

**SALMON SPAWNING GROUND SURVEYS  
IN THE BRISTOL BAY AREA, ALASKA, 1998**



by

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## INTRODUCTION

Aerial surveys of salmon spawning streams have been conducted in the Bristol Bay area of Alaska (Figure 1) for many years. Surveys provide biologists with information regarding the 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 important 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 data has been used to: (1) evaluate escapement goals and escapement/return relationships, (2) forecast future returns, (3) identify possible management problems relating to escapements, and (4) contribute to strategies designed to alleviate escapement problems. This report summarizes the 1998 salmon spawning ground surveys conducted in the Bristol Bay area.

### *Naknek/Kvichak District*

Naknek-Kvichak District is comprised of three major rivers: (1) the Kvichak River, issuing from Iliamna Lake and its tributaries, (2) the Alagnak or Branch River flowing from Kukaklek and Nonvianuk Lakes, and (3) the Naknek River emanating from Naknek Lake and its tributaries (Figure 2). All of these systems flow into Kvichak Bay.

Since 1955, Kvichak River sockeye salmon escapements have been estimated using counting towers located on the mainstem river, approximately one quarter mile downstream of Lake Iliamna's outlet. From 1957 to 1976, Alagnak River sockeye escapements were estimated using a counting tower located near the upper extent of tidal influence. Since 1977, all Alagnak sockeye escapements have been estimated using aerial surveys. From 1950 to 1957, sockeye escapements to the Naknek River system were counted using a weir on the mainstem river just upstream of the tidal influence. From 1958 to the present, escapements have been estimated using counting towers near the Naknek River 'Rapids' downstream of the outlet of Naknek Lake. Escapements of other salmon species into Naknek-Kvichak District drainages have been estimated using aerial surveys.

### *Egegik District*

Egegik River system contains two major watersheds: (1) the Egegik River, emanating from Becharof Lake and nearby coastal lowlands, and (2) the King Salmon River, issuing from runoff from the Kejulik Mountains and southern portions of Katmai National Park (Figure 3). Both rivers flow into Egegik Bay near the village of Egegik.

From 1952 through 1956, a weir was used in the Egegik River to count sockeye salmon escapements. The weir was located near the base of the Egegik River 'rapids'. From 1957 to the present, counting towers situated between the outlet of Becharof Lake and Egegik Lagoon have been used to estimate sockeye escapements. Escapements for other salmon species have been estimated using aerial surveys.

### *Ugashik District*

The Ugashik River system consists of four major watersheds: (1) the Ugashik River, flowing from Lower Ugashik Lake and nearby coastal lowlands, (2) the Dog Salmon River, emanating from glacial melt and runoff from peaks in the Aleutian Range, (3) the King Salmon River, issuing from Mother Goose Lake and three major runoff tributaries, and (4) Dago Creek, emitting from a large lowland coastal area (Figure 4). All of these systems flow into the intertidal reaches of Ugashik River and Ugashik Bay.

From 1949 to 1956, a weir located downstream from the outlet of Lower Ugashik Lake was used to count sockeye salmon escapements. From 1957 to the present, sockeye escapements have been estimated using counting towers located between the outlet of Lower Ugashik Lake and Ugashik Lagoon. Escapements for other salmon species have been estimated using aerial surveys.

### *Nushagak District*

Nushagak watershed is comprised of four major rivers: (1) the Wood River, draining Grant, Kulik, Beverley, Nerka, and Aleknagik Lakes, (2) the Nushagak River, draining Tikchik Lakes and the Nuyakuk, upper Nushagak, and Mulchatna Rivers, (3) the Igushik River, draining Ualik and Amanka Lakes, and (4) the Snake River, draining Lake Nunavaugaluk (Figures 5 through 8). All of these systems empty into Nushagak Bay.

Abundance and age composition of sockeye salmon escapements in the Wood River Lake system has been estimated annually from counting towers at the outlet of Lake Aleknagik since 1953.

Sockeye salmon distribution in the Wood River Lake system is an important element in establishing escapement goals and measuring success in achieving escapement goals for this system. Interconnecting rivers between the large lakes in the system are primarily used by three-ocean sockeye for spawning, while the lake beaches and tributary streams are used more by two-ocean sockeye. Knowledge of the age composition of returning sockeye gives managers the ability to use a variable escapement goal policy to minimize overcrowding of spawners in the interconnecting rivers while taking advantage of the extensive beach spawning areas and numerous tributary streams.

ADF&G staff conduct aerial surveys to assess sockeye spawner distribution within the Wood River Lake system each year. Personnel from the University of Washington, Fisheries Research Institute also conducted ground surveys on major creeks and some rivers of the system. Surveys of the actual spawning distribution within the creeks, rivers, and beaches of the system provide a measure of management success in obtaining the desired spawning distribution.

Salmon escapement in the Nushagak River is estimated by a sonar project, located on the Nushagak River below Portage Creek, approximately 32 km (20 miles) upstream from the river mouth. The Nushagak River sonar project has been used since 1980 to estimate annual escapements for all salmon species in the entire Nushagak drainage (Miller 1997). Prior to the advent of the sonar project, sockeye escapement was estimated by a counting tower project on the Nuyakuk River

(1959-1988). Aerial surveys of the Nushagak-Mulchatna system were conducted annually beginning in 1966. Initial surveys provided escapement estimates for chinook and chum salmon, and surveys in the Nushagak and Mulchatna systems since 1977 were used to estimate sockeye abundance in that system. Together, the combined estimates from counting towers and aerial surveys were used by fishery managers as estimates of the Nushagak River drainage sockeye escapement.

ADF&G staff continued to survey 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 surveys of the Nushagak-Mulchatna Rivers for all other species were discontinued in 1991 due to the success of the sonar project and limited funding. After terminating the Nuyakuk tower project in 1988, and terminating surveys of the Nushagak and Mulchatna systems in 1991, little information was available to assess sockeye spawning distribution in the Nushagak River.

Aerial surveys were conducted sporadically in the Tikchik Lakes system from 1954 to 1987 to assess spawner distribution of sockeye salmon. Surveys of the Tikchik Lakes were conducted sporadically since 1990 to document an apparent change in spawner distribution, evidenced by changes observed in the age composition of Nushagak River sockeye escapement, and supported by reports of low numbers of spawners in the Tikchik Lake system. These surveys have documented lower than expected numbers of spawners in the Tikchik Lakes system, based on sonar estimates in the lower Nushagak River and historical distribution patterns (Brookover et. al. 1996). However, few corresponding surveys were conducted in the Nushagak and Mulchatna drainages to completely assess distribution. With the assistance of Fisheries Research Institute personnel, the counting tower project on the Nuyakuk River was re-initiated beginning in 1995 in order to assess recent distribution and production trends in the Nushagak drainage. However this project funding is in jeopardy and it will likely not operate after the 1999 season.

Sockeye escapement is measured in the Igushik Lakes system at a counting tower located at the outlet of Amanka Lake. Spawner distribution has not been documented annually, and 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 by aerial surveys, but funding was not available for these surveys from 1991 through 1994.

### *Togiak District*

Togiak District includes two major river drainages: (1) the Togiak River, draining Togiak, Gechiak, Pungokepuk, and Ongivinuck Lakes and Nayorurun and Kemuk Rivers (Figure 9), and (2) the Kulukak River, draining Kulukak Lake (Figure 10). Various smaller systems within the district include the Tithe Creek Ponds and the Quigmy, Matogak, Osviak, Slug, Negukthlik, and Ungalikthluk Rivers. Kulukak River and the Tithe Creek Ponds 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 sockeye salmon in the Togiak River and tributaries below the counting towers, as well as other systems within the Togiak District, are estimated by aerial surveys. Abundance and distribution of chinook, chum, pink, and coho salmon spawning in Togiak District watersheds are also estimated entirely from aerial surveys.

Since 1991, the operational budget has not had sufficient funds to conduct spawning ground aerial surveys in the Togiak District. However, the USFWS and Togiak National Wildlife Refuge has provided some additional funding for aircraft charters for aerial surveys in the District to monitor salmon populations on the refuge drainages.

## METHODS

All survey flights were conducted from small fixed-wing, high-wing, wheeled aircraft (Super Cub, Cessna 180, Cessna 185, or Cessna 206) or helicopter (Robinson R-22) chartered from local air charter companies and flown by experienced survey pilots. Several surveys in the Togiak National Wildlife Refuge were flown by USFWS pilots and aircraft. Salmon were counted by Alaska Department of Fish and Game (ADF&G) or USFWS biologists familiar with the streams and target species. Counts were made from low altitudes (200 to 400 feet) at air speeds of 50 to 90 mph. Polarized sunglasses and aircraft positioning were used to minimize effects of glare off the water. Surveys were scheduled to coincide as closely as possible to the historic peak of spawning for the target species, taking into account weather, water conditions, and aircraft availability. Peak of spawning was defined as that point when the greatest number of spawning salmon are occupying redds. Counts were registered on a hand tally counter or on a tape player. This information was transferred to survey data forms either sometime during the survey or upon returning to the office.

Aerial surveys account for only a portion of the known spawning populations (Evzerof, 1975; Nielson and Green, 1981; Rogers, 1984). At the time of each survey, some of the salmon have yet to reach the spawning grounds, some have already spawned and died, some are still schooled, and some are either misidentified or not seen. Methods used to interpret aerial survey counts are described below for each commercial fishing district.

### *Naknek/Kvichak District*

Aerial surveys were flown during late summer and fall to assess escapements of sockeye, chinook, and chum salmon in portions of the Naknek-Kvichak District. Salmon counts for these drainages are indices of the total number of each species present in the spawning area at the time of the survey. Two surveys were flown, August 12 and 15, to provide estimates of Alagnak River drainage sockeye, chinook, and chum escapements. Additionally, all major chinook spawning areas in the Naknek River drainage were surveyed on August 18, and the Kvichak River chinook

escapement survey was flown August 14. These survey counts were not expanded to provide instantaneous population estimates, although expansions have been made in some earlier years based on subjective criteria.

Counting towers were used to estimate total sockeye salmon escapements to the Kvichak and Naknek Rivers. A late summer survey of sockeye salmon spawning distribution in the Kvichak River system was completed August 14, 15, and 17. Late season coho salmon surveys were completed September 29 and 30 on the Alagnak River drainage and the Naknek River drainage. All aerial survey counts in the district were made by ADF&G, Commercial Fisheries Division staff.

### *Egegik District*

No system-wide aerial surveys were flown for sockeye salmon in 1998. Aerial surveys of all known chinook and chum salmon spawning areas in both the Egegik and King Salmon Rivers were flown on August 6. With funding provided by the U.S Fish and Wildlife Service (USFWS), an aerial survey was flown on September 28 to estimate coho escapements. In addition, a weir was operated on Gertrude Creek by USFWS from April 14 to September 17. All aerial survey counts in the Egegik drainage reflect only the actual numbers of salmon sighted and should be considered a minimum indication of abundance.

### *Ugashik District*

Salmon counts in the Ugashik District reflect the actual numbers of salmon sighted on the spawning grounds for 1998. Aerial surveys of known chinook and chum salmon spawning areas in the Ugashik drainage were flown on August 15. With funding provided by the Alaska Department of Fish and Game, an aerial survey was flown on November 19 to estimate coho salmon escapement. The timing of this survey was about a month later than the preferred time due logistic problems and other work assignments that took priority over coho escapement surveys. Aerial survey counts should be considered a minimum indication of total abundance.

### *Nushagak District*

Aerial surveys were conducted to assess spawning distribution of sockeye salmon in the Wood River system in 1998. Survey methods and data analysis for the Nushagak District were similar to those described by Nelson (1979), Bucher (1981), and Russell, Bill and Bucher (1990).

