | 0   | 0   | 31  | 0   | 0   | 0   | 0     | 456   |
| 1961          | 90         | 0                   | 10  | 1   | 89    | 1   | 0   | 185   | 7   | 0   | 0   | 0   | 0   | 0   | 0   | 0     | 293   |
| 1962          | 91         | 0                   | 19  | 0   | 129   | 0   | 0   | 91    | 3   | 0   | 0   | 19  | 1   | 0   | 0   | 0     | 262   |
| 1963          | 203        | 0                   | 0   | 0   | 199   | 1   | 0   | 140   | 34  | 0   | 0   | 1   | 0   | 0   | 0   | 0     | 375   |
| 1964          | 249        | 0                   | 5   | 0   | 100   | 2   | 0   | 98    | 113 | 0   | 0   | 17  | 0   | 0   | 0   | 0     | 336   |
| 1965          | 175        | 0                   | 6   | 0   | 104   | 1   | 0   | 161   | 10  | 0   | 0   | 17  | 0   | 0   | 0   | 0     | 299   |
| 1966          | 174        | 0                   | 13  | 0   | 282   | 0   | 0   | 262   | 12  | 0   | 0   | 11  | 0   | 0   | 0   | 0     | 580   |
| 1967          | 203        | 0                   | 9   | 8   | 291   | 1   | 0   | 51    | 46  | 0   | 0   | 7   | 0   | 0   | 0   | 0     | 413   |
| 1968          | 194        | 3                   | 5   | 0   | 127   | 0   | 0   | 40    | 2   | 0   | 0   | 3   | 0   | 0   | 0   | 0     | 180   |
| 1969          | 182        | 0                   | 0   | 0   | 4     | 1   | 0   | 54    | 105 | 0   | 0   | 25  | 0   | 0   | 0   | 0     | 189   |
| 1970          | 177        | 0                   | 0   | 0   | 73    | 0   | 0   | 71    | 6   | 0   | 0   | 2   | 0   | 0   | 0   | 0     | 152   |
| 1971          | 187        | 0                   | 2   | 0   | 26    | 0   | 0   | 28    | 31  | 0   | 0   | 40  | 0   | 0   | 5   | 0     | 132   |
| 1972          | 151        | 0                   | 1   | 0   | 91    | 0   | 0   | 19    | 8   | 0   | 0   | 33  | 0   | 0   | 0   | 0     | 152   |
| 1973          | 35         | 0                   | 0   | 0   | 105   | 1   | 0   | 317   | 44  | 0   | 0   | 6   | 0   | 0   | 0   | 0     | 473   |
| 1974          | 215        | 0                   | 4   | 0   | 730   | 12  | 0   | 47    | 341 | 0   | 0   | 6   | 0   | 0   | 1   | 0     | 1,141 |
| 1975          | 100        | 0                   | 38  | 0   | 1,099 | 0   | 0   | 62    | 342 | 0   | 1   | 3   | 0   | 0   | 0   | 0     | 1,545 |
| 1976          | 82         | 0                   | 70  | 0   | 1,111 | 0   | 0   | 433   | 52  | 0   | 0   | 138 | 0   | 0   | 0   | 0     | 1,804 |
| 1977          | 109        | 0                   | 73  | 0   | 367   | 2   | 0   | 1,768 | 0   | 0   | 10  | 22  | 0   | 0   | 0   | 0     | 2,242 |
| 1978          | 584        | 0                   | 3   | 0   | 259   | 0   | 0   | 177   | 103 | 0   | 0   | 385 | 1   | 0   | 0   | 0     | 928   |
| 1979          | 794        | 0                   | 8   | 6   | 1,208 | 5   | 0   | 779   | 85  | 0   | 0   | 9   | 0   | 0   | 0   | 0     | 2,101 |
| 1980          | 804        | 0                   | 0   | 0   | 272   | 0   | 0   | 545   | 33  | 0   | 5   | 24  | 0   | 2   | 0   | 0     | 881   |
| 1981          | 222        | 0                   | 1   | 0   | 145   | 0   | 0   | 452   | 140 | 0   | 4   | 28  | 0   | 0   | 0   | 0     | 770   |
| 1982          | 646        | 0                   | 1   | 1   | 463   | 0   | 0   | 370   | 12  | 0   | 0   | 8   | 0   | 0   | 0   | 0     | 855   |
| 1983          | 260        | 0                   | 1   | 0   | 393   | 0   | 0   | 349   | 86  | 0   | 0   | 9   | 0   | 0   | 0   | 0     | 838   |
| 1984          | 581        | 0                   | 2   | 0   | 420   | 1   | 0   | 385   | 111 | 0   | 0   | 61  | 1   | 0   | 1   | 0     | 982   |
