

**Salmon Spawning Ground Surveys in the Bristol Bay  
Area, Alaska, 2008**

by

**Paul Salomone**

**Slim Morstad,**

**Tim Sands,**

**and**

**Matt Jones**

October 2009

---

---

Alaska Department of Fish and Game

Divisions of Sport Fish and Commercial Fisheries





***FISHERY MANAGEMENT REPORT NO. 09-42***

**SALMON SPAWNING GROUND SURVEYS IN THE  
BRISTOL BAY AREA, ALASKA, 2008**

by

Paul Salomone

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

Slim Morstad,

Alaska Department of Fish and Game, Division of Commercial Fisheries, King Salmon

and

Tim Sands and Matt Jones,

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

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

October 2009

The Fishery Management Reports series was established in 1989 by the Division of Sport Fish for the publication of an overview of management activities and goals in a specific geographic area, and became a joint divisional series in 2004 with the Division of Commercial Fisheries. Fishery Management Reports are intended for fishery and other technical professionals, as well as lay persons. Fishery Management Reports 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 regional peer review.

*Paul Salomone*

*Alaska Department of Fish and Game, Division of Commercial Fisheries,  
333 Raspberry Road, Anchorage, AK, 99518 USA*

*Slim Morstad,*

*Alaska Department of Fish and Game, Division of Commercial Fisheries,  
Main Street, P.O. Box 37, King Salmon, AK 99613-0037*

*and*

*Tim Sands and Matt Jones,*

*Alaska Department of Fish and Game, Division of Commercial Fisheries,  
546 Kenny Wren Road, P.O. Box 230, Dillingham, AK 99576-0230*

*This document should be cited as:*

*Salomone, P., S. Morstad, T. Sands, and M. Jones. 2009. Salmon spawning ground surveys in the Bristol Bay Area, Alaska, 2008. Alaska Department of Fish and Game, Fishery Management Report No. 09-42, 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, 4401 N. Fairfax Drive, MS 2042, Arlington, VA 22203

Office of Equal Opportunity, U.S. Department of the Interior, 1849 C Street NW MS 5230, 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 Division of Sport Fish, 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.....	iii
ABSTRACT.....	1
INTRODUCTION.....	1
Background Information by District.....	1
Naknek/Kvichak District.....	1
Egegik District.....	2
Ugashik District.....	2
Nushagak District.....	2
Togiak District.....	3
Methods.....	4
Naknek/Kvichak District.....	4
Egegik District.....	4
Ugashik District.....	5
Nushagak District.....	5
Togiak District.....	5
Results and Discussion.....	5
Naknek/Kvichak District.....	5
Egegik District.....	5
Ugashik District.....	6
Environmental Conditions.....	7
Nushagak District.....	7
Togiak District.....	7
ACKNOWLEDGEMENTS.....	8
REFERENCES CITED.....	9
TABLES AND FIGURES.....	11
APPENDIX A.....	33

## LIST OF TABLES

<b>Table</b>	<b>Page</b>
1. Aerial counts of live sockeye salmon and total escapement estimates, Wood River system, 2008. ....	12
2. Aerial counts of live sockeye salmon and total escapement estimates, Togiak District, 2008. ....	14
3. Aerial counts of live Chinook salmon and total escapement estimates, Togiak District, 2008. ....	15
4. Aerial counts of live chum salmon and total escapement estimates, Togiak District, 2008. ....	16
5. Peak aerial counts of live coho salmon and total escapement estimates, Togiak District, 2008. ....	17
6. Peak aerial survey counts of sockeye salmon, Alagnak River system 2008. ....	18
7. Aerial survey counts of Chinook, chum, pink, and coho salmon; Naknek-Kvichak District, 2008. ....	18
8. Aerial survey counts for Chinook salmon escapement, Egegik District 2008. ....	19
9. Aerial survey counts for chum salmon escapement, Egegik District 2008. ....	19
10. Aerial survey counts of coho salmon escapement, Egegik District 2008. ....	20
11. Aerial survey counts of sockeye salmon escapement, King Salmon and Dog Salmon River, Ugashik District, 2008. ....	20
12. Aerial survey counts of Chinook salmon, Ugashik District 2008. ....	21
13. Aerial survey counts of chum salmon escapement, Ugashik District 2008. ....	21
14. Aerial survey counts of coho salmon escapement, Ugashik District 2008. ....	22

## LIST OF FIGURES

<b>Figure</b>	<b>Page</b>
1. Bristol Bay management area, Alaska. ....	23
2. Naknek-Kvichak District drainages, Bristol Bay, Alaska. ....	24
3. Egegik District drainages, Bristol Bay, Alaska. ....	25
4. Ugashik District drainages, Bristol Bay, Alaska. ....	26
5. Wood River watershed, Bristol Bay, Alaska. ....	27
6. Snake River watershed, Bristol Bay, Alaska. ....	28
7. Nushagak River watershed, Bristol Bay, Alaska. ....	29
8. Tikchik Lakes system, Bristol Bay, Alaska. ....	30
9. Togiak River watershed, Bristol Bay, Alaska. ....	31
10. Kulukak River watershed, Bristol Bay, Alaska. ....	32

## LIST OF APPENDICES

<b>Appendix</b>	<b>Page</b>
A1. Sockeye salmon total escapement estimates, Naknek-Kvichak District, 1988–2008.....	34
A2. Aerial survey counts of Chinook salmon escapements, Naknek River drainage, 1988–2008.....	35
A3. Chinook salmon escapement data, Naknek-Kvichak District, 1988–2008.....	36
A4. Chum salmon escapement survey history, Alagnak River, 1990–2008. ....	37
A5. Pink salmon escapement survey history, Naknek/Kvichak District 1988–2008. ....	37
A6. Aerial survey counts of Chinook salmon escapement, Egegik District, 1988–2008.....	38
A7. Aerial survey counts of chum salmon escapement, Egegik District, 1988–2008.....	39
A8. Aerial survey counts of pink salmon escapement, Egegik District, 1988–2008.....	40
A9. Aerial survey counts of coho salmon escapement, Egegik District, 1988–2008.....	41
A10. Aerial survey counts of Chinook salmon escapement, Ugashik District, 1988–2008.....	42
A11. Aerial survey counts of chum salmon escapement, Ugashik District, 1988–2008.....	43
A12. Aerial survey counts of pink salmon escapement, Ugashik District, 1988–2008.....	44
A13. Aerial survey counts of coho salmon escapement, Ugashik District, 1988–2008.....	45
A14. Spawner distribution and total escapement estimates of sockeye salmon, Wood River system, 1988– 2008.....	46
A15. Aerial estimates of sockeye salmon escapements, Togiak District, 1988–2008. ....	47
A16. Aerial counts of live sockeye salmon, Togiak River drainage, 1988–2008. ....	48
A17. Aerial counts of live sockeye salmon, Togiak District, 1988–2008.....	49
A18. Aerial counts of live Chinook salmon, Togiak River drainage, 1988–2008.....	50
A19. Aerial counts of live Chinook salmon, Togiak District, 1988–2008.....	51
A20. Aerial counts of live chum salmon, Togiak River drainage, 1988–2008. ....	52
A21. Aerial counts of live chum salmon, Togiak District, 1988–2008.....	53
A22. Aerial counts of live coho salmon, Togiak River drainage, 1988–2008. ....	54
A23. Aerial counts of live coho salmon, Togiak District, 1988–2008.....	55



## ABSTRACT

The salmon spawning ground report is compiled annually to document the results of spawning ground surveys conducted by the Division of Commercial Fisheries staff in Bristol Bay. The report describes the conditions under which salmon were observed and other factors affecting escapement data. Although data have been collected for more than 20 years in most areas, appendices contain only information from the last 20 years to give the data current context.

**Key Words:** Bristol Bay Management, commercial fisheries, aerial surveys, escapement, spawning, sockeye salmon *Oncorhynchus nerka*, Chinook salmon *O. tshawytscha*, chum salmon *O. keta*, coho salmon *O. kisutch*, pink salmon *O. gorbuscha*, Naknek, Kvichak, Egegik, Ugashik, Wood, Nushagak, Igushik, Togiak.

## INTRODUCTION

Aerial surveys of salmon spawning streams have been conducted in the Bristol Bay area of Alaska (Figure 1) for many years. Since 1960, Alaska Department of Fish and Game (ADF&G) personnel have been the primary agency, but various other entities such as U.S. Fish and Wildlife Service (USFWS), National Park Service (NPS) and University of Washington Fisheries Research Institute (FRI) have also contributed time and/or funding. Surveys provide biologists with subjective information regarding the relative abundance and distribution of sockeye salmon *Oncorhynchus nerka*, Chinook salmon *O. tshawytscha*, chum salmon *O. keta*, pink salmon *O. gorbuscha*, and coho salmon *O. kisutch* escapements. This information is useful to fishery managers for several reasons: it supplements data gathered at counting towers on the mainstem rivers; provides data from rivers where counting towers are not utilized, and provides data for time periods and species not covered by counting tower operations. Collected information can contribute to the: (1) evaluation of escapement goals and of escapement/return relationships, (2) forecast of future returns, (3) identification of possible management problems relating to escapements (e.g. changes in distribution of spawners), (4) development of strategies designed to alleviate escapement shortfalls (such as mesh size reduction to conserve Chinook salmon). It should be noted that through time, available funding has influenced the number and coverage of aerial survey flights within Bristol Bay drainages. Readers must use caution when interpreting these data. Aerial surveys can be good indicators of general trends in fish distribution and abundance but should not be used as estimates of absolute abundance. Generally, aerial survey information is used to supplement more concrete data for developing finite estimates. In this report, we summarize 2008 salmon spawning ground surveys conducted in the Bristol Bay area.

## BACKGROUND INFORMATION BY DISTRICT

### Naknek/Kvichak District

The Naknek-Kvichak District is comprised of 3 major watersheds: (1) the Kvichak River; sourced from Iliamna Lake and its tributaries, (2) the Alagnak or Branch River; sourced from Kukaklek and Nonvianuk Lakes, and (3) the Naknek River; sourced from Naknek Lake and its tributaries (Figure 2). The marine terminus of these systems is Kvichak Bay.

Since 1955, Kvichak River sockeye salmon annual escapement has been estimated using counting towers located on the Kvichak's mainstem, approximately one-quarter mile downstream of the outlet of Lake Iliamna (West and Fair 2006). The historical perspective of Kvichak River spawning ground survey information is provided in Morstad (2002).

From 1957 to 1976, Alagnak River sockeye salmon annual escapement was estimated using a counting tower located near the upper extent of tidal influence. From 1977 to 2001, Alagnak sockeye salmon annual escapement was estimated using aerial surveys and beginning in 2002 a counting tower was established upriver from the original site. Aerial surveys and the counting tower project have been employed annually since that time. The 2007 run included the end of the first full cycle of fish to return to the river since the tower was reinstalled.

From 1950 to 1957, annual sockeye salmon escapement to the Naknek River system was counted using a weir on the mainstem of the river upstream of the area under tidal influence. From 1958 to present, escapement has been estimated using counting towers located near the Naknek River 'Rapids' downstream of the outlet of Naknek Lake (West and Fair 2006).

### **Egegik District**

The Egegik District contains 2 major watersheds: (1) the Egegik River; sourced from Becharof Lake and nearby coastal lowlands, and (2) the King Salmon River; sourced from runoff originating in the Kejulik Mountains and southern portions of Katmai National Park (Figure 3). Both rivers terminate in Egegik Bay near the village of Egegik.

From 1952 through 1956, a weir near the lower end of the Egegik River rapids was used to count sockeye salmon escapement. From 1957 to the present, counting towers situated between the outlet of Becharof Lake and Egegik Lagoon, replaced the weir project. Aerial surveys are used to estimate salmon escapements in the King Salmon River and for Egegik River coho salmon that migrate when the counting towers are not operational (West and Fair 2006).

### **Ugashik District**

The Ugashik District is made up of 4 major watersheds: (1) the Ugashik River; sourced from Lower Ugashik Lake and nearby coastal lowlands, (2) the Dog Salmon River; sourced from glacial melt and runoff from peaks in the Aleutian Range, (3) the King Salmon River; sourced from Mother Goose Lake and 3 major runoff tributaries from the Aleutian Range, and (4) Dago Creek; sourced from a large lowland coastal area (Figure 4). These systems terminate in the intertidal area of the Ugashik River, or in the case of Dago Creek, directly into Ugashik Bay.

From 1949 to 1956, a weir located downstream from the outlet of Lower Ugashik Lake was used to count sockeye salmon escapement. From 1957 to the present, sockeye salmon escapement has been estimated using counting towers located between the outlet of Lower Ugashik Lake and Ugashik Lagoon (West and Fair 2006). Sockeye salmon escapements in the King Salmon and Dog Salmon rivers are estimated using aerial surveys. Aerial surveys have also been used to document escapement trends for other species within the drainage.

### **Nushagak District**

The Nushagak District contains 4 major watersheds: (1) the Nushagak River; sourced from Tikchik Lakes and the Nuyakuk, upper Nushagak, and Mulchatna rivers (2) the Wood River; which is a tributary joining the Nushagak shortly before it terminates in Nushagak Bay and is sourced from Grant, Kulik, Beverley, Nerka, and Aleknagik lakes, (3) the Igushik River; sourced from Ualik and Amanka lakes, and (4) the Snake River, sourced from Lake Nunavaugaluk (Figures 5–8). The marine terminus for these systems is Nushagak Bay.

Since 1953, abundance and age composition of annual sockeye salmon escapement into the Wood River Lake system has been estimated using counting towers at the outlet of Lake

Aleknagik (West and Fair 2006). Periodically, ADF&G personnel conduct aerial surveys to assess sockeye salmon spawning distribution within the Wood River Lake system. In addition, personnel from FRI also conduct annual foot surveys on major creeks and some rivers of the system to better understand spawning distribution within those drainages. FRI results are documented in this report series (Table 1).

Since 1980, salmon escapement in the mainstem Nushagak River is estimated by a sonar project (Brazil 2007), located on the mainstem below the village of Portage Creek, approximately 32 km (20 miles) upstream from the river mouth. In 2006, the operating season was shortened by a month eliminating the enumeration of coho and pink salmon.

From 1959 to 1980 a counting tower project located on the Nuyakuk River was used to estimate salmon escapement in the Nushagak system. From 1980 to 1988 the project was operated concurrently with a sonar project in the mainstem of the Nushagak River. The counting tower project was discontinued in 1988, reinstated from 1995 to 2006, and then discontinued.

Aerial surveys continued in the upper Nushagak and Mulchatna areas after the development of the sonar project to provide a comparison with sonar estimates and document spawner distribution for all species except coho salmon. Chum salmon surveys were discontinued in the Nushagak District in 1980, and annual surveys of the Nushagak-Mulchatna Rivers for all other species were discontinued in 1991, but have occurred sporadically to the present.

Sporadic aerial surveys occurred in the Nuyakuk-Tikchik Lakes system from 1954 to present to assess spawning distribution of sockeye salmon. In 1990 a change in sockeye distribution was suspected based on observed changes in age composition of sockeye sampled at the Nushagak River sonar project and an aerial survey that showed distributions inconsistent with historical patterns (Russell et al. 1991). Average Nuyakuk River escapement during the 1969 to 1988 operating period for the counting tower was about 370,000 sockeye salmon (excluding 1980, when the commercial fleet was on strike). When tower counts resumed in 1995, escapement was lower and remained at an average of around 150,000 sockeye salmon per year until tower operations were terminated again in 2006, despite overall strong escapements in the Nushagak River. Unfortunately, since 1991, funds have not been available to support systemic surveys of the Nushagak-Mulchatna drainages to fully assess potential changes in spawning distribution.