Sockeye salmon escapements for each spawning stream, beach, or, river in the Wood River System have been estimated using aerial survey results expanded by the proportion of sockeye observed at a given location in relation to the tower count. Different expansion factors were assigned to each type of spawning habitat. For a more detailed description of the analysis of Wood River survey counts, see Nelson (1973).

### *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). Aerial surveys of spawning sockeye, chinook, chum, and coho salmon were conducted at the peak of spawning for each species, using criteria similar to Nelson (1979) and Bucher (1981). Primarily, ADF&G staff conducted surveys, with some counts provided by USFWS Togiak National Wildlife Refuge staff.

Peak aerial survey counts for sockeye salmon in the Togiak Lake system above the counting tower have generally accounted for 47% (range: 40% - 50%) of the escapements estimated at the tower (Nelson 1967). Therefore, to estimate total escapement, peak aerial counts of sockeye salmon in systems without counting towers were multiplied by 2.0 (i.e. Kulukak River, mainstem and tributaries of the Togiak River below the towers). 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. During the 1998 surveys, due to high and turbid water conditions in the Togiak River mainstem, a factor of 3.5 was applied. In the tributaries to the Togiak River and the smaller systems in the western portion of the district where conditions were average, the standard factor of 2.5 was used. Since 1968, escapement for chum salmon has been calculated by aerial counts using a multiplier of 2.0 (Nelson 1968). Since 1978, total pink salmon escapements have also been estimated by multiplying aerial counts by 2.0. 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 adjusted 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 conducted on August 12 and 15. The sockeye salmon escapement index count totaled 252,200 for this system (Table 1). This count was slightly above the average (1955-1998) aerial count of 242,000 (Appendix Table 1), and was approximately 18% greater than the escapement point goal of 185,000.

Aerial surveys of chinook salmon escapements into the Naknek River drainage were flown on August 18. Chinook salmon escapement counts were made in each of the four main spawning areas: mainstem Naknek River, Big Creek, King Salmon Creek, and Paul's Creek. A total of 5,505 chinook salmon were counted. The largest components of this total were counts of 2,085 chinook in Big Creek on August 18, and 2,150 chinook in the mainstem Naknek River on August 18 (Table 2). Over the period from 1970-1998 there have been 19 years in which chinook salmon escapement indices have been obtained from all four main spawning areas (Appendix Tables 2-6). The chinook

escapement index for these 19 years has ranged from a low of 2,691 in 1992 to a high of 11,730 in 1988.

Alagnak River drainage chinook salmon escapement was surveyed on August 12, yielding a count of 4,148 fish (Table 2). From 1970-1998, Alagnak chinook salmon counts have ranged from a low of 824 in 1973 to a high of 15,210 in 1997 (Appendix Table 7). An aerial survey of chinook salmon escapement into the Kvichak River was conducted on August 14 and resulted in an average count of 187 fish (Appendix Tables 8 and 9).

Chum salmon were counted only during the August 12 Alagnak River aerial surveys. Alagnak River has been the principal chum salmon producing system in the Naknek-Kvichak District (Appendix Table 10). A total of 3,150 spawning chum salmon were observed during the 1998 survey. The low count was due to poor survey conditions and the inherent difficulty in seeing chum salmon in this system.

Pink salmon were not counted during 1998 aerial surveys. Historical pink salmon escapement surveys can be found in Appendix Tables 11-13.

### *Egegik District*

The 1998 Egegik River sockeye escapement past the counting towers totaled 1,110,888 fish, or 4% above the mid-range objective of 1.1 million. The BEG range for Becharof Lake is 800 thousand to 1.4 million. Fifty additional sockeye salmon were observed on a post season aerial survey in Contact Lake.

Aerial survey counts of known chinook salmon spawning areas in the Egegik drainage yielded a total count of 1,063 chinook salmon (Table 3). There were no additional chinook salmon counted past Egegik River counting towers. This total was 10% below the average count of 1,185 (Appendix Table 14). Compared to the Gertrude Creek Weir count of 1,437 chinook salmon through August 6, the aerial survey count of 320 was only about 22% of the actual population. The commercial chinook harvest in the Egegik District totaled approximately 750 fish, or 74% below the 1978 to 1997 average harvest of 2,850. Fishing time was reduced to three days per week between June 1 and June 16, compared to a four day per week schedule in past seasons. The lack of sockeye abundance resulted in much less fishing time in general. Using gillnets with larger than 5.5 inch mesh in the commercial fishery from June 1 to July 1 was prohibited. All three of these factors probably contributed to the passage of chinook salmon through the commercial fishing district. Given the catch and escapement figures above, the Egegik chinook salmon removal rate for 1998 was probably around 41%.

The chum salmon escapement index was 2,580 fish (Table 4). The 1998 index was well below the 1982-1997 average of 8,990 fish (Appendix Table 15). The 1998 commercial chum harvest from the Egegik District totaled approximately 25,600 fish, or 75% below the 1978 to 1997 average catch of 102,000. Escapement indices of less than 10,000 chum salmon have been recorded in each of the last ten years. However, aerial surveys for chum salmon are not reliable indicators and it is believed that chum escapement indices documented over the last several years, by airplanes, have

probably greatly under estimated chum salmon escapements (Browning et.al. 1998). A comparison of the Gertrude Creek Weir count through Aug. 6 and an aerial count on that same day shows that the aerial count revealed only about 8% of the actual population; 820 for the aerial count compared to 10,648 for the weir count. The total weir count for chum salmon in 1998 was 11,612 fish.

No pink salmon were noted during the August 6 aerial survey, but the Gertrude Weir count was 2,487. A total of 606 pink salmon were reported from the commercial catch. The 1974 to 1998 pink salmon escapement indices are listed in Appendix Table 16.

The coho salmon escapement was documented with an aerial survey on September 28 (Table 5). Due to logistic problems and the prioritization of other work responsibilities, only one survey was flow in 1998. Funding for this survey was provided by the U.S. Fish and Wildlife Service in King Salmon. A combined total of 6,075 coho salmon were counted in the King Salmon and Egegik Rivers and in numerous tributaries of Becharof Lake. Of this total, approximately 5,125 fish were counted upstream of the Egegik River counting towers and 950 were counted at the Gertrude Creek Weir before it was pulled on September 17. The aerial counts were focused on main coho salmon producing areas, which are listed in Table 5. Compared to the last three years, the total count above the Egegik River counting towers for 1998 was about average. The commercial harvest totaled approximately 30,000 fish, which was 21% below the 1978 to 1997 average of 38,000. Deliveries occurred through September 3, though officially the fishery was open until September 30. Historical survey counts are listed in Appendix Table 17.

### *Ugashik District*

The 1998 sockeye salmon escapement past Ugashik River counting tower was approximately 890,500 fish, or 5% above the mid-range objective of 850,000. No system-wide aerial surveys were conducted due to a lack of funding, however; an additional 6,900 and 27,400 sockeye salmon were counted in the Dog Salmon and King Salmon Rivers, respectively, during a chinook and chum salmon survey (Table 6).

Chinook salmon escapement surveys of Dog Salmon, King Salmon, and Ugashik Rivers were flown on August 15 and yielded a count of 4,750 fish. Additionally, 18 chinook salmon were counted past the counting towers bringing the cumulative escapement count to about 4,770 (Table 7). The Painter Creek count of 1,230 was the largest escapement component for the system. The 1998 escapement count was 2% above the 1980 to 1997 average count of 4,667 chinook salmon (Appendix Table 18). The Ugashik District's commercial catch of approximately 350 chinook was 91% below the average harvest of 3,900. Overall, the 1998 Ugashik chinook run was estimated to be below average.

Aerial surveys of Dog Salmon, King Salmon, and Ugashik Rivers on August 15, yielding a count of 22,400 chum salmon (Table 8). The survey was considered to be near the peak of spawning as most fish were observed on redds. The 1998 aerial count was 31% below the 1980 to 1997 average of 32,400 (Appendix Table 19). The District's commercial chum salmon harvest was approximately 9,700 fish, and was well below the 1978 to 1997 average of 71,500.

The Ugashik pink salmon returns have historically been very small, and this year, again, was no exception. A total of 250 pink salmon were reported in the commercial catch. However, fishing only a total of 12 hours during the emergency order (EO) period from June 23 to July 27 was most likely a reason for the lack of pink salmon, as well as chinook and chum salmon, in this year's harvest. No pink salmon were observed on the escapement survey flown on August 15, and only 57 were counted past the tower before it ceased operation on July 30 (Appendix Table 20).

Aerial surveys for coho salmon were again made this year in the Ugashik drainage and are listed in Table 9. Again, because of logistic problems and assignment priorities only one survey, on November 19, was flown this year. This survey was about a month later than the optimum time for documenting coho escapement and consequently it was probably too late to be of much significance. A total of approximately 1,500 coho salmon were observed most of which came from the Painter Creek in the King Salmon River drainage. Daily commercial coho catch statistics for set net gear was about average and the district remained on the four day per week fishing schedule for the season. The coho harvest of approximately 13,300 fish was about half the average. Historic coho salmon escapement data is recorded in Appendix Table 21.

### *Nushagak District*

Spawning ground surveys for Chinook salmon have been flown sporadically in the Nushagak District for the last several years due to budgetary shortfalls. The Portage Creek sonar counting project produced an apportioned estimate of 117,495 Chinook salmon in the Nushagak River for 1998. Water levels were high and turbid. Due to counting problems in 1997 associated with unusually high water temperatures and low flows, additional mid-river sampling was conducted this season to investigate possible chinook migration routes outside the sonified portion of the water column. Aerial surveys were flown July 29 in the Upper Nushagak, August 10 and 11 in the lower Nushagak and Mulchatna River systems. Survey conditions were marginal due to high, turbid water conditions and late timing relative to the peak of spawning. However, survey results indicated spawning populations commensurate with the sonar estimate.

Spawning escapement of sockeye salmon in the Wood River system was estimated to be 1.75 million fish - 46% over the upper end of the 700 thousand to 1.2 million escapement goal range. Two-ocean sockeye comprised approximately 74% of the Wood River escapement while three-ocean sockeye contributed the other 26% of the escapement; hence Wood River was managed for the 1.2 million end of the escapement goal range. Poor sockeye run strength in the Nushagak and Igushik Rivers necessitated conservative management of the Nushagak District commercial fishery in 1998. Management staff had to implement new strategies for regulating escapement into the three Nushagak District rivers due to the new Bristol Bay Allocation Plan and the modified Wood River Special Harvest Area Plan. Complicating implementation of these management plans was an unprecedented surge of sockeye escapement (> 1,000,000 fish in 48 hours) and high water. Balancing a strong sockeye return to the Wood River with weak returns to the Nushagak and Igushik Rivers was the management strategy, and this led to the large escapement in the Wood River system in 1998.

Aerial surveys were flown on August 14, 25 and on September 2 on the Wood River Lakes drainage. The distribution of observed spawning sockeye salmon in 1998 was predominately in the beach habitat (Table 10, Appendix Table 22). Most spawning was observed on the lake beaches, followed by creeks and rivers. Creek spawning surveys were flown slightly after peak spawning had occurred, while the surveys conducted on the rivers and lake beaches were slightly prior to the peak. Large schools of sockeye salmon were observed in deeper water offshore when the beach surveys were being flown. The Wood River was not surveyed in 1997 or 1998. A live count (Table 10) was calculated for the Wood River using previous data from the river's average annual contribution.

Aerial survey estimates, for even numbered years, of pink salmon spawning escapements in the Nushagak District are listed in Appendix Table 23.