| 1985          | 319        | 0                   | 9   | 0   | 947   | 1   | 0   | 300   | 245 | 0   | 0   | 22  | 0   | 0   | 0   | 0     | 1,524 |
| 1986          | 621        | 0                   | 4   | 0   | 910   | 0   | 0   | 704   | 509 | 0   | 0   | 20  | 0   | 0   | 1   | 0     | 2,148 |
| 1987          | 416        | 0                   | 0   | 0   | 415   | 0   | 0   | 449   | 454 | 0   | 7   | 210 | 1   | 0   | 0   | 0     | 1,536 |
| 1988          | 525        | 0                   | 2   | 0   | 413   | 0   | 0   | 388   | 719 | 0   | 0   | 113 | 1   | 0   | 0   | 0     | 1,636 |
| 1989          | 531        | 0                   | 13  | 0   | 919   | 6   | 0   | 445   | 477 | 0   | 0   | 43  | 0   | 0   | 0   | 0     | 1,903 |
| 1990          | 456        | 0                   | 7   | 0   | 697   | 0   | 0   | 324   | 873 | 0   | 0   | 628 | 0   | 0   | 0   | 0     | 2,529 |
| 1991          | 749        | 0                   | 1   | 0   | 526   | 10  | 0   | 586   | 432 | 0   | 0   | 0   | 0   | 0   | 0   | 0     | 1,554 |
| 1992          | 612        | 0                   | 5   | 0   | 259   | 0   | 0   | 187   | 165 | 0   | 0   | 22  | 0   | 1   | 0   | 0     | 639   |
| 1993          | 940        | 0                   | 12  | 0   | 326   | 0   | 0   | 404   | 212 | 0   | 4   | 130 | 0   | 0   | 0   | 0     | 1,088 |
| 1994          | 655        | 0                   | 2   | 0   | 419   | 6   | 0   | 717   | 106 | 0   | 1   | 108 | 1   | 0   | 0   | 0     | 1,360 |
| 1995          | 582        | 0                   | 10  | 0   | 1,875 | 0   | 0   | 516   | 324 | 0   | 15  | 69  | 0   | 0   | 0   | 0     | 2,809 |
| 1996          | 828        | 1                   | 8   | 0   | 1,057 | 1   | 0   | 815   | 28  | 0   | 4   | 20  | 0   | 0   | 0   | 0     | 1,934 |
| 1997          | 589        | 0                   | 7   | 0   | 174   | 0   | 0   | 273   | 117 | 0   | 23  | 486 | 0   | 2   | 0   | 0     | 1,082 |
| 1998          | 681        | 0                   | 6   | 0   | 369   | 1   | 0   | 1,704 | 467 | 0   | 5   | 197 | 0   | 0   | 0   | 0     | 2,749 |
| 1999          | 1,251      | 0                   | 9   | 0   | 991   | 72  | 0   | 1,316 | 895 | 0   | 4   | 372 | 0   |     |     |       | 3,659 |
| 2000          | 1,218      | 0                   | 48  | 0   | 4,234 | 0   | 0   | 4,078 | 241 | 0   |     |     |     |     |     |       | 8,601 |
| 2001          | 721        | 0                   | 18  | 0   | 731   | 0   |     |       |     |     |     |     |     |     |     |       |       |
| 2002          | 767        | 0                   | 11  |     |       |     |     |       |     |     |     |     |     |     |     |       |       |
| 2003          | 3,676      |                     |     |     |       |     |     |       |     |     |     |     |     |     |     |       |       |
| 2004          | 5,397      |                     |     |     |       |     |     |       |     |     |     |     |     |     |     |       |       |
| 2005          | 4,219      |                     |     |     |       |     |     |       |     |     |     |     |     |     |     |       |       |

Note: the 1956–1976 escapements are based on Alagnak tower counts and the 1977–2001 escapements are based on aerial surveys. Aerial surveys expanded by 2.7 and catch added to Alagnak based on original allocation proportion between Kvichak, Naknek, and Alagnak (Clark 2005).

System: Alagnak River

Species: sockeye salmon

Risk analysis summary showing the risk of an unwarranted concern and the estimated risk that a drop in various levels of mean escapement would not be detected.