Sockeye escapement is measured in the Igushik Lakes system at a counting tower located at the outlet of Amanka Lake (West and Fair 2006). Spawner distribution surveys have not been conducted on the Igushik system for sockeye salmon and other species since 1991 (Russell et al. 1992). Spawning escapement and distribution of sockeye salmon in the Snake Lake system was estimated annually prior to 1998 by aerial surveys, but surveys were discontinued with the closure of the Snake River section to commercial fishing.

### **Togiak District**

The Togiak District contains 2 major watersheds: (1) the Togiak River; sourced from Togiak, Gechiak, Pungokebuk, and Ongivivuk lakes and Nayorurun and Kemuk rivers (Figure 9), and (2) the Kulukak River; sourced from Kulukak Lake (Figure 10). Various smaller systems within the district include the Kanik River draining Tithe Creek Ponds and the Quigmy, Matogak, Osviak, Slug, Negukthlik, and Ungalikthluk rivers. Kulukak River and the Kanik River flow into Kulukak Bay, located in the eastern portion of the district. The Togiak and Quigmy rivers flow

into Togiak Bay, located in the middle of the district, and the Matogak, Osviak, and Slug rivers flow into Hagemeister Straits and coastal waters in the western portion of the district (Figure 1).

Sockeye salmon escapement is estimated for the Togiak Lake system from counting towers operated at the outlet of Togiak Lake. Abundance and distribution of spawning populations of all salmon species in the Togiak River and tributaries below the counting towers, as well as other systems within the Togiak District (i.e. Kulukak River), are estimated by aerial surveys.

Since 1991, U.S. Fish and Wildlife Service Togiak National Wildlife Refuge (USFWS/TNWR) has provided funding for aircraft charters for aerial surveys, and has assisted with aerial surveys in the Togiak District to monitor salmon populations within drainages on the refuge.

## **METHODS**

Survey flights are conducted from small fixed-high-wing, aircraft (Super Cub, Cessna 180, Cessna 185, or Cessna 206) or by helicopter (Robinson R-22) operated by local air charter companies and flown by experienced survey pilots. ADF&G or USFWS biologists familiar with the streams and target species are responsible for developing estimates. USFWS pilots typically fly several of the surveys in the Togiak National Wildlife Refuge.

Counts are made from low altitudes (200 to 400 feet) at air speeds of 50 to 90 mph. Polarized sunglasses are used to minimize surface glare off the water. Surveys are scheduled near the historical peak of spawning for the target species, but schedules are subject to weather, water conditions, run timing, and aircraft availability. Peak of spawning is defined as the date when the greatest numbers of salmon are occupying redds. Surveys are characterized as pre peak, peak or post peak based on subjective estimation of factors such as location of fish in the drainage (schooling at the mouth versus spread out and actively spawning), the ratio of live fish to carcasses and the number of fish active on redds versus unoccupied redds. During the survey, counts are registered on a hand tally counter or recorded on audio cassette for later transfer to data forms.

Aerial surveys account for only a portion of the known spawning populations (Evzerof 1975; Nielson and Green 1981; Rogers 1984; ADF&G 2005). At the time of each survey, some of the salmon have not reached the spawning grounds, some have already spawned and died, some are still in large schools, and some are either misidentified or not seen. **For all districts except Togiak, aerial salmon counts are indices of the total number of each species present in the spawning area at the time of the survey. The aerial survey estimates are actual numbers of salmon observed and should be considered a minimum count. In the Togiak District raw counts are multiplied by an expansion factor to derive a final estimate.**

### **Naknek/Kvichak District**

Aerial surveys were flown during late summer and fall to assess escapements of sockeye and Chinook salmon in portions of the Naknek/Kvichak District. In the Alagnak drainage, 3 surveys were flown over the course of the season. On August 1, the lower Alagnak River was flown to estimate Chinook and chum salmon escapements. On August 8 and September 2, flights were conducted to estimate sockeye salmon in the upper drainages. For the Naknek drainage, all major Chinook spawning areas were surveyed under good conditions. Similar to previous years, counting towers were used to estimate total sockeye escapement to the Kvichak, Alagnak, and Naknek rivers. ADF&G Division of Commercial Fisheries staff made all aerial survey counts in the district.

## **Egegik District**

No systemwide aerial surveys were flown for sockeye salmon in 2008. An aerial survey of known Chinook and chum salmon spawning areas in both the Egegik and King Salmon rivers was flown on August 8. An aerial survey was flown on selected index streams within the Egegik system on September 24 to estimate coho salmon escapement. As in previous years, a counting tower was used to estimate total sockeye escapement to the Egegik River. ADF&G Division of Commercial Fisheries staff made all aerial survey counts in the district.

## **Ugashik District**

Aerial surveys of known Chinook and chum salmon spawning areas in the Ugashik drainage were flown on August 10. With funding provided by the USFWS, Becharof National Wildlife Refuge, an aerial survey was flown on September 24 to estimate coho salmon escapement. As in previous years, a counting tower was used to estimate total sockeye escapement to the Ugashik River. ADF&G, Division of Commercial Fisheries staff made all aerial survey counts in the district.

## **Nushagak District**

University of Washington FRI staff conducted aerial surveys of the Wood River system in 2008 on September 3. Surveys were flown in a fixed wing aircraft with one observer. The observer recorded individual estimates of sockeye salmon in creeks, rivers, and beaches of the Wood River system. In addition, FRI obtained estimates for most of the small streams in the Wood River lake system by conducting foot surveys (Table 1).

## **Togiak District**

Survey and data analysis methods used in the Togiak District were similar to those described by Nelson (1979), Bucher (1981), and Russell et al. (1990). This year, a single survey occurred on August 21 (Tables 2–5). Poor weather and pilot availability prevented additional surveys.

Total escapement was estimated for sockeye salmon in systems without counting towers (i.e. Kulukak River, mainstem and tributaries of the Togiak River below the towers) by multiplying raw aerial counts by an expansion factor between 1.5 and 3.0 depending on survey and water conditions (Table 2 lists expansion factors by stream). Since 1980, total escapement for Chinook salmon in the Togiak District has been calculated by aerial counts using a multiplier of 2.5 if the survey was timed properly relative to the spawning peak and visibility conditions were average (Table 3). The same expansion factors were used in the same systems for chum salmon (Table 4). An expansion factor of 3.0 has been used for coho salmon in all areas of the Togiak District since the initiation of coho surveys in 1980. Expansion factors have been subjectively set based on weather conditions, visibility, and survey timing with respect to the peak spawning activity.

## **RESULTS AND DISCUSSION**

### **Naknek/Kvichak District**

Aerial surveys of sockeye salmon escapement into the Alagnak River and its tributaries were flown on 2 occasions. The peak count for each of the systems is represented in Table 6 and the total aerial survey count was slightly more than 1,500,000 (Table 6). The tower on the lower Alagnak operated from June 22 until July 22 and estimated 2,180,502 sockeye salmon. The Naknek River tower was in operation from June 20 until July 18 counting 2,416,782 sockeye

salmon. The Kvichak River tower near Igiugig village began counting on June 20 and ceased July 22 counting 2,757,912 sockeye. There were no aerial surveys for sockeye salmon flown on either the Naknek or Kvichak rivers in 2008.

Aerial surveys of Chinook salmon escapements into the Naknek and Alagnak River drainages were flown in 2008 (Table 7, Appendix A2). For the Naknek River drainage, Chinook salmon escapement surveys were conducted over the course of 3 different days between August 1 and September 2. Each index tributary was flown on one occasion. The observed total was approximately 5,330 (Table 7). Escapement surveys for Chinook, chum, and pink salmon were conducted on August 1 in the Alagnak River drainage. Chinook escapement was estimated at 1,825 chum escapement at 80,000 and pink escapement at 180,000 fish (Table 7).

### **Egegik District**

The 2008 Egegik River sockeye escapement past the counting towers totaled 1,259,568 fish. Aerial surveys are unnecessary in the Egegik River for sockeye salmon since the tower estimates account for all spawning fish. In 2008 aerial surveys in the Egegik District to assess escapement of Chinook and chum salmon were flown on August 8 while flights to assess coho escapement occurred on September 24.

The single aerial survey of known Chinook salmon spawning areas in the Egegik drainage (primarily the King Salmon River) resulted in an estimate of 227 (Table 8). No additional Chinook salmon were counted at the Egegik River counting towers. This total was 77% below the average count of 1,002 (Appendix A6). The commercial Chinook harvest in the Egegik District totaled 390 fish, 64% below the 1988 to 2007 average harvest of 1,092. Since 1998, the department has reduced commercial fishing time to 3 days per week between June 1 and June 16. In 2008, because of a large preseason sockeye forecast, a more liberal 4 day per week schedule was in effect until July 13, which allowed a total of 2 extra days fishing time during this period. Using gillnets larger than 5.5-inch mesh in the commercial fishery from June 1 to July 1 has also been prohibited.

The chum salmon escapement aerial survey index developed during the August 8 survey was 1,365 fish (Table 9), 61% below the 20 year average of 3,466 (Appendix A7). The 2008 commercial chum harvest from the Egegik District totaled approximately 65,000 fish, 25% less than the 1988 to 2007 average catch of 87,000. Escapement indices less of than 2,000 chum salmon have been recorded in 7 of the last 10 years, but aerial surveys for chum salmon are unreliable. We believe that chum escapement indices developed by aerial surveys greatly underestimate chum salmon escapements. In a 1999 comparison study at Gertrude Creek, the aerial count was roughly 2% of the weir count.

In 2008, the coho salmon escapement was estimated with a September 24 aerial survey (Table 10 and Appendix A8) which resulted in an estimated coho escapement of 6,100. The commercial harvest of coho salmon was about 29,700 fish, 2% below the 20 year (1988–2007) average of 30,200.

### **Ugashik District**

The 2008 Ugashik River sockeye salmon escapement past the tower was 568,584 fish. In 2008 aerial surveys in the Ugashik District to assess escapement Chinook and chum salmon escapement were flown on August 12, while flights to assess coho escapement occurred on

September 24. Estimates of sockeye escapement are from tributaries that are not covered by the counting tower project.

The systemwide aerial surveys estimated approximately 8,000 sockeye salmon additional to tower counts were observed in the Dog Salmon River (Table 11).

Chinook salmon escapement surveys of Dog Salmon, King Salmon, and Ugashik rivers were flown on August 10 and approximately 2,000 Chinook were observed (Table 12). The 20 year average is approximately 4,000 Chinook salmon (Appendix A10). The Ugashik District's commercial catch of approximately 1,172 Chinook salmon was 25% below the 20 year average harvest of 1,574.

Aerial surveys of Dog Salmon, King Salmon, and Ugashik rivers to assess chum salmon escapement were also flown on August 12 and approximately 26,000 fish were observed (Table 13; Appendix A10). The District's commercial chum salmon harvest of approximately 137,000 fish was almost twice as high as the 20 year average of 70,000.

Aerial surveys for coho salmon in the Ugashik drainage in 2008 were made possible thanks to funding provided by US Fish and Wildlife Service, Becherof National Wildlife Refuge. A total of 6,240 coho salmon were observed on the September 24 flight (Table 14), 26% below the 20 year average of 8,473. Historical coho salmon escapement data are recorded in Appendix A11.

### **Environmental Conditions**

An unusual event occurred in the Mother Goose Lake drainage during the spring or early summer of 2005 which introduced acidic water into the drainage that lowered the pH enough to impact the ability of the system to support aquatic life. Salmon response to the event has been chronicled via aerial surveys in successive years (Westing et al. 2006; Salomone et al 2007; Sands et al. 2008) with impacts continuing into 2008.

Aerial surveys conducted in early August and again in late September, 2008 revealed that no salmon had migrated to the upper reaches of the Mother Goose drainage. Mother Goose Lake was an unusual color green, similar to that of a popular sports drink. Whether the coloration was due to algal growth or mineral content is not certain, but plant growth was present in the outlet of Mother Goose Lake.

No salmon were observed in Painter Creek which formerly hosted a significant portion of the spawning Chinook salmon in the drainage. The mainstem of the King Salmon River between the confluences of Painter Creek and Old Creek with the King Salmon River had no live fish, but a few carcasses were observed. The lowest 2 tributaries of the King Salmon River, Old and Pumice Creeks, were again well populated with Chinook, chum and some sockeye salmon. Coho salmon observed were located primarily in Pumice Creek.

### **Nushagak District**

The survey results for the Wood River system are summarized in Table 1. No other areas in the Nushagak District were surveyed in 2008.

### **Togiak District**

This year's survey season was characterized by fair to poor weather conditions throughout the season. A single survey of the Togiak River occurred for chum and Chinook salmon, but coverage and assessment was incomplete.

The counting tower escapement project located, just below Togiak Lake, estimated a total of 205,680 sockeye salmon moved into Togiak Lake (Table 2). The spawning escapement of sockeye salmon in the Kulukak Section, including the Kulukak River, Kulukak Lake, and Tithe Creek Ponds, was not assessed this year (Appendix A12, A13, and A14).

A survey of the Togiak River on August 21 resulted in an estimate of 1,860 Chinook salmon (Table 3). Lacking complete information on escapement, it is not possible to evaluate if the escapement goal was reached but based on weak commercial catch rates and low effort, it is likely that escapement in the Togiak District was average to below average. Aerial counts for Chinook salmon and historical counts are available in Appendix A19 and A20.

Chum salmon counts are conducted coincidentally with the Chinook salmon surveys. As mentioned above, only one survey was performed this year. This survey was delayed due to weather and pilot availability (Table 4, Appendix A21 and A22).

No aerial surveys were performed for coho salmon in 2008, and therefore we could not estimate coho escapement for Togiak River or its tributaries (Table 14; Appendix A23 and A24). Similar to other years, weak market demand for coho salmon resulted in low harvest.

## **ACKNOWLEDGEMENTS**

We would like to thank the U.S. Fish and Wildlife Service, National Park Service, and the University of Washington, Fisheries Research Institute, for equipment, personnel and funding they provided to help gather escapement data in 2008.

## REFERENCES CITED

- ADF&G (Alaska Department of Fish and Game). 2005. An atlas to the catalog of waters important for spawning, rearing or migration of anadromous fishes. State of Alaska, ADF&G Habitat Division.
- Bucher, W. A. 1981. Spawning ground surveys in the Nushagak and Togiak Districts of Bristol Bay, 1980. Alaska Department of Fish and Game, Division of Commercial Fisheries, Bristol Bay Data Report 81, Anchorage.
- Brazil, C. E. 2007. Sonar enumeration of Pacific salmon escapement into the Nushagak River, 2003. Alaska Department of Fish and Game, Fishery Data Series No. 07-37.  
<http://www.sf.adfg.state.ak.us/FedAidPDFs/fds07-37.pdf>
- Evzerov, A. V. 1975. An evaluation of the errors occurring in salmon census by aerial survey. In Canadian Translation Fisheries and Aquatic Sciences. No. 4714, 1981. [Transl. from Russian] (Otsenka pogreshnogie aerovizual' nogo metoda ucheta Lososei), p. 82-84. From Lososevye Dal' Nego Vostoka (CVI:1975).
- Morstad, S. 2002. Kvichak River sockeye salmon spawning ground surveys, 1955-2002. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 2A02-32, Anchorage.
- Nelson, M. L. 1979. Spawning ground surveys in the Nushagak and Togiak Districts of Bristol Bay, 1977-1979. Alaska Department of Fish and Game, Division of Commercial Fisheries, Bristol Bay Data Report 73, Anchorage.
- Nielson, J. D., and G. H. Green. 1981. Enumeration of spawning salmon from spawner residence time and aerial counts. Transactions of the American Fisheries Society 110:554-556.
- Rogers, D. E. 1984. Aerial survey estimates of Bristol Bay sockeye salmon escapements. Proceedings of the Workshop on Stream Indexing for Salmon Escapement Estimation. Canadian Technical Report of Fisheries and Aquatic Sciences. 1326:197-208.
- Russell, R. B., D. L. Bill, and W. A. Bucher. 1990. Salmon spawning ground surveys in the Bristol Bay area, 1989. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 2K89-15, Anchorage.
- Russell, R. B., D. L. Bill, and W. A. Bucher. 1991. Salmon spawning ground surveys in the Bristol Bay area, 1990. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 2K90-04, Anchorage.
- Russell, R. B., J. R. Regnart, and T. E. Brookover. 1992. Salmon spawning ground surveys in the Bristol Bay area, 1991. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 2A92-01, Anchorage.
- Salomone, P., S. Morstad, T. Sands, C. Westing, T. Baker, F. West, and C. Brazil. 2007. 2006 Bristol Bay area annual management report. Alaska Department of Fish and Game, Fishery Management Report No. 07-22, Anchorage. <http://www.sf.adfg.state.ak.us/FedAidpdfs/fmr07-22.pdf>
- Sands, T., C. Westing, P. Salomone, S. Morstad, T. Baker, F. West, and C. Brazil. 2008. 2007 Bristol Bay area annual management report. Alaska Department of Fish and Game, Fishery Management Report No. 08-28, Anchorage. <http://www.sf.adfg.state.ak.us/FedAidpdfs/fmr08-28.pdf>
- West, F. W., and L. F. Fair. 2006. Abundance, age, sex, and size statistics for Pacific Salmon in Bristol Bay, 2003. Alaska Department of Fish and Game, Fishery Data Series No. 06-47, Anchorage.  
<http://www.sf.adfg.state.ak.us/FedAidpdfs/fds06-47.pdf>
- Westing, C., T. Sands, S. Morstad, P. Salomone, L. Fair, F. West, C. Brazil, and K. A. Weiland. 2006. Annual management report 2005 Bristol Bay Area. Alaska Department of Fish and Game, Fishery Management Report No. 06-37. Anchorage. <http://www.sf.adfg.state.ak.us/FedAidpdfs/fmr06-37.pdf>



## **TABLES AND FIGURES**

Table 1.—Aerial counts of live sockeye salmon and total escapement estimates, Wood River system, 2008.