### *Togiak District*

Peak aerial counts and total population estimates were derived from aerial surveys for sockeye salmon in major river systems of the Togiak District in 1998. (Table 11). The expanded aerial survey estimate of 21,900 sockeye salmon for the Togiak River and its tributaries below the counting tower was 18.5% below the 1978-1997 average of 26,881 fish (Appendix Table 24). Escapement past the counting tower was 153,576 sockeye, 2.4% over the escapement goal of 150,000. The spawning escapement of sockeye salmon in Kulukak Section, including Kulukak River, Kulukak Lake, and Tithe Creek Ponds, was estimated at 12,950 fish, only 53% of the 1988-1997 average of 24,550. Peak aerial sockeye salmon counts into the mainstem portion of the Togiak River, the Pungokepuk, Nayorurun and Kemuk were below the 1978-1997 average (Appendix Tables 25 and 26), while counts for the Gechiak and Ongivinuck tributaries to the Togiak River were above average. Total sockeye salmon escapement for Togiak District was 214,626 fish. Due to weather, surveys were conducted after the peak of spawning on several systems, while the majority of systems were surveyed at peak spawning levels in the Togiak and Kulukak River drainages.

Aerial surveys for peak live counts and expanded escapement estimates for Chinook salmon were conducted in all the major drainages within the Togiak District for 1998 (Table 12). The expanded escapement estimate for Togiak District was 11,666 Chinook salmon. The 1998 district-wide chinook escapement was 18% below the 1992-1997 average of 14,202 fish (ADF&G, 1998). The aerial peak live count for the Togiak River and tributaries was 22% below the 1978-1997 average, and aerial counts for all chinook systems in the Togiak District combined were 39% below the 20-year average (Appendix Tables 27 and 28). The escapement goal of 10,000 Chinook salmon into the Togiak River was virtually achieved with an expanded spawning estimate of 9,856 fish. Chinook peak aerial counts for smaller river systems within the district were all below average with the exception of Quigmy River. Kulukak River escapement estimate (375 chinook) was poor and comprised only 37% of the 1978-1997 average.

Conditions and timing were fair to poor for most of the Chinook salmon systems surveyed. A standard multiplier of 2.5 was applied to most of the aerial counts including the tributaries to the Togiak River, however, due to high, turbid water conditions in the mainstem Togiak River, a 3.5

multiplier was used to compensate for poor visibility. The Negukthlik survey conditions were also poor due to turbid water; thus a factor of 3.0 was used. Surveys for streams west of Togiak River, Negukthlik and Ungalikthluk Rivers were flown in conjunction with USFWS.

Chum salmon escapement was poor in the entire Togiak District, and was estimated to be 102,455 (Table 13). The 1998 estimate is 53% below the 1978-1997 average (220,018 chum) reported by ADF&G (1998). Peak counts of chum salmon were well below the 1978-1997 average in all streams surveyed within the Togiak District (Appendix Tables 29 and 30). Pink salmon counts (for even years only) were slightly (9%) above the long-term average (Appendix Table 23).

Chum salmon counts were conducted coincidentally with the Chinook salmon surveys. Survey timing was generally post-peak for spawning activity. Significant numbers of chum salmon carcasses were observed in all rivers surveyed. However, a multiplier of 2.0 was still used.

Aerial surveys yielding peak live counts and expanded escapement estimates for coho salmon were successfully completed for most major systems in Togiak District for 1997. Total coho escapement for Togiak River and tributaries was estimated to be 25,335 fish (Table 14). This was 40% below the 1980-1997 average of 42,162 fish. Potentially, the escapement could have been much higher, but illegal commercial coho fishing was observed in-river this year. District-wide coho escapement counts were 16% below the average for the same period (Appendix Tables 31 and 32). Coho salmon appeared to be mostly on spawning beds with few schools observed, and no carcasses were visible, indicating that the survey was probably at or near the peak of spawning activity.

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Table 1. Aerial survey counts of sockeye salmon, Alagnak River system, 1998<sup>1</sup>

Location	Number of Fish	Percent of Total
Nonvianuk River		0
Nonvianuk Lake		0.0
Kulik River	14,100	5.6
Kulik Lake		0.0
Alagnak River	0	0.0
Kukaklek Lake		0.0
Nanuktuk Creek	29,900	11.9
Battle River	16,900	6.7
Battle Lake		0.0
Spectacle Creek	97,500	38.7
Funnel Creek	93,800	37.2
Total	252,200	100.0

<sup>1</sup> Aerial surveys were conducted with fixed-wing aircraft.

Table 2. Aerial survey counts of chinook, chum, pink, and coho salmon, Naknek-Kvichak District, 1998.<sup>1</sup>

Location	Survey Date	Number of Salmon			
		Chinook	Chum	Pink	Coho
Kvichak River	14-Aug	187			
Alagnak River	12-Aug	4,148	3,150 <sup>a</sup>	3,200	
Naknek River :					
Paul's Creek	18-Aug	210			
King Salmon Creek	18-Aug	1,060			
Big Creek	18-Aug	2,085			
Mainstem Naknek River	18-Aug	2,150			
Total		9,840	3,150	3,200	

<sup>1</sup> Aerial surveys were conducted with fixed-wing aircraft.

<sup>a</sup> Incidental observation.

Table 3. Aerial survey peak counts of chinook salmon escapement, Egegik District, 1998.

Location	Survey Date	Number of Chinook Salmon Counted
Egegik River	Aug. 6 <sup>a</sup>	0
Shosky Creek	Aug. 6	29
Whale Mountain Creek	Aug. 6	45
Mossy Creek	Aug. 6	55
Mink Creek	Aug. 6	0
Gertrude Creek	Aug. 6	320
Kaye's Creek	Aug. 6	165
Takayoto Creek	Aug. 6	120
Angle Creek	Aug. 6 <sup>b</sup>	
Contact Creek	Aug. 6	329
Mainstem King Salmon River	Aug. 6 <sup>b</sup>	
Total		1,063

<sup>a</sup> Tower count.

<sup>b</sup> No counts due to turbid water conditions.

Table 4. Aerial survey peak counts of chum salmon escapement, Egegik District, 1998.

Location	Survey Date	Number of Chum Salmon Counted
Egegik River	Aug.6 <sup>a</sup>	17
Shosky Creek	Aug.6	8
Whale Mountain Creek	Aug.6	1,480
Mossy Creek	Aug.6	4
Mink Creek	Aug.6	0
Gertrude Creek	Aug.6	920
Kaye's Creek	Aug.6	4
Takayoto Creek	Aug.6	4
Angle Creek	Aug.6 <sup>b</sup>	
Contact Creek	Aug.6	140
Mainstem King Salmon River	Aug.6 <sup>b</sup>	
Total		2,577

<sup>a</sup> Tower count.

<sup>b</sup> No counts due to turbid water conditions.

Table 5. Aerial survey counts of coho salmon escapement, Egegik District, 1998.

Location	Survey Date	Number of Coho Salmon Counted	Comments
<u>Egegik River Drainage<sup>1</sup></u>			
Egegik River Rapids	September 28	2,600	Many schooled off mouth of Myers Creek
Stream 115.8 (Featherly Creek)	September 28	230	
Stream 107.6 (Burl's Creek)	September 28	25	
Stream 90.3 (Salmon Creek)	September 28	140	
Stream 89.8	September 28	100	
Stream 87.0 (Bear Creek)	September 28	190	
Stream 73.5 (Becharof Creek)	September 28	180	
Stream 48.1 (Kejulik River)	September 28	1,660	
Sub-total		5,125	
<u>King Salmon River Drainage</u>			
Gertrude Creek	September 17	950	U.S. Fish and Wildlife Weir Count
Sub-total		950	
District Total		6,075	

<sup>1</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 lake outlet. This is the same system of designation used for years by previous investigators. Due to logistic problems only one survey was flow this season.

**Table 6.** Aerial survey peak counts of sockeye salmon escapement, King Salmon and Dog Salmon River, Ugashik District, 1998.

Location	Survey Date	Number of Sockeye Salmon Counted
<u>King Salmon River System:</u>		
Needle Lake	Aug. 15	1,800
Volcano Creek	Aug. 15	0
Painter Creek	Aug. 15	25,500
Indecision Creek	Aug. 15	125
Sub-total		<u>27,425</u>
<u>Dog Salmon River System:</u>		
Figure-Eight Creek	Aug. 15	4,200
Goblet Creek	Aug. 15	20
Oldham Creek	Aug. 15	1,500
Wandering Creek	Aug. 15	1,200
Mainstem Dog Salmon River	Aug. 15	0 <sup>a</sup>
Sub-total		<u>6,920</u>
Total		34,345

<sup>a</sup> No fish were observed due to turbid water conditions.

Table 7. Peak survey counts of chinook salmon escapement, Ugashik District, 1998.

Location	Survey Date	Number of Chinook Salmon Counted
<u>King Salmon River System</u>		
Old Creek	Aug. 15	438
Pumice Creek	Aug. 15	352
Painter Creek	Aug. 15	1,230
Mainstem King Salmon River	Aug. 15	883
Mother Goose Lake	Aug. 15	0
Indecision Creek	Aug. 15	0
Volcano Creek	Aug. 15	0
Sub-total		<u>2,903</u>
<u>Dog Salmon River System</u>		
Figure-Eight Creek	Aug. 15	713
Goblet Creek	Aug. 15	28
Oldham Creek	Aug. 15	350
Wandering Creek	Aug. 15	320
Mainstem Dog Salmon River	Aug. 15	0 <sup>a</sup>
Sub-total		<u>1,411</u>
<u>Ugashik River System</u>		
Mainstem Ugashik River	Aug. 15	368 <sup>b</sup>
Grassy Creek	Aug. 15	90
Sub-total		<u>458</u>
Total		<u>4,772</u>

<sup>a</sup> No fish were observed due to turbid water conditions.

<sup>b</sup> Includes tower and below tower counts.

Table 8. Peak survey counts of chum salmon escapement, Ugashik District, 1998.

Location	Survey Date	Number of Chum Salmon Counted
<u>King Salmon River System</u>		
Old Creek	Aug. 15	4,350 <sup>a</sup>
Pumice Creek	Aug. 15	2,000
Painter Creek	Aug. 15	3,800
Mainstem King Salmon River	Aug. 15	10,600
Needle Lake	Aug. 15	220
Indecision Creek	Aug. 15	0
Volcano Creek	Aug. 15	4
Sub-total		<u>20,974</u>
<u>Dog Salmon River System</u>		
Figure-Eight Creek	Aug. 15	570
Goblet Creek	Aug. 15	0
Oldham Creek	Aug. 15	50
Wandering Creek	Aug. 15	220
Mainstem Dog Salmon River	Aug. 15	0 <sup>b</sup>
Sub-total		<u>840</u>
<u>Ugashik River System</u>		
Mainstem Ugashik River	Aug. 15	601 <sup>c</sup>
Grassy Creek	Aug. 15	6
Sub-total		<u>607</u>
Total		<u>22,421</u>

<sup>a</sup> Includes carcasses.

<sup>b</sup> No fish were observed due to turbid water conditions.

<sup>c</sup> Includes tower and below tower counts.

Table 9. Aerial survey counts of coho salmon escapement, Ugashik District, 1998. <sup>a</sup>

Location	Survey Date	Number of Coho Salmon Counted	Comments
<u>Ugashik Drainage</u>			
<u>Upper Ugashik Lake</u>			
Crooked Creek	November 19	20	Upstream
Deer Creek	November 19	0	
<u>Lower Ugashik Lake</u>			
Black Creek to Cabin	November 19	0	
Black Creek to Elizabeth Lake	November 19	0	
Ugashik Outlet	November 19	0	
<u>King Salmon River Tributaries</u>			
Pumice Creek	November 19	20	
Old Creek	November 19	7	
Painter Creek	November 19	1,389	
<u>Dog Salmon River Tributaries</u>			
Figure Eight Creek	November 19	23	
District Total		1,459	

<sup>a</sup> Only one survey was flown and much later than in previous years due to logistic problems.