Location	Date	Count
Wood River <sup>a</sup>	3 Sep	2,500
Lake Aleknagik Total		18,966
Eagle Creek <sup>b</sup>	11 Aug	338
Hansen Creek <sup>b</sup>	No Survey	
Happy Creek <sup>b</sup>	7 Aug	11,144
Bear Creek <sup>b</sup>	12 Aug	1,461
Yako Creek <sup>b</sup>	14 Aug	1,003
Whitefish Creek <sup>b</sup>	10 Aug	47
Ice Creek <sup>b</sup>	8 Aug	4,355
Mission Creek <sup>b</sup>	13 Aug	618
Sunshine Creek	No Survey	
Youth Creek	No Survey	
Northshore Beaches	No Survey	
Southshore Beaches	No Survey	
Yako Beaches	No Survey	
Agulowok River & lower River Bay Total	3 Sep	91,000
Lake Nerka Total		90,674
Fenno Creek <sup>b</sup>	No Survey	
Pike Creek <sup>b</sup>	24 Aug	1,259
Stovall Creek <sup>b</sup>	24 Aug	2,504
Bear Creek	No Survey	
Teal Creek <sup>b</sup>	19 Aug	3,309
Pick Creek <sup>b</sup>	15 Aug	14,179
Elva Creek <sup>b</sup>	22 Aug	130
Kema Creek <sup>b</sup>	26 Aug	1,408
Hidden Lake Creek <sup>b</sup>	18 Aug	6,285
Lynx Creek <sup>b</sup>	23 Aug	8,400
Sam Creek <sup>b</sup>	No Survey	
Joe Creek <sup>b</sup>	No Survey	
Upper River Bay Beaches, NW	No Survey	
Upper River Bay Beaches, SE	No Survey	
Allan Cr. - Ross Cr. Beaches	No Survey	
N6 - River Bay Beach	No Survey	
Pick Creek Beach <sup>b</sup>	3 Sep	0
Elva Creek Beach	3 Sep	0
Amakuk Arm Beaches	No Survey	
Amakuk Arm - Ott's Bay Beach	3 Sep	1,600
Ott's Bay Beach	3 Sep	5,500

-continued-

Table 1.–Page 2 of 2.

Location	Date	Count
Anvil Bay Beaches	3 Sep	39,100
Anvil Bay - Elbow Pt. Beach	No Survey	
Elbow Pt. - Lynx Cr. Beach	No Survey	
Lynx Cr. - Teal Cr. Beach	No Survey	
Kema Lake Beaches	No Survey	
Hidden Lake Beaches	No Survey	
Lynx Lake Beaches	3 Sep	7,000
Little Togiak River <sup>b</sup> Total	3 Sep	28,000
Little Togiak Lake Total	3 Sep	12,900
Northshore Beaches	3 Sep	4,000
Southshore Beaches	3 Sep	700
D Slough Beaches	3 Sep	8,200
Agulukpak River Total	3 Sep	295,000
Lake Beverley Total		38,200
Tsun Creek	No Survey	
Moose Creek <sup>b</sup>	No Survey	
Hope Creek	No Survey	
Hardluck Bay Beaches	3 Sep	17,800
Sam's Beach	3 Sep	1,200
Golden Horn Beaches	3 Sep	
Silver Horn Beaches	3 Sep	17,200
B12 & B9 Beaches	3 Sep	1,800
B9 B1	3 Sep	0
Other	3 Sep	200
Hope Lake Beach	3 Sep	
Peace River Total	3 Sep	1,500
Lake Mikchalk Total	3 Sep	3,500
Narrows	3 Sep	0
Northshore Beaches	3 Sep	0
Southshore Beaches	3 Sep	3,500
Wind River Total	3 Sep	500
Lake Kulik Total	3 Sep	25,650
K1 & K2 Creeks	3 Sep	
K5 Creek - Grant River Beaches	3 Sep	0
Grant River - K2 Creek Beaches	3 Sep	24,100
Southshore Beaches	3 Sep	1,550
Grant River <sup>b</sup>	20 Aug	14,772
Total		623,162

<sup>a</sup> Total does not include tower count of 1,528,086 sockeye salmon.

<sup>b</sup> Ground survey counts conducted by Fisheries Research Institute, University of Washington.

Table 2.–Aerial counts of live sockeye salmon and total escapement estimates, Togiak District, 2008.

Location	Date	Aerial Counts	Total Escapement Estimate	
		Number	Factor <sup>a</sup>	Number
<u>Togiak Section</u>				
Togiak Tower				205,680
Togiak River mainstem		No Surveys Done	2.0	0
Gechiak Lake System		No Surveys Done	1.5	0
Pungokebuk Lake		No Surveys Done	1.5	0
Nayorurun River		No Surveys Done	1.5	0
Kemuk River		No Surveys Done	1.5	0
Ongivinuk Lake System		No Surveys Done	1.5	0
Subtotal				0
<u>Kulukak Section</u>				
Kulukak River		No Surveys Done	2.0	0
Kulukak Lake		No Surveys Done	2.0	0
Tithe Creek Ponds		No Surveys Done	1.5	0
Subtotal				0
<u>Matogak, Osviak, and Cape Peirce Sections</u>				
Matogak River		No Surveys Done	3.0	0
Osviak River		No Surveys Done	2.5	0
Slug River		No Surveys Done	2.0	0
Subtotal				0
<u>Other</u>				
Quigmy River		No Surveys Done	2.5	0
Negukthlik River		No Surveys Done	3.0	0
Ungalikthluk River		No Surveys Done	2.0	0
Subtotal				0
<b>Total</b>				<b>205,680</b>

<sup>a</sup> Derived by expanding peak live count to reflect fish not counted due to variables such as schooled and dead fish, late or poor survey conditions, bad weather, etc.

Table 3.—Aerial counts of live Chinook salmon and total escapement estimates, Togiak District, 2008.

Location	Aerial Counts		Total Escapement Estimate	
	Date	Number	Factor <sup>a</sup>	Number
<u>Togiak Section</u>				
Togiak River mainstem				
A	21 Aug	105	2.0	210
B	21 Aug	80	2.0	160
C	21 Aug	175	2.0	350
D	21 Aug	100	2.0	200
E	21 Aug	165	2.0	330
F	21 Aug	305	2.0	610
Subtotal	21 Aug	930	2	1,860
Gechiak River	21 Aug	No Surveys Done	2.0	0
Pungokepek River	21 Aug	30	2.0	60
Nayorurun River	21 Aug	No Surveys Done	2.0	0
Kemuk River	21 Aug	No Surveys Done	2.0	0
Ongivinuk River	21 Aug	110	2.0	220
Subtotal		140		280
Togiak River Drainage Total		1,070		2,140
<u>Kulukak Section</u>				
Kulukak River		No Surveys Done	2.0	0
<u>Matogak, Osviak, and Cape Peirce Sections</u>				
Matogak River		No Surveys Done	2.0	0
Osviak River		No Surveys Done	2.0	0
Slug River		No Surveys Done	2.0	0
Subtotal		0		0
<u>Other</u>				
Quigmy River		No Surveys Done	2.0	0
Negukthlik River		No Surveys Done	3.0	0
Ungalikthluk River		No Surveys Done	2.0	0
Subtotal		0		0
Total		1,070		2,140

<sup>a</sup> Derived by expanding peak live count to reflect fish not counted due to variables such as schooled and dead fish, late or poor survey conditions, bad weather, etc.

Table 4.–Aerial counts of live chum salmon and total escapement estimates, Togiak District, 2008.

Location	Aerial Counts		Total Escapement Estimate	
	Date	Number	Factor <sup>a</sup>	Number
<u>Togiak Section</u>				
Togiak River mainstem				
A	21 Aug	1,100	2.0	2,200
B	21 Aug	1,200	2.0	2,400
C	21 Aug	1,000	2.0	2,000
D	21 Aug	1,200	2.0	2,400
E	21 Aug	14,000	2.0	28,000
F	21 Aug	120,000	2.0	240,000
Subtotal		138,500		277,000
Gechiak River	21 Aug	No Surveys Done	2.0	0
Pungokepek River	21 Aug	250	2.0	500
Nayorurun River	21 Aug	No Surveys Done	2.0	0
Kemuk River	21 Aug	No Surveys Done	2.0	0
Ongivinuk River	21 Aug	1,040	2.0	2,080
Subtotal		1,290		2,580
Togiak River Drainage Total		139,790		279,580
<u>Kulukak Section</u>				
Kulukak River		No Surveys Done	2.0	0
<u>Matogak, Osviak, and Cape Peirce Sections</u>				
Matogak River		No Surveys Done	2.0	0
Osviak River		No Surveys Done	2.0	0
Slug River		No Surveys Done	2.0	0
Subtotal		0		0
<u>Other</u>				
Quigmy River		No Surveys Done	2.0	0
Negukthlik River		No Surveys Done	2.0	0
Ungalikthluk River		No Surveys Done	2.0	0
Subtotal		0		0
Total		139,790		279,580

<sup>a</sup> Derived by expanding peak live count to reflect fish not counted due to variables such as schooled and dead fish, late or poor survey conditions, bad weather, etc.

Table 5.–Peak aerial counts of live coho salmon and total escapement estimates, Togiak District, 2008.

Location	Aerial Counts		Total Escapement Estimate	
	Date	Number	Factor <sup>a</sup>	Number
<u>Togiak Section</u>				
Togiak River mainstem				
A		No Surveys Done		0
B		No Surveys Done		0
C		No Surveys Done		0
D		No Surveys Done		0
E		No Surveys Done		0
F		No Surveys Done		0
Subtotal		0		0
Gechiak River		No Surveys Done		0
Pungokebuk River		No Surveys Done		0
Nayorurun River		No Surveys Done		0
Kemuk River		No Surveys Done		0
Ongivinuk River		No Surveys Done		0
Subtotal		0		0
Togiak River Drainage		0		0
<u>Kulukak Section</u>				
Kulukak River		No Surveys Done	2.0	
<u>Matogak, Osviak, and Cape Peirce Sections</u>				
Matogak River		No Surveys Done	2.0	0
Osviak River		No Surveys Done	3.0	0
Slug River		No Surveys Done	3.0	0
Subtotal		0		0
<u>Other</u>				
Quigmy River		No Surveys Done	3.0	
Negukthlik River		No Surveys Done	3.0	
Ungalikthluk River		No Surveys Done	3.0	0
Subtotal		0		0
<u>Total</u>				

<sup>a</sup> Derived by expanding peak live count to reflect fish not counted due to variables such as schooled and dead fish, late or poor survey conditions, bad weather, etc.

Table 6.–Peak aerial survey counts of sockeye salmon, Alagnak River system 2008.

Location	Number of Fish	Percent of Total
Nonvianuk River		0.0
Nonvianuk Lake	150,000	10.0
Kulik River	270,000	18.0
Kulik Lake	40,000	2.7
Alagnak River	5,000	0.3
Kukaklek Lake	90,000	6.0
Nanuktuk Creek	99,000	6.6
Battle River	150,000	10.0
Battle Lake	65,000	4.3
Moraine/Spectacle Creek	472,000	31.4
Funnel Creek	163,000	10.8
Total	1,504,000	100.0

*Note:* Aerial surveys were conducted with a fixed wing aircraft.

Table 7.–Aerial survey counts of Chinook, chum, pink, and coho salmon; Naknek-Kvichak District, 2008.

Location	Survey Date	Number of Salmon			
		Chinook	Chum	Pink	Coho
Kvichak River		No survey	No survey	No survey	No survey
Alagnak River	1 Aug	1,825	80,000	180,000	No survey
Naknek River : <sup>a</sup>					
Paul's Creek	1 Aug	110	No count	No count	No survey
King Salmon Creek	1 Aug	680	50	No count	No survey
Big Creek	7 Aug	2,110	65,000	15,000	No survey
Mainstem Naknek River	8 Sep	2,430	No count	No count	No count

<sup>a</sup> Naknek River drainage flown under poor conditions; no estimate possible.

Table 8.–Aerial survey counts for Chinook salmon escapement, Egegik District 2008.

Location	Survey Date	Chinook Salmon Counted
Egegik River	No Survey	
Shosky Creek	8 Aug	0
Whale Mountain Creek	8 Aug	0
Mossy Creek	8 Aug	0
Mink Creek	8 Aug	3
Gertrude Creek	8 Aug	37
Kaye's Creek	8 Aug	47
Takayoto Creek	8 Aug	78
Angle Creek	No Survey	
Contact Creek	8 Aug	62
Mainstem King Salmon River	No Survey	
Total		227

Table 9.–Aerial survey counts for chum salmon escapement, Egegik District 2008.

Location	Survey Date	Chum Salmon Counted
Egegik River	No Survey	
Shosky Creek	8 Aug	4
Whale Mountain Creek	8 Aug	164
Mossy Creek	8 Aug	73
Mink Creek	8 Aug	1
Gertrude Creek	8 Aug	450
Kaye's Creek	8 Aug	170
Takayoto Creek	8 Aug	3
Angle Creek	No Survey	
Contact Creek	8 Aug	500
Mainstem King Salmon River	No Survey	
Total		1,365

Table 10.—Aerial survey counts of coho salmon escapement, Egegik District 2008.

Location <sup>a</sup>	Survey Date	Coho Salmon Counted
Egegik River Rapids	No Survey	
Stream 115.8 (Featherly Creek)	24 Sep	800
Stream 107.6 (Burl's Creek)	24 Sep	1,600
Stream 90.3 (Salmon Creek)	24 Sep	2,300
Stream 89.8 (Ruth Creek)	24 Sep	0
Stream 87.0 (Bear Creek)	24 Sep	250
Stream 73.5 (Becharof Creek)	24 Sep	800
Stream 48.1 (Kejulik River)	24 Sep	350
<b>Total</b>		<b>6,100</b>

<sup>a</sup> Streams tributary to Becharof Lake are designated by the number of miles between their mouth and the outlet of Becharof Lake (Egegik River) as one travels around the lake in a clockwise fashion from the Becharof outlet. This is the same system of designation used for years by previous investigators.

Table 11.—Aerial survey counts of sockeye salmon escapement, King Salmon and Dog Salmon River, Ugashik District, 2008.

Location	Survey Date	Sockeye Salmon Counted
<u>King Salmon River System:</u>		
Mother Goose Lake and outlet	10 Aug	See Text for Ugashik District
Needle Lake	10 Aug	See Text for Ugashik District
Volcano Creek	10 Aug	See Text for Ugashik District
Painter Creek	10 Aug	See Text for Ugashik District
Indecision Creek	10 Aug	See Text for Ugashik District
Subtotal		
<u>Dog Salmon River System:</u>		
Figure-Eight Creek	10 Aug	5,200
Goblet Creek	10 Aug	0
Oldham Creek	10 Aug	2,500
Wandering Creek	10 Aug	0
Mainstem Dog Salmon River	10 Aug	0
Subtotal		7,700
<u>Ugashik River System</u>		
Mainstem Ugashik River	10 Aug	20,000
Grassy Creek	10 Aug	No Survey
Subtotal		20,000
<b>Total</b>		<b>27,700</b>

Table 12.—Aerial survey counts of Chinook salmon, Ugashik District 2008.

Location	Survey Date	Chinook Salmon counted
<u>King Salmon River System</u>		
Old Creek	10 Aug	31
Pumice Creek	10 Aug	1,500
Painter Creek	10 Aug	See Text for Ugashik District
Mainstem King Salmon River	10 Aug	See Text for Ugashik District
Indecision Creek	10 Aug	See Text for Ugashik District
Volcano Creek	10 Aug	See Text for Ugashik District
Subtotal		1,531
<u>Dog Salmon River System</u>		
Figure-Eight Creek	10 Aug	443
Goblet Creek	10 Aug	60
Oldham Creek	10 Aug	0
Wandering Creek	10 Aug	4
Mainstem Dog Salmon River	10 Aug	No Survey
Subtotal		507
<u>Ugashik River System</u>		
Mainstem Ugashik River	10 Aug	0
Grassy Creek	10 Aug	0
Subtotal		0
Total		2,038

Table 13.—Aerial survey counts of chum salmon escapement, Ugashik District 2008.

Location	Survey Date	Chum Salmon Counted
<u>King Salmon River System</u>		
Old Creek	10 Aug	18,200
Pumice Creek	10 Aug	7,700
Painter Creek	10 Aug	See Text for Ugashik District
Mainstem King Salmon River	10 Aug	See Text for Ugashik District
Needle Lake	10 Aug	See Text for Ugashik District
Indecision Creek	10 Aug	See Text for Ugashik District
Volcano Creek	10 Aug	See Text for Ugashik District
Subtotal		25,900
<u>Dog Salmon River System</u>		
Figure-Eight Creek	10 Aug	250
Goblet Creek	10 Aug	0
Oldham Creek	10 Aug	0
Wandering Creek	10 Aug	90
Mainstem Dog Salmon River	10 Aug	No Survey
Subtotal		340
<u>Ugashik River System</u>		
Mainstem Ugashik River	10 Aug	0
Grassy Creek	10 Aug	0
Subtotal		0
Total		26,240

Table 14.—Aerial survey counts of coho salmon escapement, Ugashik District 2008.

Location	Survey Date	Coho Salmon Counted
<u>Ugashik Drainage</u>		
<u>Upper Ugashik Lake</u>		
Crooked Creek	24 Sep	300
Deer Creek	24 Sep	600
<u>Lower Ugashik Lake</u>		
"E" Creek	24 Sep	800
South Creek	24 Sep	
Ugashik Outlet	24 Sep	1,700
<u>King Salmon River Tributaries</u>		
Pumice Creek	24 Sep	1,600
Old Creek	24 Sep	40
Painter Creek	No Survey	
<u>Dog Salmon River Tributaries</u>		
Figure Eight Creek	24 Sep	1,200
District Total		6,240



Figure 1.—Bristol Bay management area, Alaska.

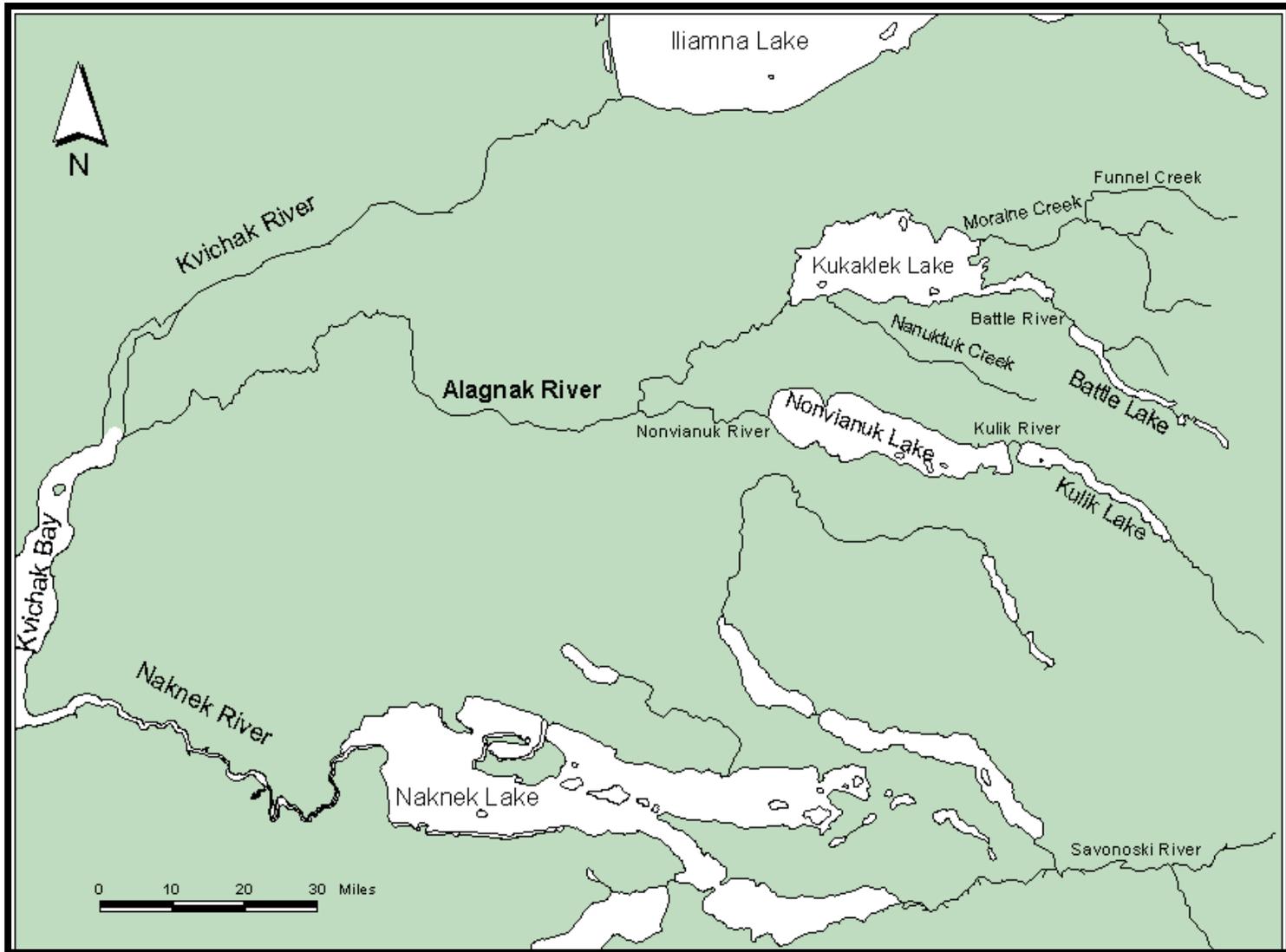


Figure 2.—Naknek-Kvichak District drainages, Bristol Bay, Alaska.

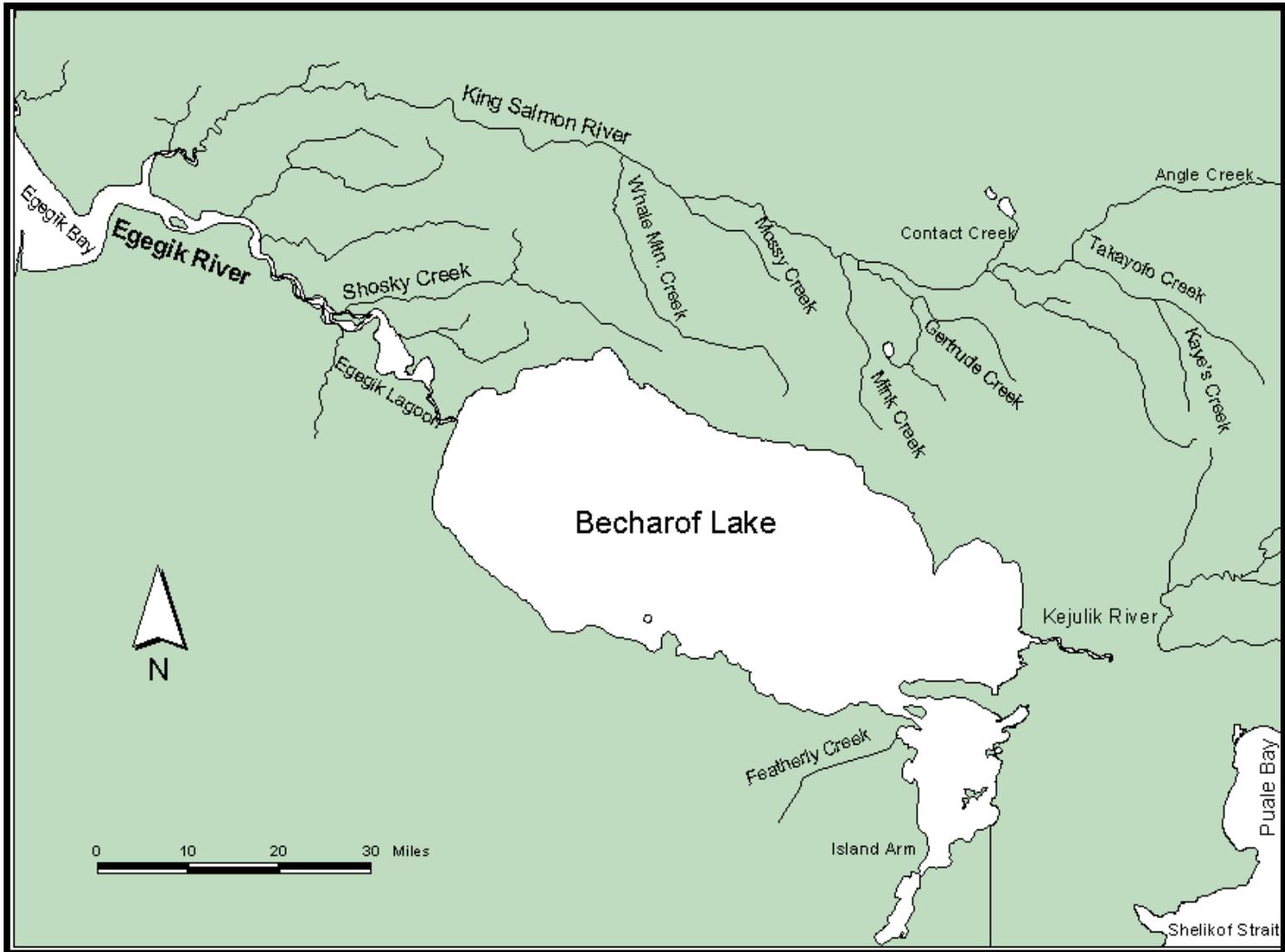


Figure 3.—Egegik District drainages, Bristol Bay, Alaska.

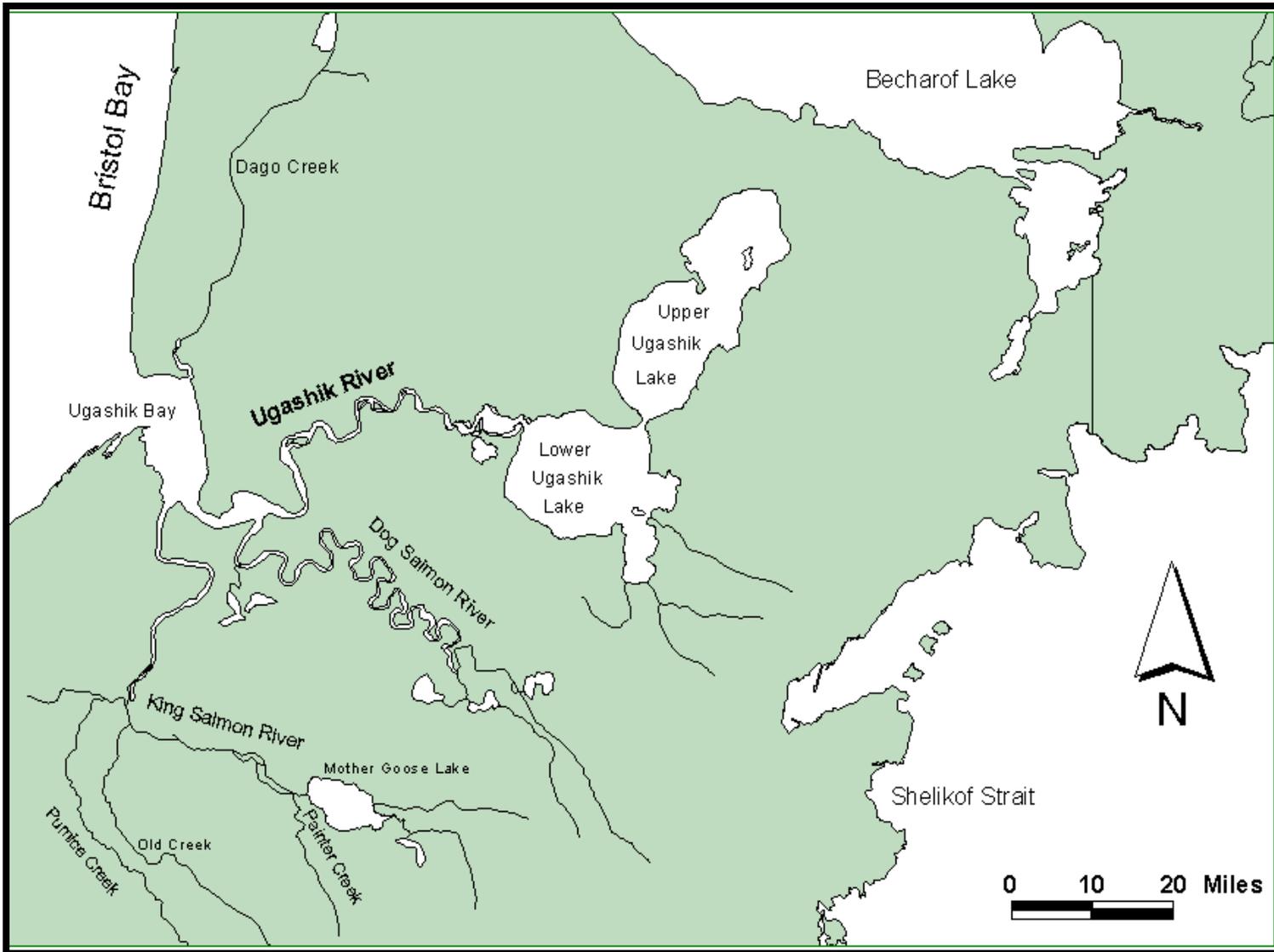


Figure 4.—Ugashik District drainages, Bristol Bay, Alaska.