Table 10. Peak aerial live counts and total escapement estimates of sockeye salmon in the Wood River system, 1998.

Area	Date	Aerial Count <sup>1</sup>	Population Estimate	Distribution %
Wood River		6,270 <sup>c</sup>	9,400	0.5%
Lake Aleknagik		47,890	278,600	15.9%
Eagle Creek <sup>a</sup>	8/9/98	360		
Hansen Creek <sup>a</sup>	8/6/98	8,680		
Happy Creek <sup>a</sup>	8/6/98	8,410		
Bear Creek <sup>a</sup>	8/5/98	2,660		
Yako Creek <sup>a</sup>	8/1/98	1,490		
Whitefish Creek <sup>a</sup>	8/17/98	560		
Ice Creek <sup>ab</sup>	8/7/98	9,800		
Mission Creek <sup>a</sup>	8/15/98	1,270		
Sunshine Creek	8/18/98	1,280		
Youth Creek	8/25/98	80		
Northshore Beaches	8/25/98	7,000		
Southshore Beaches	8/25/98	6,300		
Yako Beaches <sup>2</sup>	8/25/98	0		
Agulowok River & lower River Bay	8/25/98	75,000	112,000	6.4%
Lake Nerka		76,540	445,300	25.4%
Fenno Creek <sup>a</sup>	8/7/98	4,730		
Pike Creek	8/14/98	1,580		
Stovall Creek	8/14/98	980		
Bear Creek	8/14/98	50		
Teal Creek	8/14/98	100		
Pick Creek <sup>a</sup>	8/21/98	6,810		
Elva Creek <sup>a</sup>	8/25/98	100		
Kema Creek	8/14/98	280		
Hidden Lake Creek <sup>a</sup>	8/23/98	1,150		
Lynx Creek <sup>a</sup>	8/22/98	1,350		
Upper River Bay Beaches, NW	8/25/98	1,000		
Upper River Bay Beaches, SE	8/25/98	4,200		
Allan Cr. - Ross Cr. Beaches	8/25/98	4,900		
N6 - River Bay Beach	9/2/98	11,100		
Pick Creek Beach	8/25/98	800		
Elva Creek Beach	8/25/98	1,900		
Amakuk Arm Beaches	8/25/98	1,300		

(Continued)

Table 10. (Continued)

Area	Date	Aerial Count <sup>1</sup>	Population Estimate	Distribution %
Amakuk Arm - Ott's Bay Beach	8/25/98	4,600		
Ott's Bay Beach	8/25/98	900		
Anvil Bay Beaches	8/25/98	9,000		
Anvil Bay - Elbow Pt. Beach	8/25/98	8,100		
Elbow Pt. - Lynx Cr. Beach	8/25/98	5,700		
Lynx Cr. - Teal Cr. Beach	8/25/98	1,200		
Kema Lake Beaches	8/25/98	380		
Hidden Lake Beaches	8/25/98	330		
Lynx Lake Beaches	8/25/98	4,000		
Little Togiak River <sup>a</sup>	8/25/98	2,940	4,400	0.3%
Little Togiak Lake		9,000	52,400	3.0%
Northshore Beaches	8/25/98	1,000		
Southshore Beaches	8/25/98	3,500		
D Slough Beaches	8/25/98	4,500		
Agulukpak River	8/25/98	64,000	95,500	5.4%
Lake Beverley		76,580	445,600	25.4%
Tsun Creek	8/14/98	0		
Moose Creek	8/14/98	3,150		
Hope Creek	8/14/98	3,150		
Hardluck Bay Beaches	8/25/98	19,900		
Sam's Beach	8/25/98	1,800		
Golden Horn Beaches	8/25/98	4,400		
Silver Horn Beaches	8/25/98	27,600		
B12 & B9 Beaches	8/25/98	16,300		
Hope Lake Beach	8/14/98	280		
Peace River	8/25/98	4,000	8,000	0.5%
Lake Mikchalk		8,300	48,300	2.8%
Narrows				
Northshore Beaches	8/25/98	1,500		
Southshore Beaches	8/25/98	6,800		

(Continued)

Table 10. (Continued)

Area	Date	Aerial Count <sup>1</sup>	Population Estimate	Distribution %
Wind River	8/16/97	800	1,600	0.1%
Lake Kulik		41,950	244,100	13.9%
K1 & K2 Creeks	8/14/98	2,350		
K5 Creek - Grant River Beaches	8/25/98	2,900		
Grant River - K2 Creek Beaches	8/25/98	29,000		
Southshore Beaches	8/25/98	7,700		
Grant River	8/14/98	5,280	10,600	0.6%
<b>Total</b>		412,280	1,755,800	100.0%

- <sup>1</sup> All counts rounded to the nearest 10 fish.
- <sup>2</sup> Access blocked by beaver dams.
- <sup>a</sup> Ground survey counts conducted by FRI, University of Washington..
- <sup>b</sup> Partial count.
- <sup>c</sup> Proportional count based on past data.

Table 11. Peak aerial counts of live sockeye salmon and total escapement estimates, Togiak District, 1998.

Stream	Aerial Counts		Total Escapement Estimate	
	Date	Number	Factor <sup>1</sup>	Number
<u>Togiak Section</u>				
Togiak Tower				153,576
Togiak River mainstem	18-Aug	4,890	2.0	9,780
Gechiak Lake System	18-Aug	3,100	2.0	6,200
Pungokepuk Lake	18-Aug	150	2.0	300
Nayorurun River	24-Aug	10	2.0	20
Kemuk River	24-Aug	0	2.0	0
Ongivinuk Lake System	18-Aug	2,800	2.0	5,600
Subtotal		10,950		21,900
<u>Kulukak Section</u>				
Kulukak River	06-Aug	1,125	2.0	2,250
Kulukak Lake	06-Aug	1,050	2.0	2,100
Tithe Creek Ponds	24-Aug	4,300	2.0	8,600
Subtotal		6,475		12,950
<u>Matogak, Osviak, and Cape Pierce Sections</u>				
Matogak River	18-Aug	900	2.5	2,250
Osviak River	18-Aug	2,600	2.5	6,500
Slug River <sup>2</sup>	10-Aug	5,010	2.0	10,020
Subtotal		8,510		18,770
<u>Other</u>				
Quigmy River	18-Aug	20	2.5	50
Negukthiik River	27-Aug	2,300	3.0	6,900
Ungalikthluk River	27-Aug	240	2.0	480
Subtotal		2,560		7,430
Total		28,495		214,626

<sup>1</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..

<sup>2</sup> USFWS estimate.

Table 12. Peak aerial counts of live chinook salmon and total escapement estimates, Togiak District, 1998.

River	Aerial Counts		Total Escapement Estimates	
	Date	Number	Factor <sup>1</sup>	Number
<u>Togiak Section</u>				
Togiak River mainstem				
A	06-Aug	10	3.5	35
B	06-Aug	20	3.5	70
C	06-Aug	250	3.5	875
D	06-Aug	50	3.5	175
E	06-Aug	400	3.5	1,400
F	06-Aug	1,200	3.5	4,200
Subtotal		1,930		6,755
Gechiak River	06-Aug	400	2.5	1,000
Pungokepuk River	06-Aug	150	2.5	375
Nayorurun River	06-Aug	275	2.5	688
Kemuk River	06-Aug	140	2.5	350
Ongivinuk River	06-Aug	275	2.5	688
Subtotal		1,240		3,101
Togiak River Drainage Total		3,170		9,856
<u>Kulukak Section</u>				
Kulukak River	06-Aug	375	2.5	938
<u>Matogak, Osviak, and Cape Pierce Sections</u>				
Matogak River <sup>2</sup>	30-Jul	92	2.5	230
Osviak River <sup>2</sup>	29-Jul	58	2.5	145
Slug River <sup>2</sup>	29-Jul	39	2.5	98
Subtotal		189		473
<u>Other</u>				
Quigmy River <sup>2</sup>	30-Jul	45	2.5	113
Negukthlik River	07-Aug	75	3.0	225
Ungalikthluk River	07-Aug	25	2.5	63
Subtotal		145		400
Total		3,879		11,666

1 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..

2 USFWS estimate.

Table 13. Peak aerial counts of live chum salmon and total escapement estimates, Togiak District, 1998.

River	Aerial Counts		Total Escapement Estimate	
	Date	Number	Factor <sup>1</sup>	Estimate
<u>Togiak Section</u>				
Togiak River mainstem				
A	06-Aug	2,300	2.0	4,600
B	06-Aug	1,400	2.0	2,800
C	06-Aug	2,750	2.0	5,500
D	06-Aug	1,300	2.0	2,600
E	06-Aug	4,300	2.0	8,600
F	06-Aug	8,950	2.0	17,900
Subtotal		21,000		42,000
Gechiak River	06-Aug	3,600	2.0	7,200
Pungokebuk River	06-Aug	1,050	2.0	2,100
Nayorurun River	06-Aug	3,000	2.0	6,000
Kemuk River	06-Aug	250	2.0	500
Ongivinuk River	06-Aug	1,650	2.0	3,300
Subtotal		9,550		19,100
Togiak River Drainage Total		30,550		61,100
<u>Kulukak Section</u>				
Kulukak River	06-Aug	2,700	2.0	5,400
<u>Matogak, Osviak, and Cape Pierce Sections</u>				
Matogak River <sup>2</sup>	30-Jul	4,980	2.0	9,960
Osviak River <sup>2</sup>	29-Jul	3,870	2.0	7,740
Slug River <sup>2,3</sup>	29-Jul	1,060	2.0	10,020
Subtotal		9,910		27,720
<u>Other</u>				
Quigmy River <sup>2</sup>	30-Jul	2,630	2.0	5,260
Negukthlik River	07-Aug	150	2.5	375
Ungalikthluk River	07-Aug	1,300	2.0	2,600
Subtotal		4,080		8,235
Total		47,240		102,455

1 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..

2 U.S. Fish and Wildlife Service estimate.

3 Surveys were past peak of spawning; estimate is the number of live chums observed times the expansion factor, plus the number of chum carcasses counted.

Table 14. Peak aerial counts of live coho salmon and total escapement estimates, Togiak District, 1998.

Stream	Aerial Counts		Total Escapement Estimate	
	Date	Number	Factor <sup>1</sup>	Number
<u>Togiak Section</u>				
Togiak River mainstem				
A	06-Oct	460	3.0	1,380
B	06-Oct	625	3.0	1,875
C	06-Oct	100	3.0	300
D	06-Oct	100	3.0	300
E	06-Oct	310	3.0	930
F	06-Oct	1,075	3.0	3,225
Subtotal		2,670		8,010
Gechiak River	06-Oct	2,550	3.0	7,650
Pungokepuk River	06-Oct	575	3.0	1,725
Nayorurun River	06-Oct	400	3.0	1,200
Kemuk River	06-Oct	500	3.0	1,500
Ongivinuk River	06-Oct	1,750	3.0	5,250
Subtotal		5,775		17,325
Togiak River Drainage		8,445		25,335
<u>Kulukak Section</u>				
Kulukak River	07-Oct	3,650	3.0	10,950
<u>Matogak, Osviak, and Cape Pierce Sections</u>				
Matogak River <sup>2</sup>	28-Sep	1,785	3.0	5,355
Osviak River <sup>2</sup>	28-Sep	2,001	3.0	6,003
Slug River <sup>2</sup>	28-Sep	523	3.0	1,569
Subtotal		4,309		12,927
<u>Other</u>				
Quigmy River	07-Oct	390	3.0	1,170
Negukthlik River <sup>3</sup>				
Ungalikthluk River	06-Oct	2,770	3.0	8,310
Subtotal		3,160		9,480
Total		19,564		58,692

<sup>1</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..