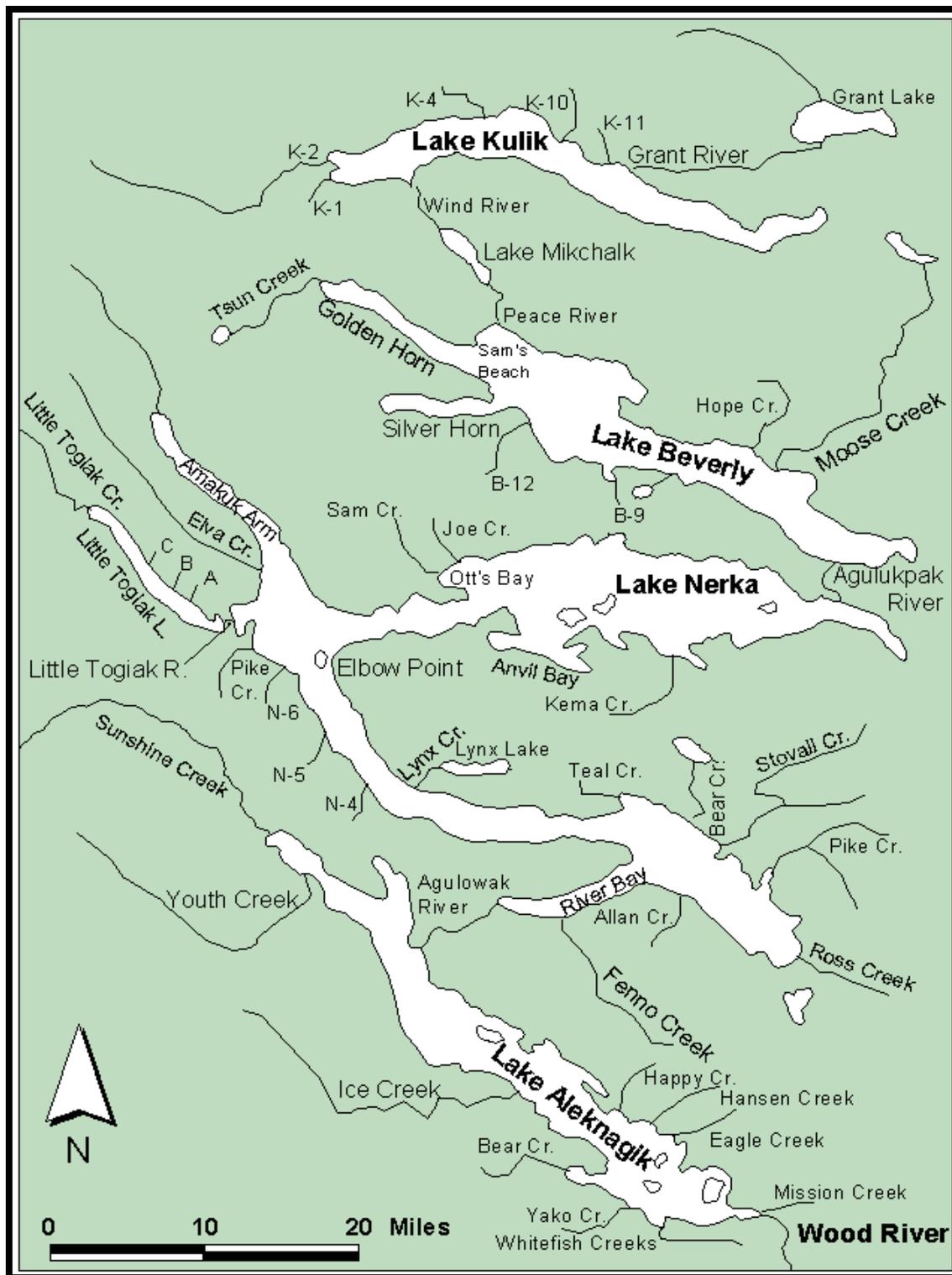


Figure 5.—Wood River watershed, Bristol Bay, Alaska.

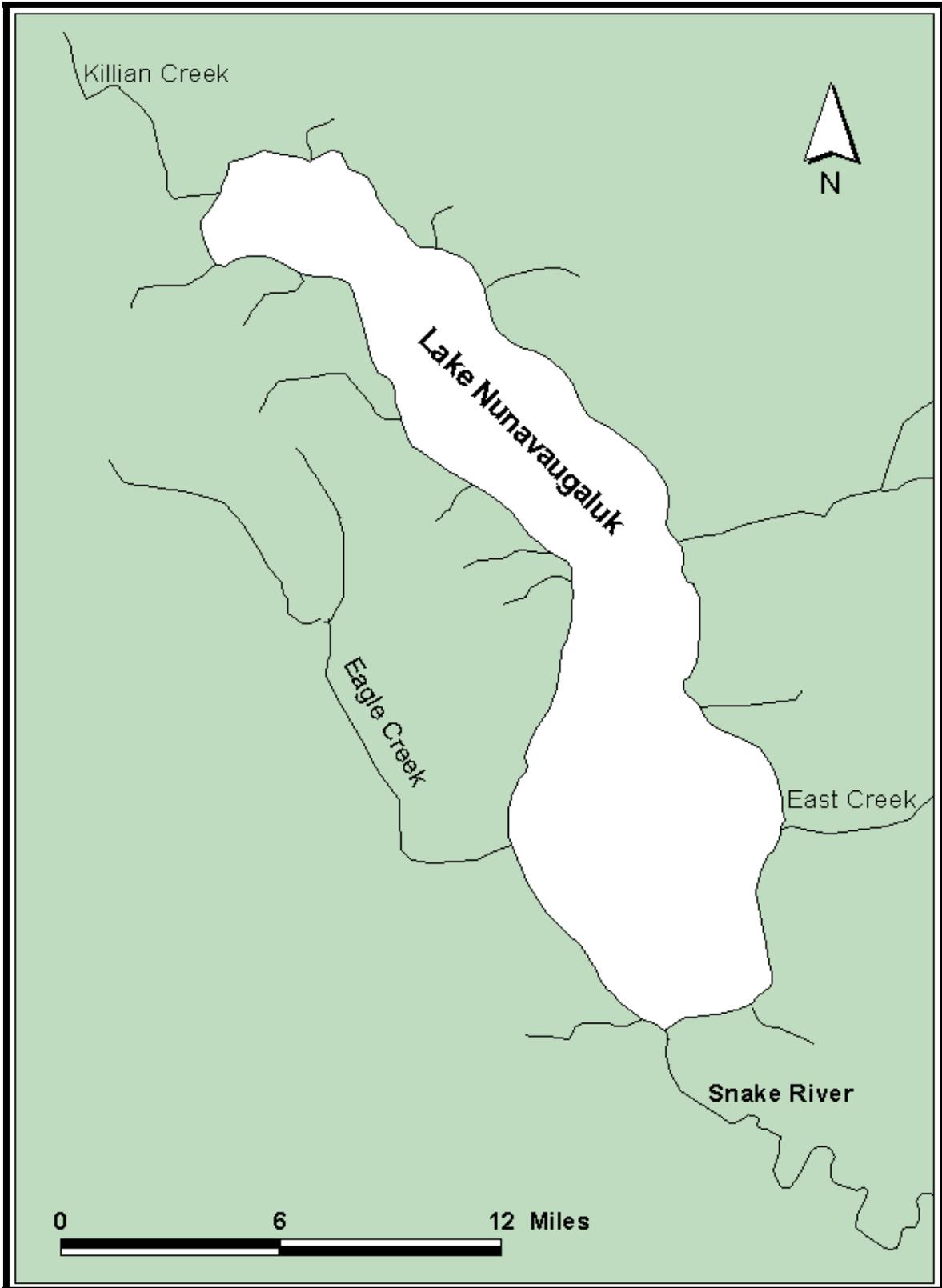


Figure 6.—Snake River watershed, Bristol Bay, Alaska.

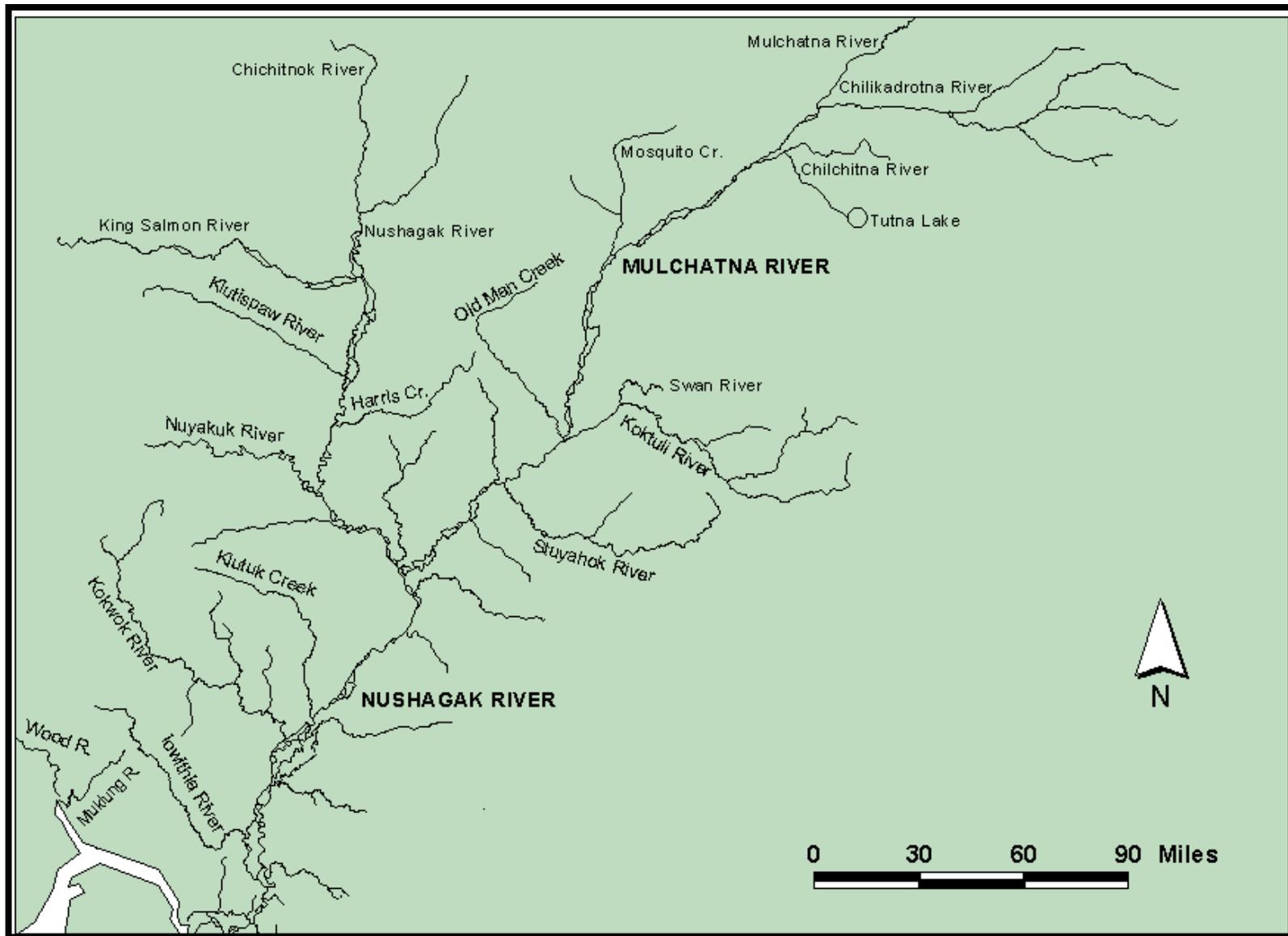


Figure 7.—Nushagak River watershed, Bristol Bay, Alaska.

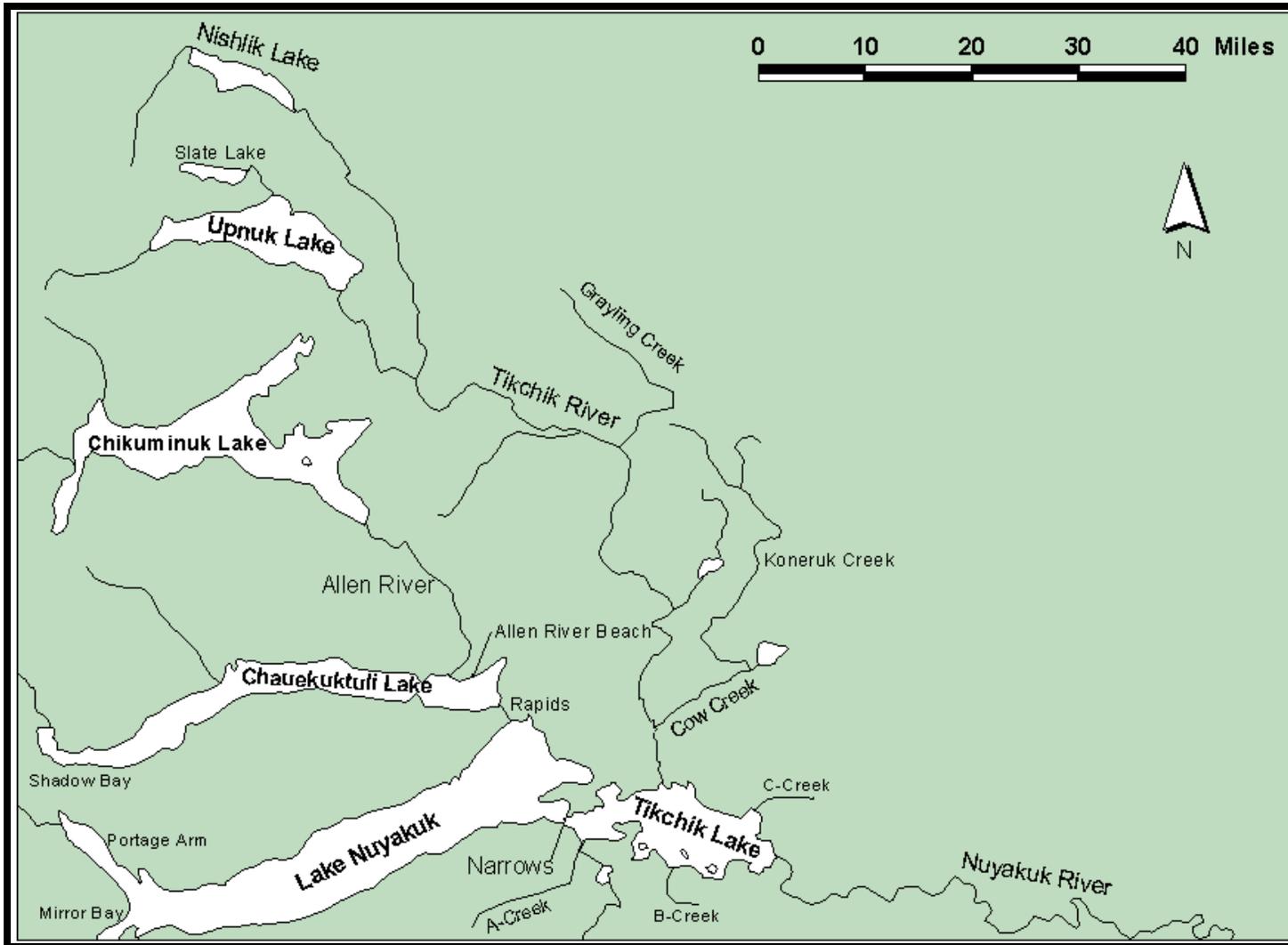


Figure 8.—Tikchik Lakes system, Bristol Bay, Alaska.

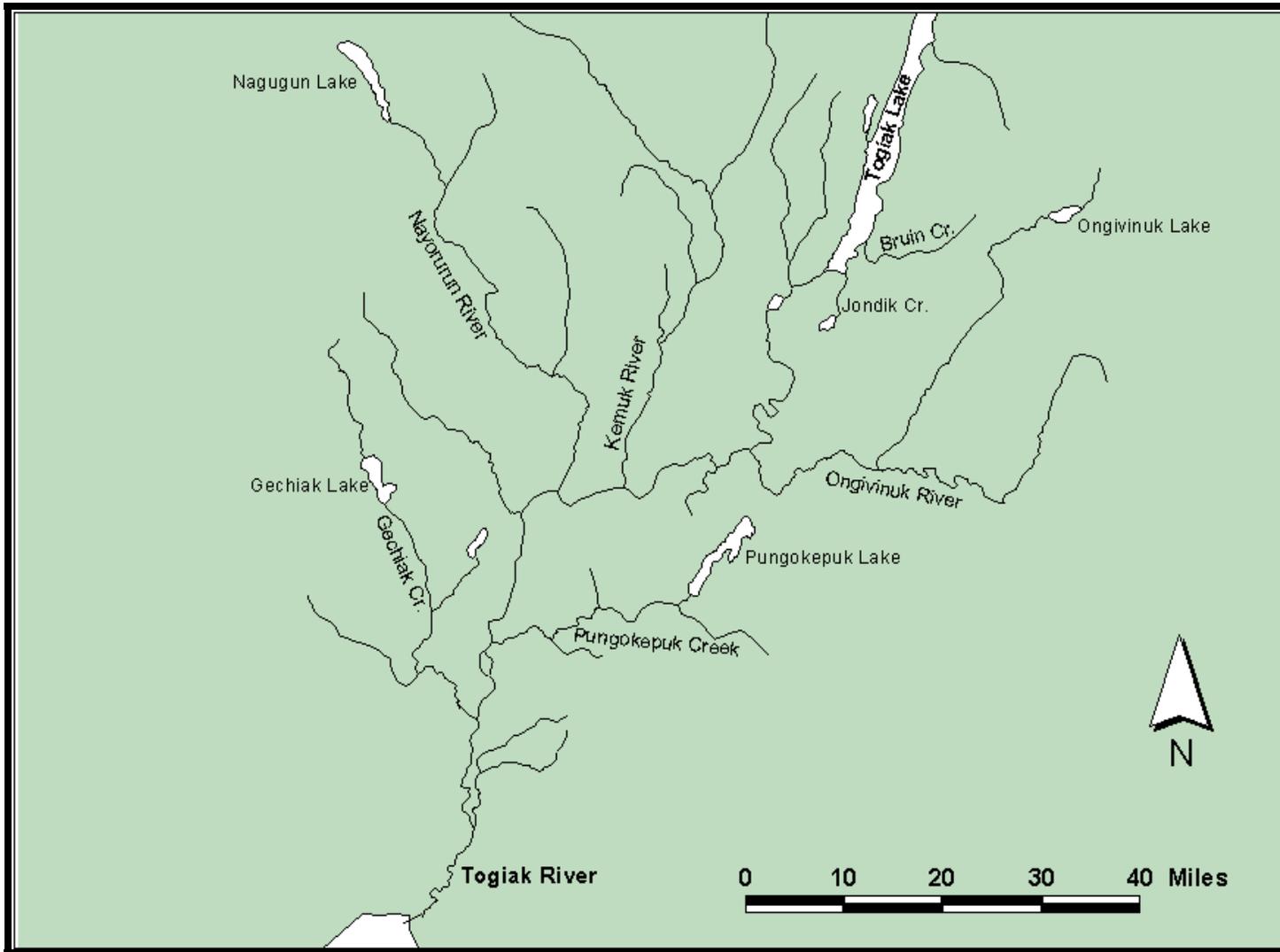


Figure 9.—Togiak River watershed, Bristol Bay, Alaska.

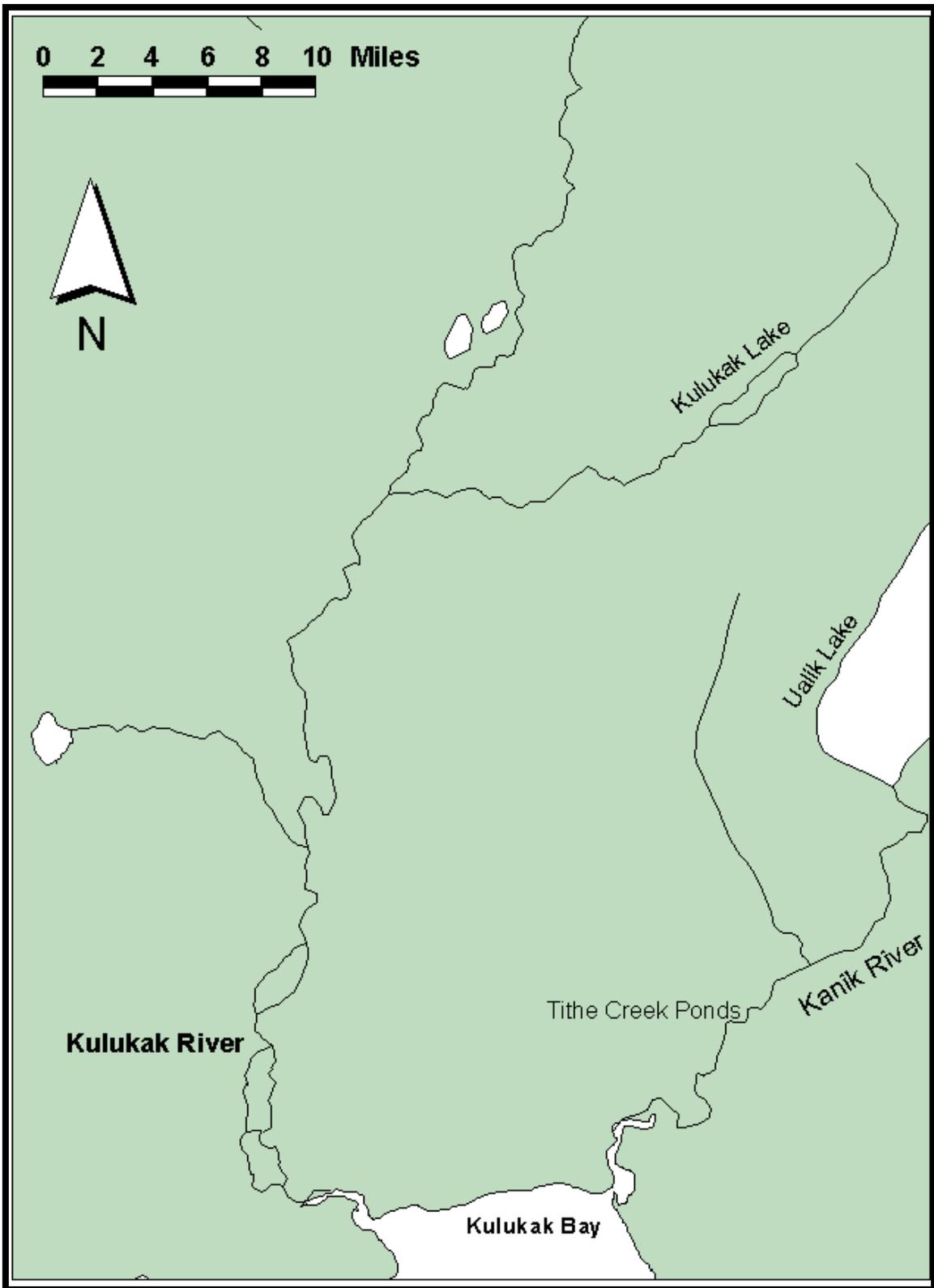


Figure 10.—Kulukak River watershed, Bristol Bay, Alaska.

## **APPENDIX A**

Appendix A1.—Sockeye salmon total escapement estimates, Naknek-Kvichak District, 1988–2008.

Year	Kvichak	Naknek	Alagnak	Total	Alagnak Percent of Total
1988	4,065,216	1,037,862	194,630 <sup>a</sup>	5,297,708	4
1989	8,317,500	1,161,984	196,760 <sup>a</sup>	9,676,244	2
1990	6,970,020	2,092,578	168,760 <sup>a</sup>	9,231,358	2
1991	4,222,788	3,578,508	277,589 <sup>a</sup>	8,078,885	3
1992	4,725,864	1,606,650	226,643 <sup>a</sup>	6,559,157	3
1993	4,025,166	1,535,658	347,975 <sup>a</sup>	5,908,799	6
1994	8,337,840	990,810	242,595 <sup>a</sup>	9,571,245	3
1995	10,038,720	1,111,140	215,713 <sup>a</sup>	11,365,573	2
1996	1,450,578	1,078,098	306,750 <sup>a</sup>	2,835,426	11
1997	1,503,732	1,025,664	218,115 <sup>a</sup>	2,747,511	8
1998	2,296,074	1,202,172	252,200 <sup>a</sup>	3,750,446	7
1999	6,196,914	1,625,364	463,600 <sup>a</sup>	8,285,878	6
2000	1,827,780	1,375,488	451,300 <sup>a</sup>	3,654,568	12
2001	1,095,348	1,830,360	267,000 <sup>a</sup>	3,192,708	8
2002	703,884	1,263,918	282,100 <sup>a</sup>	2,249,902	13
2003	1,686,804	1,831,170	2,110,000 <sup>a</sup>	5,627,974	37
2004	5,500,134	1,939,374	5,396,592	12,836,100	42
2005	2,320,422	2,744,622	4,219,026	9,284,070	45
2006	3,055,128	1,953,228	1,773,966	6,782,322	26
2007	2,810,208	2,945,304	2,466,414	8,221,926	30
2008	2,757,912	2,416,782	2,180,502	7,355,196	30
Mean <sup>b</sup>	4,057,506	1,696,498	1,003,886	6,757,890	15

*Note:* Estimates based on visual counts from towers unless otherwise noted.

<sup>a</sup> Aerial survey counts.

<sup>b</sup> Mean of counts from 1988–2008.

Appendix A2.–Aerial survey counts of Chinook salmon escapements, Naknek River drainage, 1988-2008.

Year	Mainstem Naknek River	Paul's Creek	King Salmon Creek	Big Creek	Total
1988	7,380	150	600	3,600	11,730
1989	1,700	50	100	860	2,710
1990	4,500	150	350	2,000	7,000
1991	1,655	121	275	2,340	4,391
1992	1,550	88	158	895	2,691
1993	5,520	86	700	1,710	8,016
1994	5,970	203	974	2,531	9,678
1995	2,790	26	239	1,905	4,960
1996	2,965	157	312	1,576	5,010
1997	7,520	248	902	1,783	10,453
1998	2,150	210	1,060	2,085	5,505
1999	<sup>a</sup>	223	847	2,250	3,320
2000	1,900	43	178	1,112	3,233
2001	3,800	118	413	2,009	6,340
2002	4,240	314	934	2,015	7,503
2003	4,150	583	1,348	<sup>a</sup>	6,081
2004	6,900	315	1,582	4,081	12,878
2005 <sup>a</sup>					
2006 <sup>a</sup>					
2007 <sup>a</sup>					
2008	2,430	110	680	2,110	5,330
Mean	4,043	181	645	2,047	6,559

<sup>a</sup> Counts unavailable due to poor conditions.

Appendix A3.–Chinook salmon escapement data, Naknek-Kvichak District, 1988–2008.

Year	Non-expanded Escapement Indices by Drainage <sup>a</sup>			Total
	Naknek	Alagnak	Kvichak	
1988	11,730	4,600	190	16,520
1989	2,710	3,650	100	6,460
1990	7,000	1,720	170	8,890
1991	4,391	2,531		6,922
1992	2,691	3,042	264	5,997
1993	8,016	10,170	115	18,301
1994	9,678	8,480	306	18,464
1995	4,960	6,860	96	11,916
1996	5,010	9,885	132	15,027
1997	10,453	15,210	103	25,766
1998	5,505	4,148	187	9,840
1999	3,320 <sup>b</sup>	2,178	1,200	6,698
2000	3,233	2,220	6	5,459
2001	6,340	5,458	36	11,834
2002	7,503	3,765		11,268
2003	6,081 <sup>c</sup>	8,209		14,290
2004	12,878	6,755		19,633
2005		5,084		
2006		4,278		
2007		3,455		
2008	6,559	1,825		8,384
Mean	6,559	5,585	223	12,546

<sup>a</sup> Includes aerial indices from all streams surveyed in drainage.

<sup>b</sup> No index count for Naknek River.

<sup>c</sup> No index count for Big Creek.

Appendix A4.–Chum salmon escapement survey history, Alagnak River, 1990–2008.

Year	Count Dates	Aerial Index Estimate
1990	8/08	8,500
	8/18	48,800
1991	8/09	43,000
	8/19	64,300
1992	8/10	114,000
1993	8/09	4,600
1994	8/08	62,900
1995	8/10	132,000
1996	8/12	145,000
1997	8/07	37,800
1998	8/12	3,150
1999	8/10	11,800
2000	8/07	10,120
2001	8/08	70,800
2002	8/02	157,800
2003	8/13	78,000
2004		
2005	7/30	20,300
2006		
2007	8/08	100,000
2008	8/01	80,000

*Note:* Blank cells represent no data.

Appendix A5.–Pink salmon escapement survey history, Naknek/Kvichak District 1988–2008.

Year	Survey Dates	Non-expanded Escapement Indices by Drainage		
		Alagnak	Kvichak	Naknek
1988	8/12	415,000	25,300	
1990	8/08	45,100		
1990	8/18	240,500		
1992	8/10	15,000		
1994	8/08			
1996	8/12		7,000	10,000
1998	8/12	3,200		20,000
2000	8/07	30,000		
2002	8/02	127,500		
2004	8/17	650,000		
2006				
2008	8/01	180,000		
Mean		146,600	16,150	105,333

Appendix A6.—Aerial survey counts of Chinook salmon escapement, Egegik District, 1988–2008.

Year	Egegik River	Shosky Creek	Whale					Gertrude Creek	Kaye's Creek	Takayoto Creek	Angle Creek <sup>a</sup>	Contact Creek	King Salmon River	Total
			Mountain Creek	Mossy Creek	Mink Creek									
1988	50	151	0	12			248	120	177		110		868	
1989	14	90	13	43	7		310	120	300		100		997	
1990	24 <sup>b</sup>	85	7	35	2		260	175	175		205		968	
1991	0 <sup>b</sup>	62	60	30	33		83	117	95		73		553	
1992 <sup>c</sup>	15	143	52	54	22		416	320	190		296		1,508	
1993	80	58	6	38	6		350	170	200		235		1,143	
1994 <sup>c</sup>	66 <sup>b</sup>	48	32	118	77		840	214	230		705		2,330	
1995 <sup>c</sup>	60 <sup>b</sup>	32	10	53	103		456	248	130		275		1,367	
1996	42 <sup>b</sup>	102	8	38	20		230	74	123	6	203		846	
1997	30 <sup>b</sup>	39	2	18	10		260	173	374		740		1,646	
1998	0 <sup>b</sup>	29	45	55			320	165	120		329		1,063	
1999	6 <sup>b</sup>	75	10	51			165	6	115		145		573	
2000	0 <sup>b</sup>	4	0	16			85	41	73		341		560	
2001	0 <sup>b</sup>	32	0	35			116	120	153		299		755	
2002	0 <sup>b</sup>	24	4	0			277	220	149		238		912	
2003	0 <sup>b</sup>	35	0	20	10		297	180	313		197		1,052	
2004	0	20	0	40	4		226	134	219		870		1,513	
2005	0 <sup>b</sup>	21	8	36	0		165	71	99		150		550	
2006	0 <sup>b</sup>	1	0	1	1		66	80	50	27	50		276	
2007	0 <sup>b</sup>	15	0	7	3		131	113	214		72	0	555	
Average	19	53	13	35	21		265	143	175	17	282	0	1,002	
2008		0	0	0	3		37	47	78		62		227	
Deviation		-100%	-100%	-100%	-86%		-86%	-67%	-55%		-78%		-77%	

Note: Peak aerial counts unless otherwise noted. Data not expanded. Blank cells represent no data.