<sup>2</sup> U.S.F.W.S. survey.

<sup>3</sup> Survey precluded by muddy water.

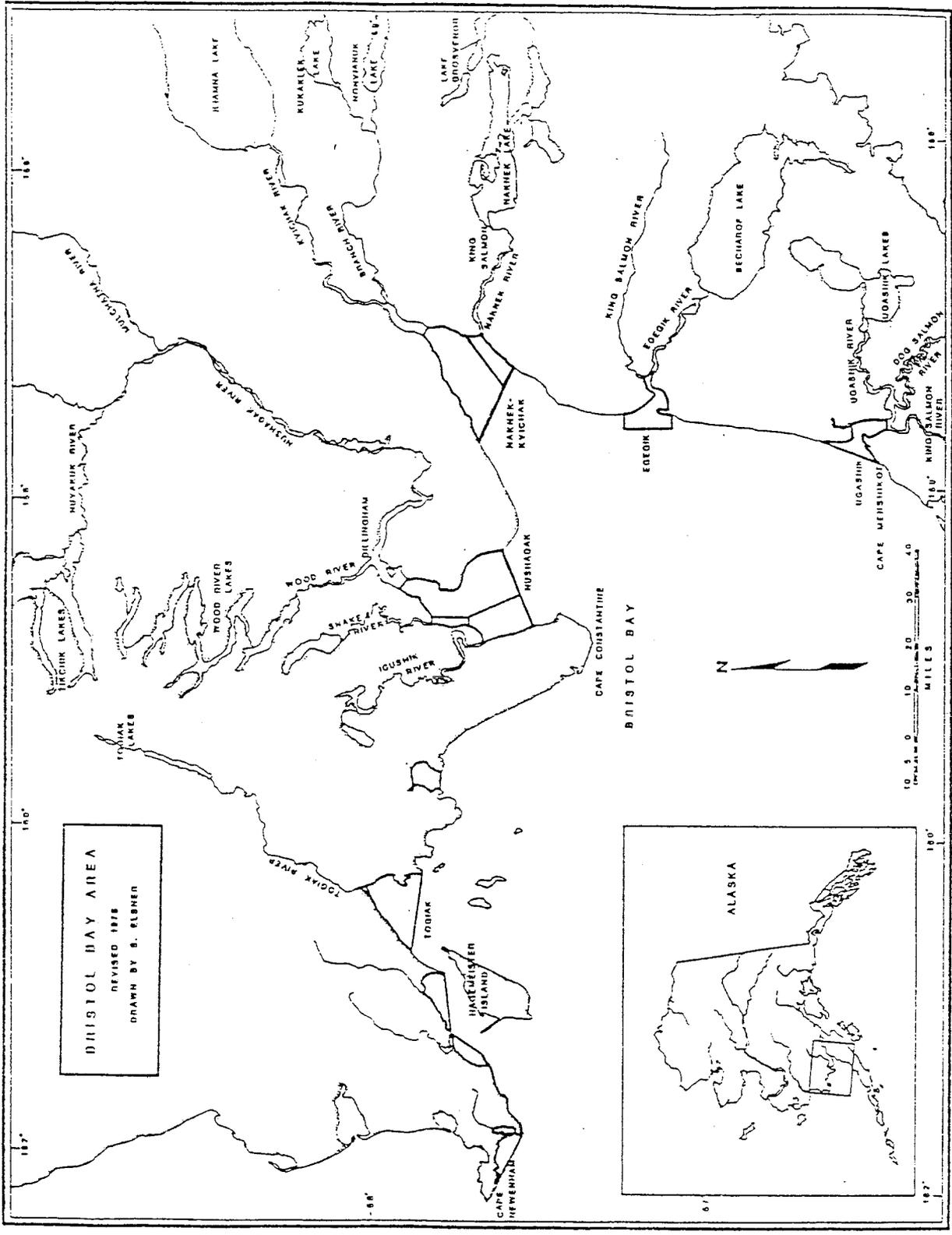
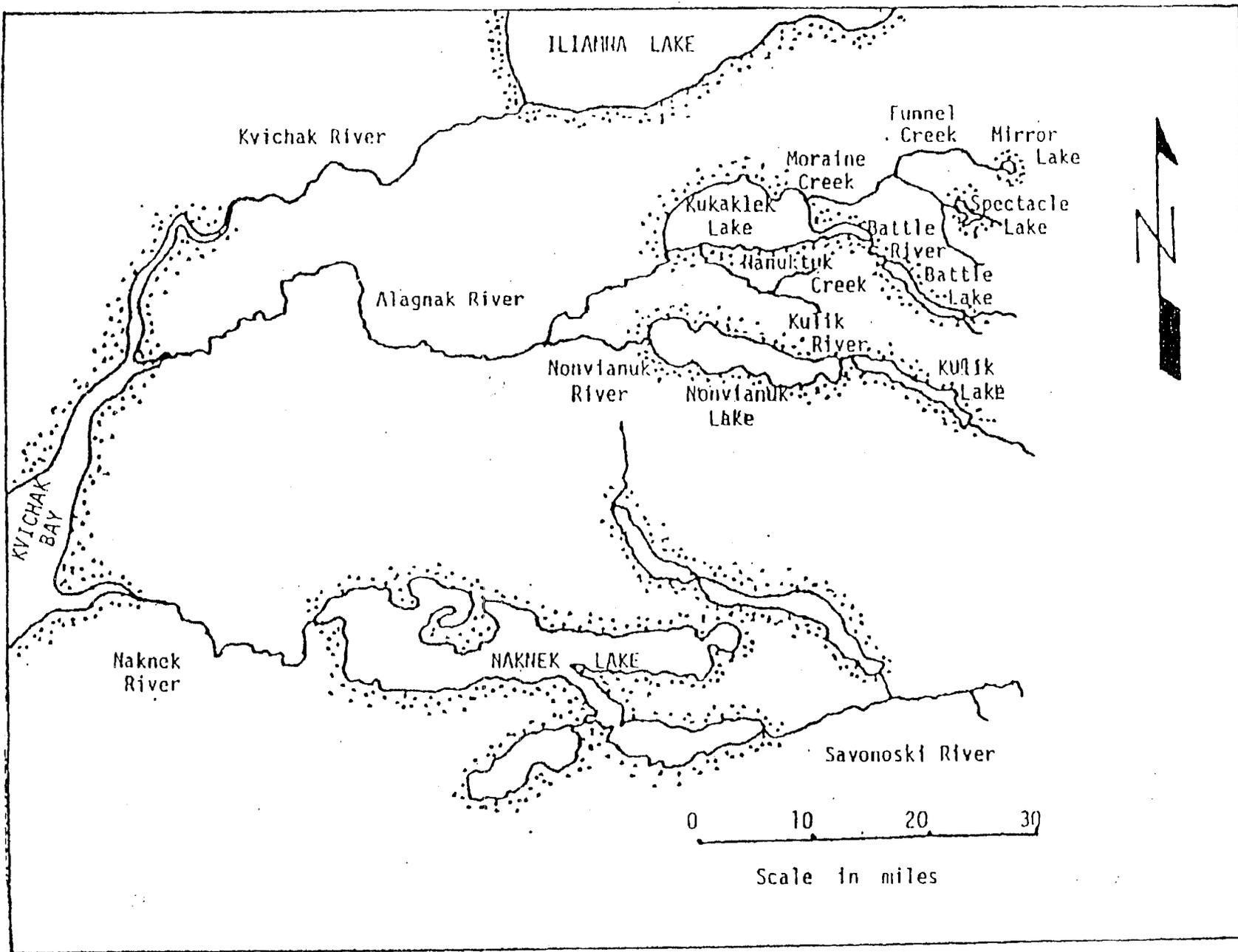


Figure 1. Bristol Bay management area, Alaska.

Figure 2. Alagnak River drainage, Bristol Bay, Alaska.



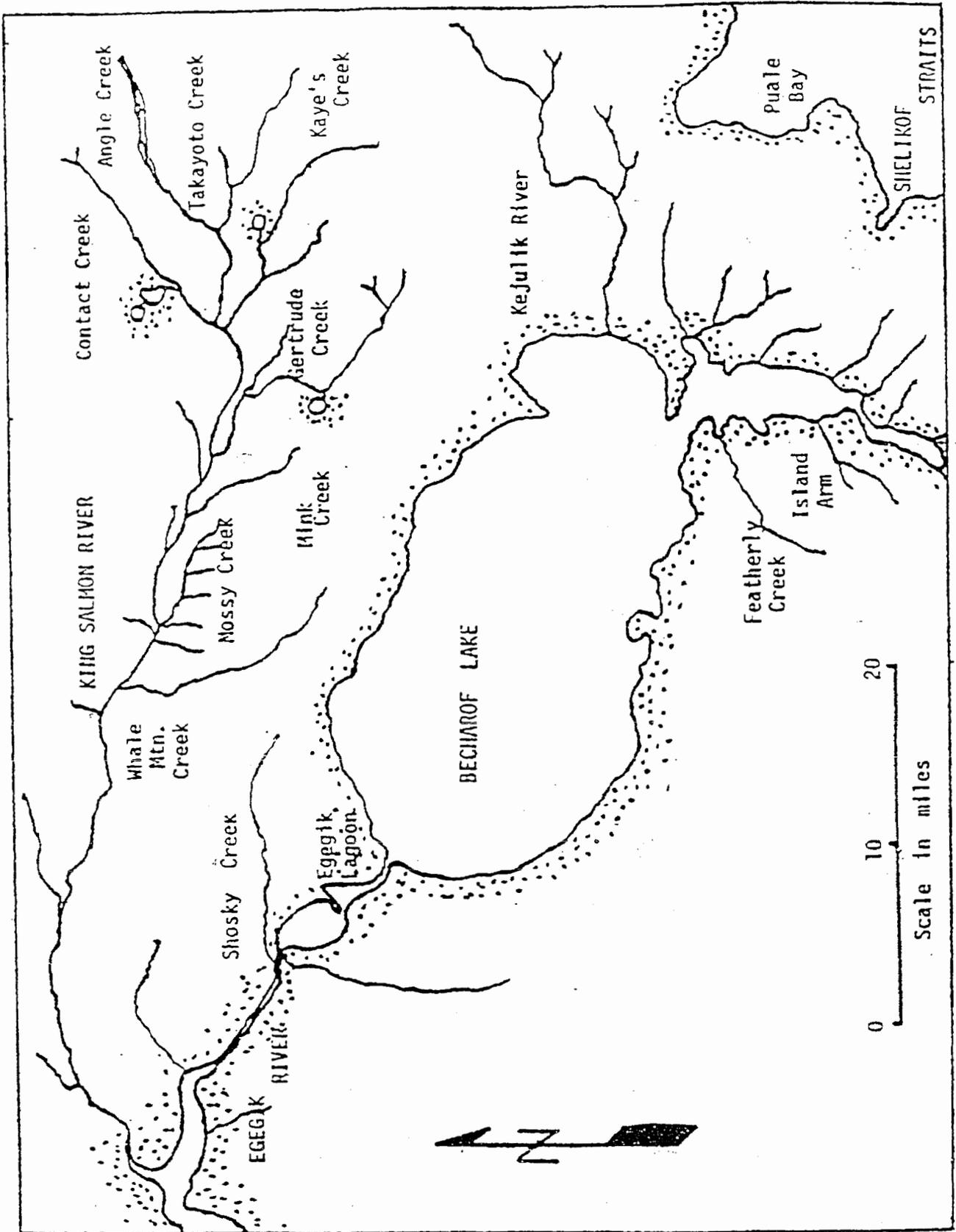


Figure 3. Egegik River drainage, Bristol Bay, Alaska.