<sup>a</sup> Angle Creek is usually too turbid to survey.

<sup>b</sup> Tower count.

<sup>c</sup> Helicopter surveys.

Appendix A7.—Aerial survey counts of chum salmon escapement, Egegik District, 1988–2008.

Year	Egegik River	Shosky Creek	Whale					Kaye's Creek	Takayoto Creek	Angle Creek <sup>a</sup>	Contact Creek	King Salmon River	Total
			Mountain Creek	Mossy Creek	Mink Creek	Gertrude Creek							
1988	500	50	4,400	100	50	5,200	1,600	0		3,200		15,100	
1989	0	10	3,200	25	100	1,100	0	0		200	14	4,649	
1990	72 <sup>b</sup>	0	2,000	0	150	1,675	80	0		750		4,727	
1991	0 <sup>b</sup>	0	1,500	70	100	990	280	0		480		3,420	
1992 <sup>c</sup>	50	0	680	15	25	4,500	400	0		3,630	200	9,500	
1993	100	0	1,020	8	1	1,075	0	0		100		2,304	
1994 <sup>c</sup>	42 <sup>b</sup>	0	1,700	5	7	760	175	30		260		2,979	
1995 <sup>c</sup>	144 <sup>b</sup>	2	395	15	30	560	162	5		600		1,913	
1996	12	<sup>d</sup>	438	4	20	530	<sup>d</sup>	24	<sup>d</sup>	633	<sup>d</sup>	1,661	
1997	0 <sup>b</sup>	<sup>d</sup>	220	8	10	495	290	60	<sup>d</sup>	640	<sup>d</sup>	1,723	
1998	17 <sup>b</sup>	8	1,480	4	<sup>d</sup>	920	4	4	<sup>d</sup>	140	<sup>d</sup>	2,577	
1999	6 <sup>b</sup>	<sup>d</sup>	1,040	4	<sup>d</sup>	243	<sup>d</sup>	4	<sup>d</sup>	140	<sup>d</sup>	1,437	
2000	0 <sup>b</sup>	<sup>d</sup>	492	4	<sup>d</sup>	475	32	6	<sup>d</sup>	180	<sup>d</sup>	1,189	
2001	0 <sup>b</sup>	<sup>d</sup>	424	6	<sup>d</sup>	494	40	30	<sup>d</sup>	1,240	<sup>d</sup>	2,234	
2002	0 <sup>b</sup>	<sup>d</sup>	284	5	<sup>d</sup>	302	16		<sup>d</sup>	150	<sup>d</sup>	757	
2003	0 <sup>b</sup>	0	540	70	50	690	0	0	<sup>d</sup>	3,800	<sup>d</sup>	5,150	
2004	0 <sup>b</sup>	0	260	50	20	610	50	0	<sup>d</sup>	750	<sup>d</sup>	1,740	
2005	0 <sup>b</sup>	0	300	10	14	770	30	0	<sup>d</sup>	390	<sup>d</sup>	1,514	
2006	0 <sup>b</sup>	20	340	9	4	450	4	0	0	130	<sup>d</sup>	957	
2007	0 <sup>b</sup>	3	2,450	60	30	860	60	0	<sup>d</sup>	320	0	3,783	
Average	47	7	1,158	24	41	1,135	179	9	0	887	71	3,466	
2008		4	164	73	1	450	170	3	<sup>d</sup>	500	<sup>d</sup>	1,365	

*Note:* Peak aerial counts unless otherwise noted. Data not expanded. Blank cells represent no data.

<sup>a</sup> Angle Creek usually too turbid to survey.

<sup>b</sup> Tower counts.

<sup>c</sup> Helicopter surveys.

<sup>d</sup> No count.

Appendix A8.—Aerial survey counts of pink salmon escapement, Egegik District, 1988–2008.

Year	Egegik River	Whale Mountain Creek	Gertrude Creek	Contact Creek	Other	Total
1988	23,000					23,000
1989	300					300
1990	17,000		40 <sup>a</sup>			17,040
1991		88 <sup>b</sup>	24 <sup>b</sup>	36 <sup>b</sup>		148
1992 <sup>d</sup>	6 <sup>c</sup>	10			3	13
1993	50					50
1994	21,282 <sup>c</sup>					21,282
1995	24 <sup>c</sup>					24
1996	103,116 <sup>c</sup>					103,116
1997	0 <sup>c</sup>		1,290 <sup>e</sup>			1,290
1998	2 <sup>c</sup>		2,487 <sup>e</sup>			2,489
1999	6 <sup>c</sup>		1,125 <sup>e</sup>			1,131
2000	0 <sup>c</sup>					
2001	0 <sup>c</sup>					
2002	0 <sup>c</sup>					
2003	0 <sup>c</sup>					
2004	0 <sup>c</sup>					
2005	0 <sup>c</sup>					
2006	0 <sup>c</sup>					
2007	0 <sup>c</sup>					
Average	9,692	49	993	36	3	14,157
2008	0 <sup>c</sup>					

*Note:* Peak aerial counts unless otherwise noted. Data not expanded. Blank cells represent no data.

<sup>a</sup> Foot surveys conducted by USFWS.

<sup>b</sup> Float counts.

<sup>c</sup> Tower counts.

<sup>d</sup> Helicopter surveys.

<sup>e</sup> Gertrude Creek weir counts.

Appendix A9.–Aerial survey counts of coho salmon escapement, Egegik District, 1988–2008.

Year	Number of Surveys	Coho Salmon Count	Comments
1988	6	13,715	Included King Salmon River & tributaries
1989	9	4,485	Included Gertrude & Whale Mountain Creeks
1990	7	13,400	Peak survey on August 17
1991	0	220	Incidental observation made August 6
1992 <sup>a</sup>	0	200	Incidental observation in Egegik River August 6
1993	0	1,130	Incidental observation from Egegik River August 16
1994 <sup>a,b</sup>	2	7,412	Included King Salmon River & tributaries
1995 <sup>c</sup>	2	5,258	Included King Salmon River & tributaries
1996 <sup>d</sup>	2	9,043	Included King Salmon River & tributaries
1997	3	4,106	Gertrude Weir Count & selected Becharof Lake tributaries
1998	1	6,075	Gertrude Weir Count & selected Becharof Lake tributaries
1999	1	4,353	Gertrude Weir Count & selected Becharof Lake tributaries
2000	1	4,870	Selected Becharof Lake tributaries
2001	1	5,100	Selected Becharof Lake tributaries
2002	1	7,050	Selected Becharof Lake tributaries
2003	1	5,280	Selected Becharof Lake tributaries
2004	1	41,400	Selected Becharof Lake tributaries
2005	1	22,450	Selected Becharof Lake tributaries
2006	1	21,000	Selected Becharof Lake tributaries
2007	1	2,000	Selected Becharof Lake tributaries (Sept 7)
2008	1	6,100	Selected Becharof Lake tributaries (Sept 24)

<sup>a</sup> Helicopter surveys.

<sup>b</sup> The Egegik River Tower was maintained through September 11 and approximately 10,140 coho salmon were counted.

<sup>c</sup> The Egegik River Tower was maintained through August 30 and approximately 7,470 coho salmon were counted.

<sup>d</sup> The Egegik River Tower was maintained August 7 to September 11 and approximately 24,918 coho salmon were counted.

Appendix A10.—Aerial survey counts of Chinook salmon escapement, Ugashik District, 1988–2008.

Year	Ugashik River	Dog <sup>a</sup> Salmon River	King Salmon	Painter Creed	Pumice Creek	Old Creek	Total
1988	249 <sup>d</sup>	900	5,820	1,170	1,025	660	9,824
1989	226 <sup>c,d</sup>	848	1,670	1,030	510	520	4,804
1990	67 <sup>b,d</sup>	540	1,500	590	450	610	3,757
1991	131 <sup>b,d</sup>	449	700	365	375	420	2,440
1992 <sup>e</sup>	260 <sup>b,d</sup>	821	1,260	855	750	815	4,761
1993	188 <sup>b,d</sup>	579	1,970	865	450	635	4,687
1994 <sup>e</sup>	233 <sup>b,d</sup>	1,741	2,225	1,005	2,530	1,490	9,224
1995	149 <sup>b,d</sup>	882	440	366	501	505	2,843
1996	76 <sup>b,d</sup>	1,079	1,200	403	<sup>f</sup>	<sup>f</sup>	2,758
1997	839 <sup>b,d</sup>	906	802	525	536	558	4,166
1998	458 <sup>b,d</sup>	1,411	883	1,230	352	438	4,772
1999	237 <sup>b,d</sup>	535	<sup>f</sup>	166	340	213	1,491
2000	26 <sup>b</sup>	425	<sup>f</sup>	314	339	246	1,350
2001	346 <sup>b,c,d</sup>	929	828	563	646	530	3,842
2002	618 <sup>b,c,d</sup>	1,121	430	472	586	408	3,635
2003	469 <sup>b,c,d</sup>	1,053	334	490	596	351	3,293
2004	309 <sup>b,c,d</sup>	1,640	1,176	1,069	470	374	5,038
2005	NA <sup>f</sup>	NA <sup>f</sup>	NA <sup>f</sup>	NA <sup>f</sup>	124 <sup>g</sup>	54 <sup>g</sup>	178
2006	53	195	- <sup>f</sup>	- <sup>f</sup>	2,100	201	2,549
2007	38	308	220	2	4,700	785	6,053
Average	262	861	1,341	638	915	516	4,073
2008		507	<sup>f</sup>	<sup>f</sup>	1,500	31	2,038

<sup>a</sup> Includes Figure-Eight, Goblet, Oldham, and Wandering creeks.

<sup>b</sup> Tower count plus later aerial survey counts of main river.

<sup>c</sup> Tower counts.

<sup>d</sup> Survey included Grassy Creek (tributary downstream of Ugashik Lagoon).

<sup>e</sup> Helicopter surveys.

<sup>f</sup> Flown but no estimate.

<sup>g</sup> New observer counts not reliable.

Appendix A11.—Aerial survey counts of chum salmon escapement, Ugashik District, 1988–2008.

Year	Ugashik River	Dog <sup>a</sup> Salmon River	King Salmon River	Painter Creek	Pumice Creek	Old Creek	Other	Total
1988	752 <sup>c,d</sup>	2,290	25,000	10,500	11,650	5,800	950	56,942
1989	600 <sup>c,d</sup>	1,005	7,500	3,700	2,200	2,010	625	17,640
1990	312 <sup>c,d</sup>	170	6,200	1,150	1,630	410	10	9,882
1991	315 <sup>c,d</sup>	240	7,400	750	2,550	2,525	130	13,910
1992 <sup>e</sup>	510 <sup>a,c,d</sup>	1,210	8,525	4,000	14,000	15,000	0	43,245
1993	93 <sup>c,d</sup>	105	7,000	720	2,040	1,025	8	10,991
1994 <sup>e</sup>	66 <sup>b,c</sup>	851	9,150	1,625	12,750	6,975	150	31,567
1995	6 <sup>b,c</sup>	160	3,900	1,370	2,600	1,800	0	9,836
1996	138 <sup>b</sup>	85	16,500	700	7,400	2,500	0	27,323
1997	100 <sup>b,c</sup>	450	10,500	4,200	5,300	9,480	115	30,145
1998	607 <sup>b,c</sup>	840	10,600	3,800	2,000	4,350	224	22,421
1999	278 <sup>b,c</sup>	400	<sup>h</sup>	650	1,660	2,020	50	5,058
2000	7 <sup>b</sup>	510	<sup>h</sup>	2,150	7,300	5,850		15,817
2001	78 <sup>b,c</sup>	1,140	8,100	6,000	13,500	7,800	200	36,818
2002	0 <sup>b,c</sup>	1,000	8,200	3,100	5,100	4,200	100	21,700
2003	142 <sup>b,c</sup>	1,130	5,500	8,000	4,000	3,000	50	21,822
2004	24 <sup>b,c</sup>	950	1,800	20,000	5,700	5,000	50	33,524
2005	NA <sup>g</sup>	NA <sup>g</sup>	NA <sup>g</sup>	NA <sup>g</sup>	1310 <sup>h</sup>	2030 <sup>h</sup>	NA <sup>h</sup>	3,340
2006	140	940	NA <sup>g</sup>	NA <sup>g</sup>	15,150	830	NA	17,060
2007	290	450	10,000	1	20,300	15500	NA	46,541
Average	235	733	9,117	4,023	6,907	4,905	166	23,779 <sup>f</sup>
2008		340	<sup>g</sup>	<sup>g</sup>	7,700	18,200		26,240

Note: Blank cells represent no data.

<sup>a</sup> Includes Figure-Eight, Goblet, Oldham, and Wandering creeks.

<sup>b</sup> State tower counts, Federal tower count was 5,700 in 2001, 870 in 2002, and 630 in 2003.

<sup>c</sup> Survey included Grassy Creek (tributary downstream of Ugashik Lagoon).

<sup>d</sup> Included tower count plus later aerial survey count.

<sup>e</sup> Helicopter surveys.

<sup>f</sup> Average of the sums of indices for all locations

<sup>g</sup> Flown but no estimate.

<sup>h</sup> New observer counts not reliable.

Appendix A12.—Aerial survey counts of pink salmon escapement, Ugashik District, 1988–2008.

Year	Number of Surveys <sup>a</sup>	Pink Salmon Count	Comments
1988	7	2,800	Peak count on August 23: 2,000 in King Salmon River
1989	8	50	Observed in Ugashik River on August 9
1990	5	2,000	Peak count on August 13
1991	0	660	Ugashik River tower count
1992 <sup>b</sup>	0	1,728	Ugashik River tower count
1993	0	0	
1994 <sup>b</sup>	0	425	Observed near Ugashik Lake Outlet on August 11
1995	0	36	Ugashik River tower count
1996	0	550	Observed in King Salmon River on August 12
1997	0	0	
1998	0	57	Ugashik River tower count
1999	0	6	Ugashik River tower count
2000	0	46	Ugashik River tower count
2001 <sup>c</sup>	0	708	Ugashik River tower count
2002 <sup>d</sup>	0	714	Ugashik River tower count
2003 <sup>e</sup>	0	156	Ugashik River tower count
2004	0	120	Ugashik River tower count
2005	0	0	
2006	0	0	
2007	0	0	
2008	0	0	

*Note:* Blank cells represent no data.

<sup>a</sup> Zero indicates no surveys designated to look for pink salmon and any observations recorded would be incidental to surveying for other species.

<sup>b</sup> Helicopter survey.

<sup>c</sup> Includes 66 from State tower count and 642 from Federal tower count.

<sup>d</sup> Includes 24 from State tower count and 690 from Federal tower count.

<sup>e</sup> Includes 66 from State tower count and 90 from Federal tower count.

Appendix A13.–Aerial survey counts of coho salmon escapement, Ugashik District, 1988–2008.

Year	Number of Surveys	Salmon Counts	Comments
1988	7	28,280	12,900 in King Salmon River on September 7
1989	4	11,515	7,615 observed on August 14
1990	5	12,610	
1991	0	400	Incidental observation made August 12
1992 <sup>a</sup>	0	790	Incidental observation made August 11
1993	0	705	Incidental observation made August 16
1994 <sup>a</sup>	0	760	Incidental observation made August 11
1995	0		
1996 <sup>b</sup>	1	8,275	Surveyed on September 27 and 28
1997 <sup>b</sup>	2	9,400	Surveyed on September 30 and October 17
1998 <sup>b</sup>	1	1,459	Surveyed on November 19
1999 <sup>b</sup>	1	10,210	Surveyed on October 14
2000 <sup>b</sup>	1	12,070	Surveyed on October 12
2001 <sup>b</sup>	1	4,540	Surveyed on September 27
2002 <sup>b</sup>	1	3,805	Surveyed on September 22
2003 <sup>b</sup>	1	19,670	Surveyed on September 21
2004 <sup>b,c</sup>	1	5,440	Surveyed on September 26
2005	1	9,850	Surveyed on September 20
2006	1	20,100	Surveyed on September 28
2007	1	1,102	Surveyed on September 11
2008	1	6,240	Surveyed on September 24

*Note:* Blank cells represent no data.