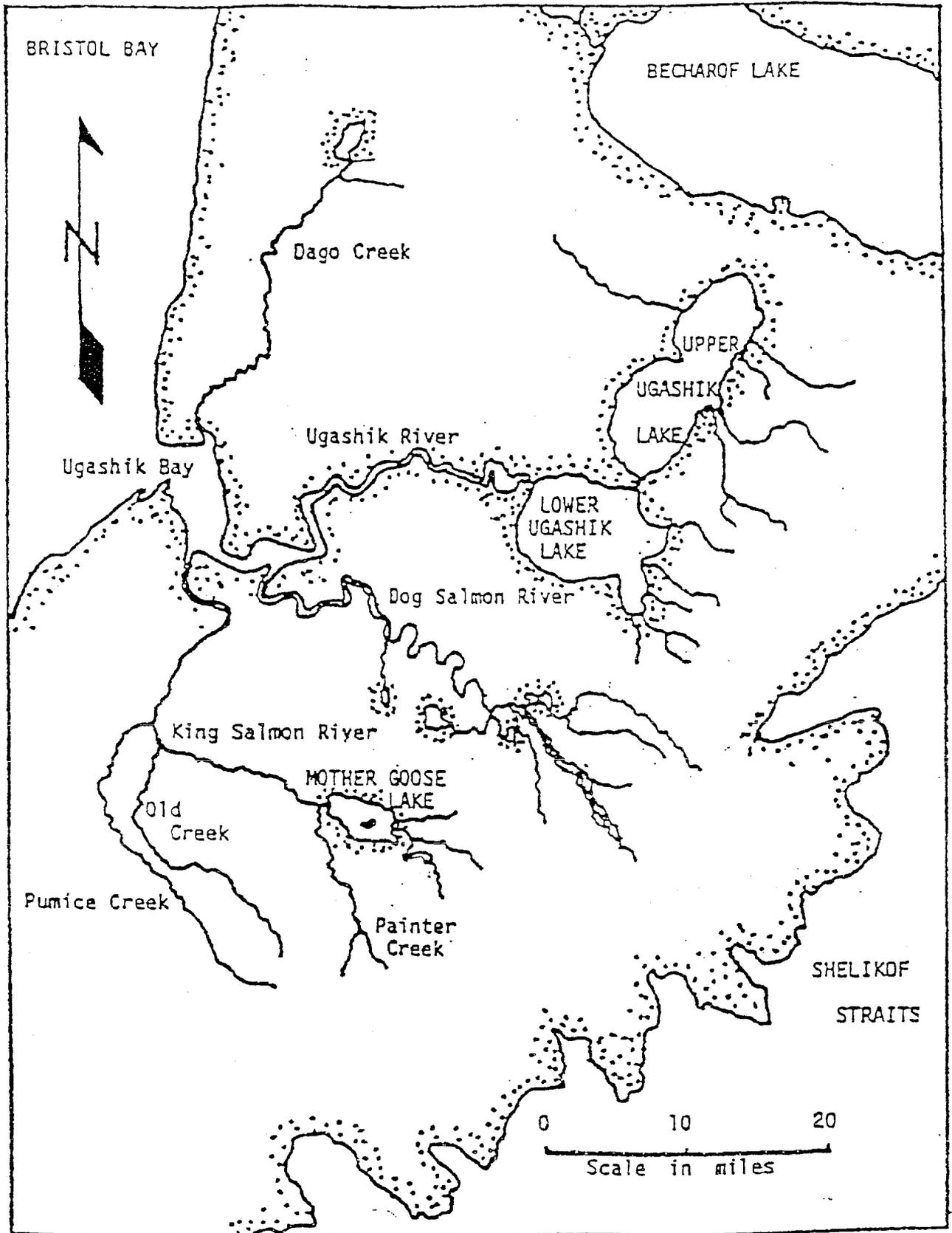


Figure 4. Ugashik River drainage, Bristol Bay, Alaska.

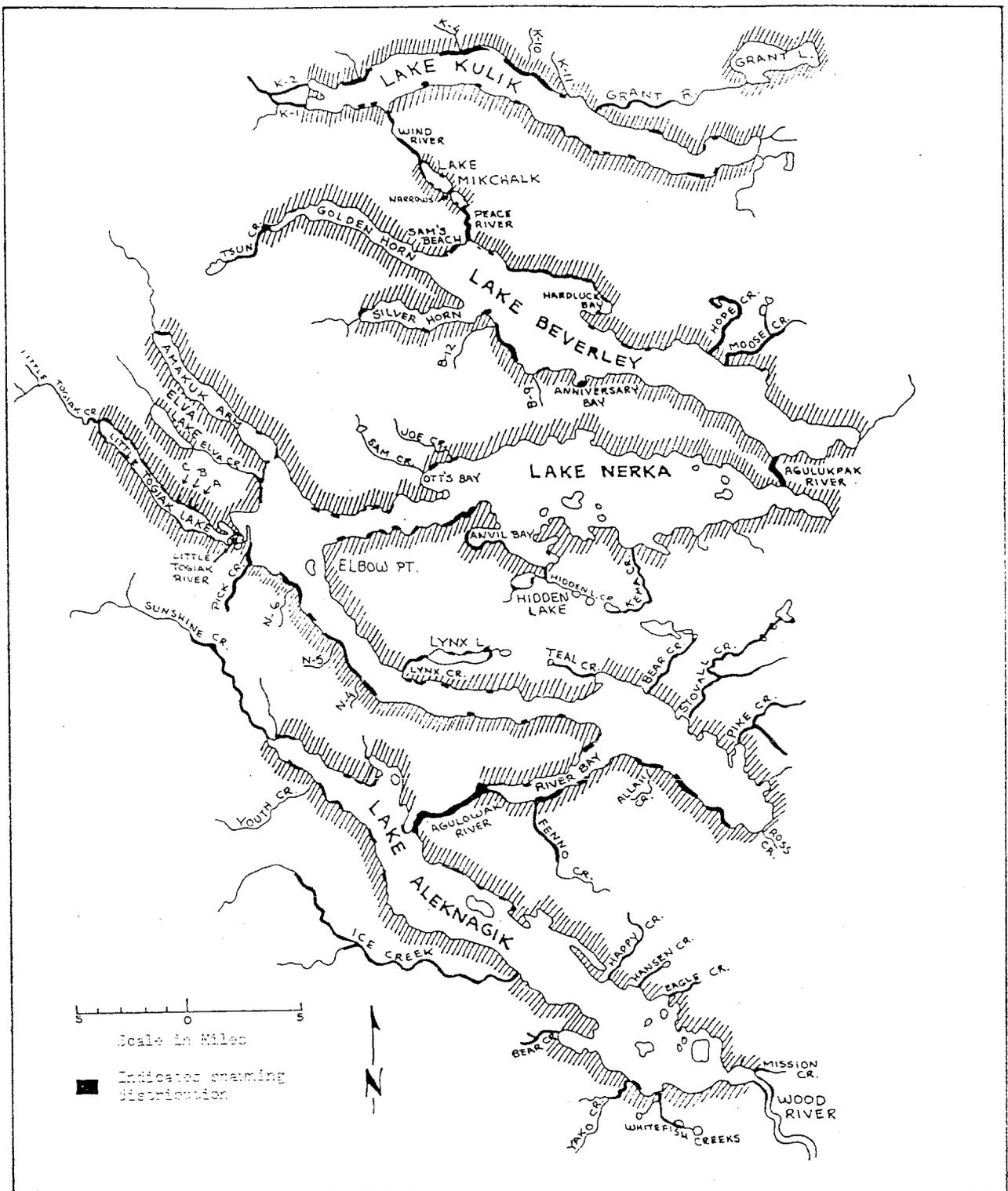


Figure 5. Wood River Lakes system, Bristol Bay, Alaska.

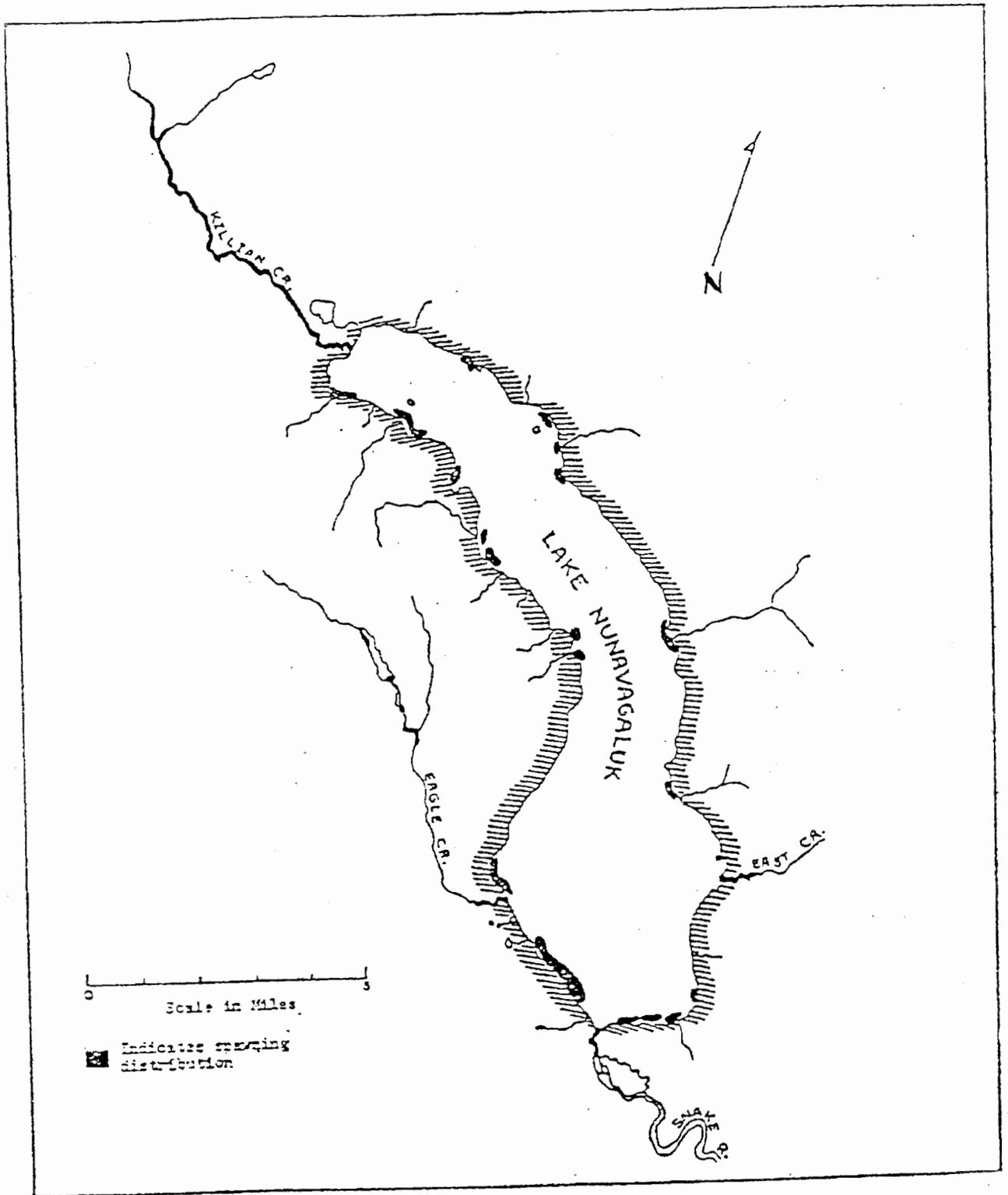


Figure 6. Lake Nunavaugaluk system, Bristol Bay, Alaska.

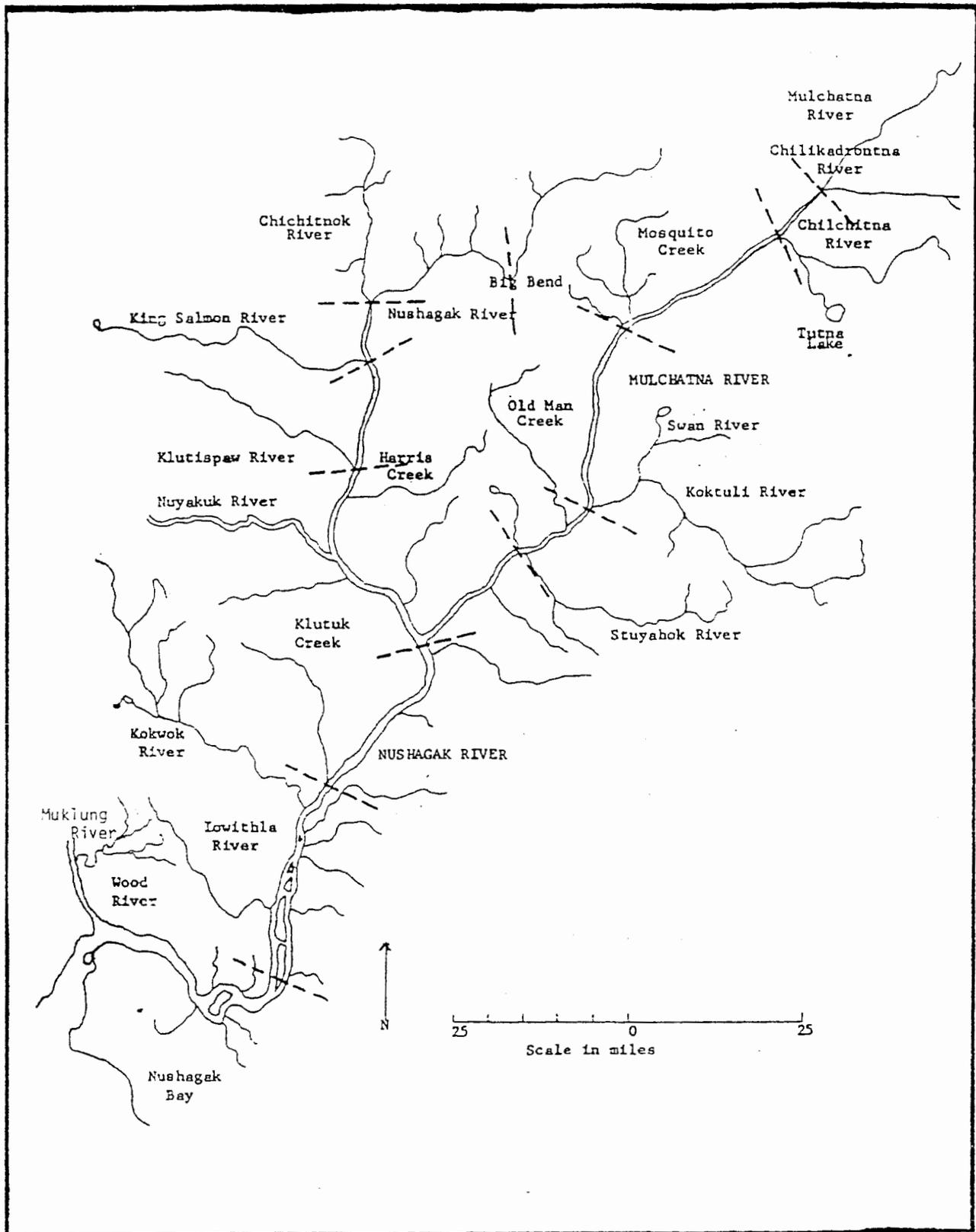


Figure 7. Nushagak-Mulchatna River system, Bristol Bay, Alaska.

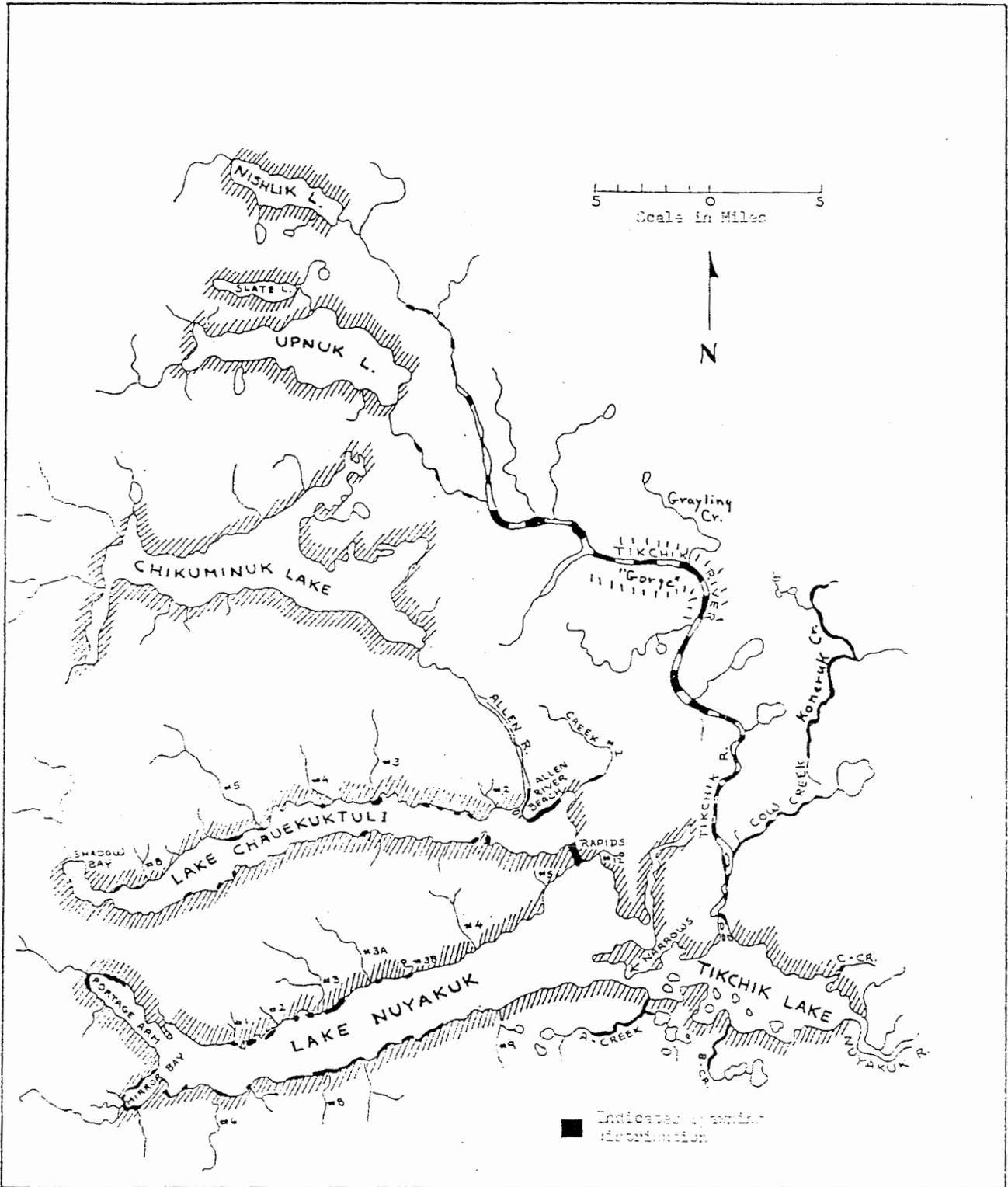


Figure 8. Tikchik Lakes system, Bristol Bay, Alaska.

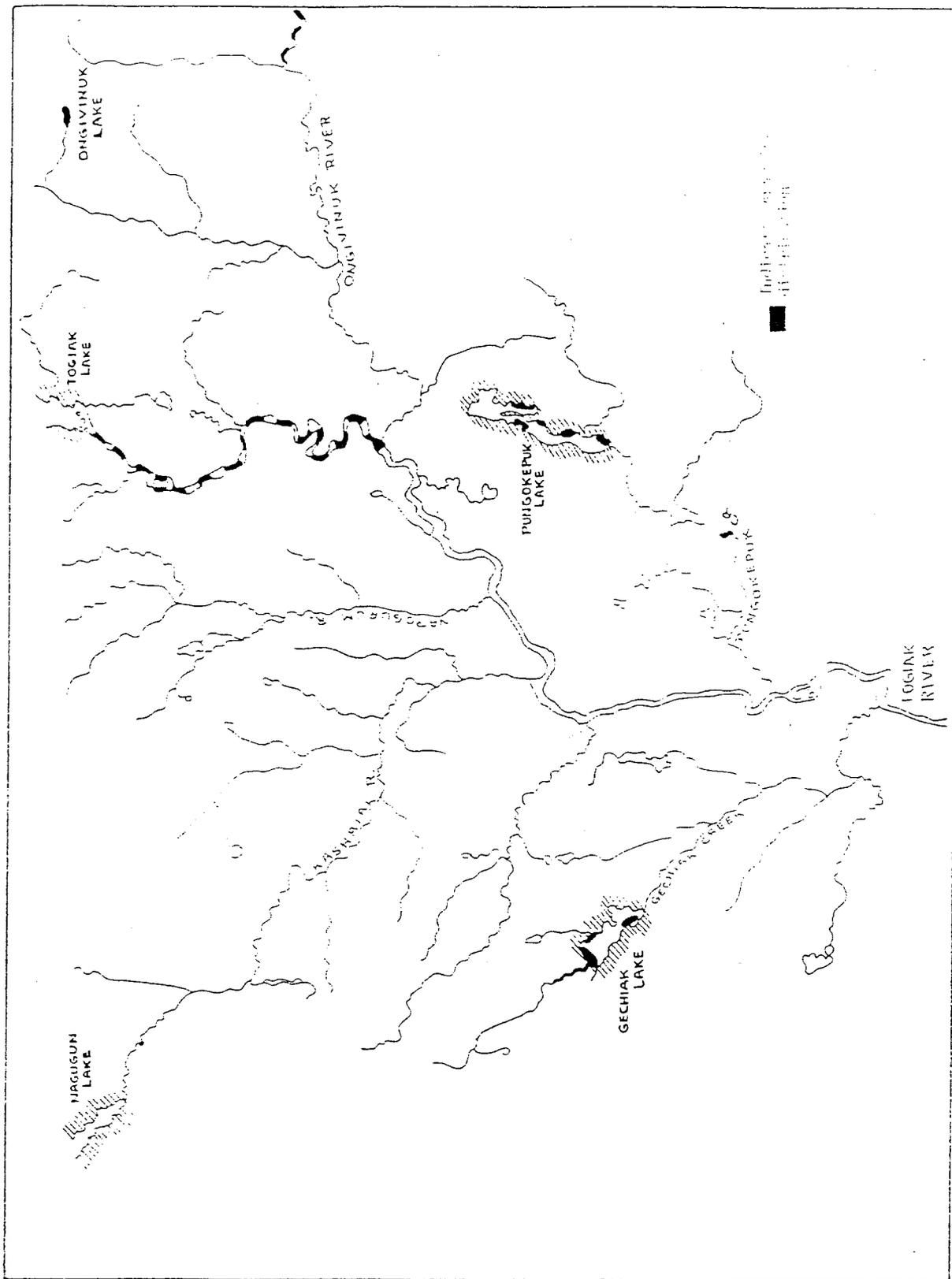


Figure 9. Togiak River system, Bristol Bay, Alaska.