<sup>a</sup> Helicopter survey.

<sup>b</sup> Surveys are of selected areas in the Ugashik Lakes, King Salmon and Dog Salmon River drainages.

<sup>c</sup> In 2004 surveys of Painter, Old, and Pumice Creeks could not be completed; 5,360 coho were counted from the Ugashik Lakes area, which was the second highest count for this area in 9 years.

Appendix A14.–Spawner distribution and total escapement estimates of sockeye salmon, Wood River system, 1988–2008.

Year	Spawner Distribution (%)			Total Escapement <sup>a</sup>
	Creeks	Beaches	Rivers	
1988	31.0	44.4	24.6	866,800
1989	19.6	28.9	51.5	1,186,400
1990				1,069,400
1991			19.0	1,159,900
1992	24.9	56.7	18.4	1,286,300
1993	40.9	34.1	25.0	1,176,100
1994	25.5	36.4	38.1	1,471,900
1995	33.5	52.9	13.6	1,482,200
1996	25.8	39.3	34.9	1,649,600
1997	15.6	60.8	23.6	1,512,400
1998	20.0	66.2	13.8	1,755,800
1999				1,512,400
2000				1,300,000
2001				1,458,700
2002				1,283,700
2003				1,459,800
2004				1,543,400
2005	39.8	46.6	13.6	1,496,600
2006	12.5	55.0	32.5	4,008,100
2007	21.0	35.0	44.0	1,528,086
Mean	25.8	46.4	27.1	1,510,379
2008	21.0	9.0	70.0	623,162

*Note:* Blank cells represent no data.

<sup>a</sup> Estimated from Wood River tower counts. Rounded to the nearest hundred.

Appendix A15.–Aerial estimates of sockeye salmon escapements, Togiak District, 1988–2008.

Year	Togiak River & Tributaries <sup>a</sup>	Kulukak Systems <sup>b</sup>
1988	32,400	31,700
1989	19,800	10,800
1990	47,100	49,600
1991	23,700	23,900
1992	16,500	26,400
1993	15,900	31,800
1994	19,400	29,700
1995	25,500	14,600
1996	30,200	19,000
1997	20,600	8,000
1998	21,900	13,000
1999	40,200	12,300
2000	40,300	22,400
2001 <sup>c</sup>	6,700	17,000
2002	16,200	8,500
2003		8,000
2004	3,100	
2005	3,470	
2006		
2007		
1988-07 Mean (20 Year)	22,528	20,419
1988-97 Mean (10 Year)	25,110	24,550
1998-07 Mean (10 Year)	18,839	13,533
2008		

*Note:* All counts are rounded to the nearest hundred.

<sup>a</sup> Estimates do not include fish spawning above the counting tower (Togiak Lake outlet); estimates for Ungalikthluk, Osviak, Matogak, and Slug rivers are not included in the 1977–1994 data as reported in Bristol Bay Data Reports 73 and 81.

<sup>b</sup> Includes Kulukak River, Kulukak Lake, and Tithe Creek Ponds.

<sup>c</sup> Togiak count includes only the Togiak mainstem and Ongivinuk Rivers.

Appendix A16.–Aerial counts of live sockeye salmon, Togiak River drainage, 1988–2008.

Year	Togiak Mainstem	Gechiak River	Pungokepuk River	Narogurum River	Kashaiak River	Ongivinuk River	Total
1988	9,400	2,000	1,100	0	0	3,700	16,200
1989	7,600	1,500	630			150	9,880
1990	8,770	5,720	5,980	0	2,550	1,190	24,210
1991	7,990	1,640	1,220			1,010	11,860
1992	3,030	1,280	1,400			2,200	7,910
1993	2,300	1,270	540			2,950	7,060
1994	3,100	560	1,870			3,900	9,430
1995	3,260	1,745	1,000		4,200	2,330	12,535
1996	9,160	2,270	150	100	240	3,190	15,110
1997	8,200	1,600	450	50	650	2,800	13,750
1998	4,890	3,100	150	10	0	2,800	10,950
1999	5,400	11,275	1,475	100	75	6,700	25,025
2000	12,600	8,100	925	150	100	775	22,650
2001	3,260					100	3,360
2002	2,050	5,000	75	1,525	0	1,450	10,100
2003							
2004	3,050					50	3,100
2005	2,790	320	120	10	120	110	3,470
2006							
2007							
Mean	5,697	3,159	1,139	216	794	2,083	13,087 <sup>a</sup>
Percent	43.5	24.1	8.7	1.7	6.1	15.9	100.0
2008							

*Note:* Blank cells represent no data.

<sup>a</sup> Sum of means for all streams.

Appendix A17.–Aerial counts of live sockeye salmon, Togiak District, 1988–2008.

Year	Togiak River <sup>a</sup>	Kulukak River <sup>b</sup>	Tithe Creek Ponds	Quigmy River	Matogak River	Osviak River	Slug River	Negukthlik River	Ungalikthluk River	Total
1988	16,200	12,600	3,250	250	100	380	5,880	200	2,700	41,560
1989	9,880	2,920	2,500					5,000		20,300
1990	24,210	10,600	14,200	100	400	2,200	3,540	9,700	3,800	68,750
1991	11,860	8,650	3,320	35	860	2,530	560	3,400	2,650	33,865
1992	7,910	7,530	4,950	40	300	3,340	1,460	3,600	3,760	32,890
1993	7,060	9,600	6,300					3,100	5,680	31,740
1994	9,430	10,270	4,600	580	990	1,750	6,070	2,230	3,240	39,160
1995	12,535	3,000	4,310	200	610	1,470	2,820	390	1,720	27,055
1996	15,110	2,490	7,000		360	780	1,045	1,000		27,785
1997	13,750	2,300	3,000		360	780	1,045	1,000		22,235 <sup>c</sup>
1998	10,950	2,175	4,300	20	900	2,600	5,010	2,300	240	28,495
1999	25,025	3,250	3,200	1,100	2,400	750	1,400	1,625	625	39,375
2000	22,650	6,100	5,075	125	526	1,512	1,201	2,175	575	39,939
2001	3,360	5,140	3,500	160	370	210	4,620	740	2,340	20,440
2002	10,100	2,375	1,875	660	1,450	1,705	371	160	0	18,696
2003		900	4,136	110	500	2,180	2,330	1,500	2,580	14,236 <sup>c</sup>
2004	3,100			330	1,096	1,381	1,499	1,200	2,440	11,046
2005	3,470					1,485				4,955 <sup>c</sup>
2006										<sup>c</sup>
2007										
Mean	12,153	5,619	4,720	285	748	1,566	2,590	2,313	2,311	32,304 <sup>d</sup>
Percent	37.6	17.4	14.6	0.9	2.3	4.8	8.0	7.2	7.2	100.0
2008										

*Note:* Blank cells represent no data.

<sup>a</sup> Includes all surveyed sections of Togiak River proper and all tributaries to the Togiak River.

<sup>b</sup> Includes surveys of Kulukak Lake. Counts prior to 1977 include Kulukak Lake only and are not included in the mean.

<sup>c</sup> Complete count not available.

<sup>d</sup> Sum of means for all streams.

Appendix A18.–Aerial counts of live Chinook salmon, Togiak River drainage, 1988–2008.

Year	Togiak River Section <sup>a</sup>						Gechiak River	Pungokepuk River	Nayorurun River	Kemuk River	Ongivinuk River	Total
	A	B	C	D	E	F						
1988	70	70	160	160	170	710	390	180	60	70	90	2,130
1989	10	30	370			940	190	80			40	1,660
1990	230	170	680	365	805	1,085	370	125	75	400	10	4,315
1991	505	165	475	225	520	455	460	105	90	100	150	3,250
1992	150	250	440	225	450	690	250	160	70	175	105	2,965
1993	170	120	220	160		1,810 <sup>b</sup>	595	240	130	65	440	3,950
1994				215	815	1,580	420	215	225	570	380	4,420
1995	120	220	750	255	800	800	715	140	425	520	295	5,040
1996	75	150	160	100	255	625	335	120	120	235	325	2,500
1997	100	350	1,300	600	820	1,000	275	180	150	275	100	5,150
1998	10	20	250	50	400	1,200	400	150	275	140	275	3,170
1999	150	210	540	510	225	480	365	90	240	305	270	3,385
2000	75	50	500	400	850	1,450	350	85	125	100	75	4,060
2001	610	500	500	200	300	950	700	270	550	1,050	160	5,790
2002	140	410	820	250	390	690	400	45	65	210	125	3,545
2003				180	265	495			115	100	135	1,290
2004	198	549	1,044	603	657	1,598	90	320	666	239	198	6,162
2005	117	414	927	576	635	1,139	144	170	360	265	347	5,094
2006												
2007												
Mean	171	230	571	298	522	983	379	157	220	283	196	4,011 <sup>c</sup>
Percent	4.3	5.7	14.2	7.4	13.0	24.5	9.5	3.9	5.5	7.1	4.9	100.0
2008	125	200	200	150	1,050	400		50			200	2,375

Note: Blank cells represent no data.

<sup>a</sup> Section A: Togiak Bay - Gechiak River  
 Section B: Gechiak River - Pungokepuk River  
 Section C: Pungokepuk River - Nayorurun River

Section D: Nayorurun River - KASHAIK River  
 Section E: Kemuk River - Ongivinuck River  
 Section F: Ongivinuck River - Togiak Lake

<sup>b</sup> Includes count for Section E.

<sup>c</sup> Sum of means for all streams.

Appendix A19.–Aerial counts of live Chinook salmon, Togiak District, 1988–2008.

Year	Togiak River <sup>a</sup>	Quigmy River	Kulukak River	Matogak River	Osviak River	Slug River	Negukthlik River	Ungalikthluk River	Total
1988	2,130	10	490	0	40	0	650	170	3,490
1989	1,660		740				560		2,960
1990	4,315	30	635	75	60	0	930	25	6,070
1991	3,250	25	285	75	100		1,175	55	4,965
1992	2,965	15	485	40	105	30	490	35	4,165
1993	3,950		1,140	80	110	100	830	70	6,280
1994	4,420	20	835	40	60	10	540	190	6,115
1995	5,040	35	430	65	135	50	740	80	6,575
1996	2,500	35	698	35	71	30	402		3,771
1997	5,150	10	310	50	65	33		10	5,628
1998	3,170	45	375	92	58	39	75	25	3,879
1999	3,385	10	240	105	40	150	345	130	4,405
2000	4,060	26	340	65	42	6	1,100	226	5,865
2001	5,790	24	330	58	84	2	201	74	6,563
2002	3,545	28	860	54	62	7	1,203	161	5,920
2003	1,290	17	360	28	99	66	466	40	2,366
2004	6,162	4	594	17	63	15	720	60	7,635
2005	5,094	16	447	133	202	90	255	396	6,633
2006		15		140	680				835
2007									
Mean	3,771	21	533	64	115	39	628	109	5,281 <sup>b</sup>
Percent	71.4	0.4	10.1	1.2	2.2	0.7	11.9	2.1	100.0
2008	2,375								2,375

*Note:* Blank cells represent no data.

<sup>a</sup> Includes all surveyed sections of Togiak River proper and all tributaries to the Togiak River.

<sup>b</sup> Sum of means for all streams.



Appendix A21.–Aerial counts of live chum salmon, Togiak District, 1988–2008.

Year	Togiak River <sup>a</sup>	Quigmy River	Kulukak River	Matogak River	Osviak River	Slug River	Negukthlik River	Ungalikthluk River	Total
1988	34,900	10,800	35,000	12,000	17,400	7,600	400	11,300	129,400
1989	19,990	2,820	5,580	7,450	4,900		560		41,300
1990	18,150	555	5,550	1,475	2,300	3,650	750	1,300	33,730
1991	39,580	4,420	9,540	4,730	8,700		120	3,020	70,110
1992	22,700 <sup>b</sup>	600	4,800 <sup>b</sup>	4,400	7,100	1,700	100	4,000	45,400
1993	27,660		6,950	1,970	1,360	3,060	20	4,020	45,040
1994	33,900	890	10,700	1,630	2,000	4,360	230	1,090	54,800
1995	138,600	2,200	7,600	5,200	13,920	6,440	1,000	7,200	182,160
1996	42,950	960	7,560	560	810	2,670	40		55,550
1997	39,650	1,700	4,550	3,000	2,500	1,890			53,290
1998	30,550	2,630	2,700	4,980	3,870	1,060	150	1,300	47,240
1999	23,055	1,340	3,430	5,700	3,650	4,750	410	11,360	53,695
2000		2,870	4,950	9,090	10,880	4,150	200	5,520	37,660
2001	75,600	2,590	22,300	2,840	2,220	5,570	220	5,480	116,820
2002	31,150	3,300	15,400	7,600	6,360	800	530	6,940	72,080
2003	4,125 <sup>c</sup>	720	3,425	1,340	3,480	1,030	30	4,970	19,120
2004	39,958	1,080	5,831	2,310	1,970	416	100	250	51,915
2005	5,233	8,100	790	17,200	15,300	1,350	1,760	4,440	54,173
2006		5,200		3,720	4,530				13,450
2007									
Mean	38,977	2,932	8,703	5,116	5,961	3,156	389	4,813	70,046 <sup>d</sup>
Percent	55.6	4.2	12.4	7.3	8.5	4.5	0.6	6.9	100.0
2008	139,790								139,790

Note: Blank cells represent no data.

<sup>a</sup> Includes all surveyed sections of Togiak River proper and tributaries to the Togiak River.

<sup>b</sup> Preferred estimate from a management survey due to post-peak spawning ground survey.

<sup>c</sup> Partial aerial survey data.

<sup>d</sup> Sum of means for all streams.



Appendix A23.–Aerial counts of live coho salmon, Togiak District, 1988–2008.

Year	Togiak River <sup>a</sup>	Quigmy River	Kulukak River	Matogak River	Osviak River	Slug River	Negukthlik River	Ungalikthluk River	Total
1988	8,590	460	1,840	310	490	470	370	3,170	15,700
1989									
1990	7,130	1,029	5,195	2,675	1,491	810		4,153	22,483
1991	140		4,200						4,340 <sup>b</sup>
1992	26,700		12,640						39,340
1993									
1994									
1995		855	1,185	1,392	1,080	1,149		5,196 <sup>c</sup>	10,857
1996	21,660	1,211	10,290	3,062	2,805	1,944	851	5,917	47,740
1997	6,875	325	1,675	150	1,046	1,397		1,690	13,158
1998	8,445	390	3,650	1,785	2,001	523		2,770	19,564
1999	1,185	169	500	220	213	117	95	450	2,949
2000									
2001		149		372	370	418			1,309
2002		421		597	539	62		1,027	2,646
2003		680	1,610	1,620					3,910
2004									
2005									
2006			1,539						1,539
2007									
Mean	10,091	569	4,029	1,218	1,115	766	439	3,047	21,273 <sup>d</sup>
Percent	47.4	2.7	18.9	5.7	5.2	3.6	2.1	14.3	100.0
2008									

Note: Blank cells represent no data.

<sup>a</sup> Includes all surveyed sections of Togiak River proper and tributaries to the Togiak River.

<sup>b</sup> Timing of aerial surveys did not coincide with the period of peak spawning activity, and therefore, counts were not included in the mean or percent.

<sup>c</sup> Negukthlik and Ungalikthluk rivers combined.

<sup>d</sup> Sum of means for all streams.