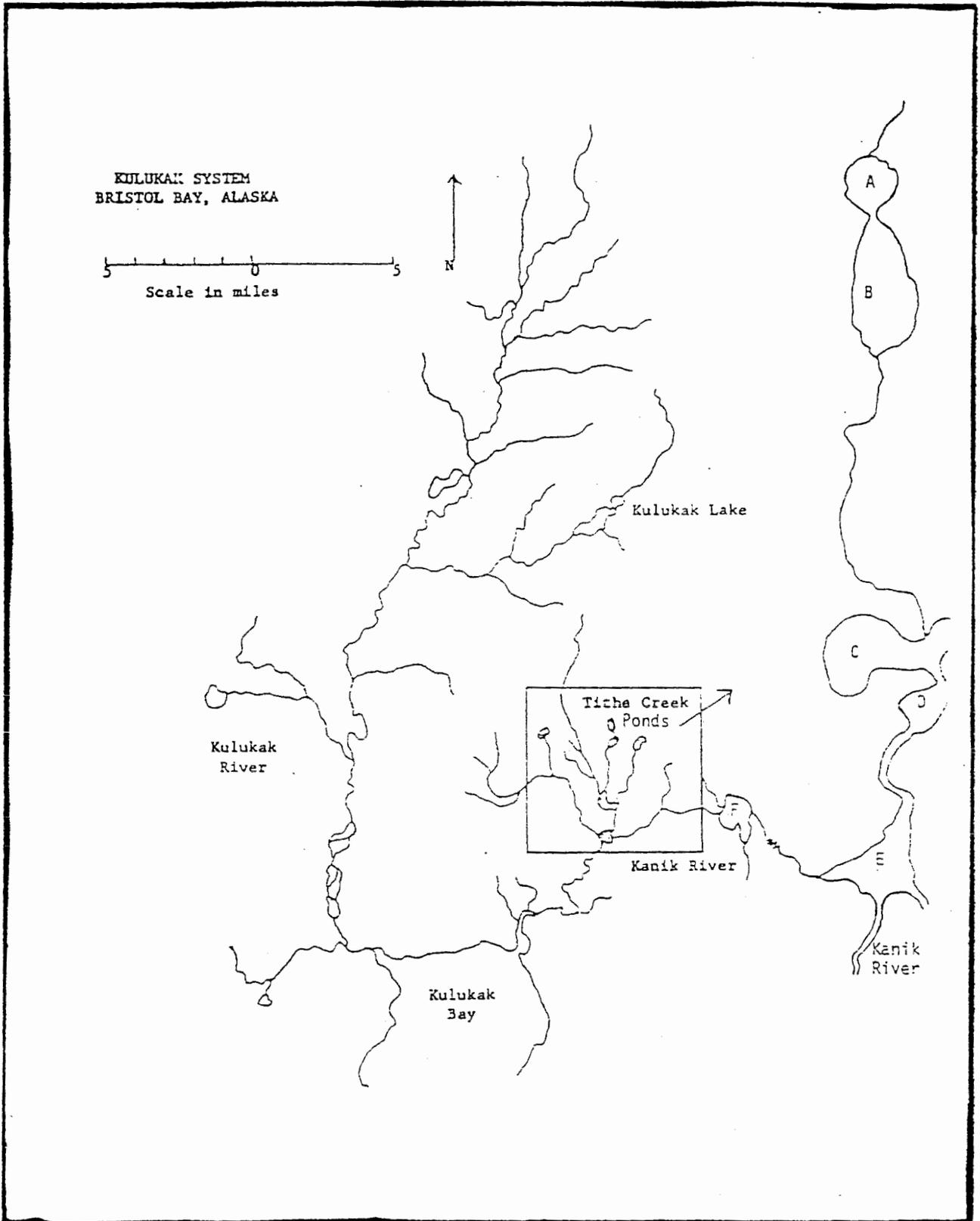


Figure 10. Kulukak River system, Bristol Bay, Alaska.

**Appendix Table 1.** Sockeye salmon total escapement estimates, Naknek-Kvichak District, 1955-1998.  
 Estimates based on visual counts from towers unless otherwise noted.

Year	Kvichak	Naknek	Alagnak	Total	Alagnak Percent of Total
1955	250,546	278,500 <sup>b</sup>	171,500 <sup>a</sup>	700,546	24
1956	9,443,318	1,772,595 <sup>b</sup>	784,000 <sup>a</sup>	11,999,913	7
1957	2,842,810	634,645 <sup>b</sup>	126,595	3,604,050	4
1958	534,785	278,118	94,650	907,553	10
1959	680,000	2,231,807	825,431	3,737,238	22
1960	14,630,000	828,381	1,240,530	16,698,911	7
1961	3,705,849	351,078	90,036	4,146,963	2
1962	2,580,884	723,066	90,630	3,394,580	3
1963	338,760	905,358	203,304	1,447,422	14
1964	957,120	1,349,604	248,700	2,555,424	10
1965	24,325,926	717,798	175,020	25,218,744	1
1966	3,775,184	1,016,445	174,336	4,965,965	4
1967	3,216,208	755,640	202,626	4,174,474	5
1968	2,557,440	1,023,222	193,872	3,774,534	5
1969	8,394,204	1,331,202	122,490	9,847,896	1
1970	13,935,306	732,502	177,060	14,844,868	1
1971	2,387,392	935,754	187,302	3,510,448	5
1972	1,009,962	586,518	151,188	1,747,668	9
1973	226,554	356,676	35,280	618,510	6
1974	4,433,844	1,241,058	214,848	5,889,750	4
1975	13,140,450	2,026,686	100,480	15,267,616	1
1976	1,965,282	1,320,750	81,822	3,367,854	2
1977	1,341,144	1,085,856	100,000 <sup>a</sup>	2,527,000	4
1978	4,149,288	813,378	229,400 <sup>a</sup>	5,192,066	4
1979	11,218,434	925,362	294,200 <sup>a</sup>	12,437,996	2
1980	22,505,268	2,644,698	297,900 <sup>a</sup>	25,447,866	1
1981	1,754,358	1,796,220	82,210 <sup>a</sup>	3,632,788	2
1982	1,134,840	1,155,552	239,300 <sup>a</sup>	2,529,692	9
1983	3,569,982	888,294	96,220 <sup>a</sup>	4,554,496	2
1984	10,490,670	1,242,474	215,370 <sup>a</sup>	11,948,514	2
1985	7,211,046	1,849,938	118,030 <sup>a</sup>	9,179,014	1
1986	1,179,322	1,977,645	230,180 <sup>a</sup>	3,387,147	7
1987	6,065,880	1,061,806	154,210 <sup>a</sup>	7,281,896	2
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

(Continued)

Appendix Table 1. (Continued)

Year	Kvichak	Naknek	Alagnak	Total	Alagnak Percent of Total
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
Mean	5,625,711	1,238,599	241,778	7,106,087	5

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

<sup>b</sup> Weir counts.

Appendix Table 2. Aerial survey counts of chinook salmon escapements, Naknek River drainage, 1970-1998.

Year	Mainstem Naknek River	Paul's Creek	King Salmon Creek	Big Creek	Total
1970	3,060		260	825	4,145
1971	1,639	52	704	490	2,885
1972	351	156	1,224	1,060	2,791
1973	1,315		115	1,106	2,536
1974		91	495	860	1,446
1975	2,250	144	279	779	3,452
1976	5,950	31	180	970	7,131
1977	4,830		1,860		6,690
1978					<sup>a</sup>
1979					<sup>a</sup>
1980	300	17		30	347
1981	2,890		591	790	4,271
1982	5,360	340	980	1,930	8,610
1983	2,860	290	460	4,220	7,830
1984	790	400	385	3,420	4,995
1985	590				590
1986	2,200	73	102	1,542	3,917
1987	2,800	7	290	1,353	4,450
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
Mean	3,111	140	544	1,626	5,422 <sup>b</sup>
Percent	57	3	10	30	100

<sup>a</sup> Counts unavailable.

<sup>b</sup> The sum of mean indices.

Appendix Table 3. Chinook salmon escapement survey history, mainstem Naknek River, 1929-1998.

Year	Count Dates	Surveyors	Actual Weir Count <sup>1</sup>	Non-expanded Aerial Index Count	Expanded Aerial Index Estimate <sup>2</sup>	Comments
1929	7/03-7/31		1,498			Chinook count peaked 7/27.
1930	6/20-8/09		1,999			Chinook count peaked 8/09.
1931	6/17-8/09		896			Chinook count peaked 8/07.
1932	6/23-8/10		1,869			
1950	7/08-8/20		3,097			Chinook count peaked 8/09.
1951	6/28-8/07		1,876			Chinook count peaked 8/04.
1952	6/25-8/10		633			Chinook count peaked 8/06.
1953	6/24-8/10		2,074			Chinook count peaked 7/26.
1954	6/20-8/11		3,474			Chinook count peaked 8/10.
43 1955	6/13-8/17		4,188			Chinook count peaked 8/16.
1956	6/22-8/28		7,378			Chinook count peaked 8/18.
1957	6/28-8/04		8,504			Chinook count peaked 8/03.
1966		Redick				300 were counted 8/26 from a skiff in the Rapids.
1967	Mid-Aug.	Paddock			800	
1968					1,200	Conservative estimate.
1969					1,200	
1970	7/31	Whitehead		845		
	8/03	Siedelman		3,060		Visibility very good. Super-cub.
	8/22	Siedelman		1,540	1,750	Water high & murky. Spawning pre-peak.
	8/22	Whitehead		1,310		
	8/25	Whitehead		2,225		Counting conditions optimal.
	8/25	Siedelman		2,536	2,500	Conditions good. Spawning pre-peak.

(Continued)

Appendix Table 3. (Continued)

Year	Count Dates	Surveyors	Actual Weir Count <sup>1</sup>	Non-expanded Aerial Index Count	Expanded Aerial Index Estimate <sup>2</sup>	Comments
1971	8/26	Cunningham		1,639		Fish concentrated near Rapids Camp. Few dead.
1972	8/23	Cunningham & McCurdy		351		Poor counting conditions. Post-peak.
1973	8/19	Russell		1,315		Counting conditions good. Peak near at hand.
1974	8/19	Russell			450	Count accuracy questionable. Many fish were deep.
1975	8/17	Russell		2,250		Good viewing, peak near. Still fish spawning 9/08.
1976	8/13	Bill		2,615		Spawning near peak. Very few dead.
	8/16	Russell		5,950	7,250	Pre-peak. Still lots fish holding in large groups.
1977	8/22	Russell		4,830	5,750	Pre-peak. Few dead. Some still holding deep.
1978	8/09	Gwartney			4,000	Near peak.
1983	8/14	Bill		2,860	3,000	Pre-peak. Still fish holding in large groups.
1984	8/14	Bill		790	2,370	
1985	8/06	Bill			600	Pre-peak.
	8/27	Bill		590	700	
1986	8/18	Russell		1,990		Spawning pre-peak. Still many fish holding.
	8/19	Meyer		2,200		Peak of spawning drawing near.
1987	8/19	Meyer		2,800		Pre-peak. Fish still in large groups. Few redds.
	8/28	Bill		2,655	2,855	
1988	8/09	Minard		7,380	7,400	Approaching peak. Most fish on redds.
1989	8/14	Minard		1,700		Fish actively spawning. Few carcasses observed.
1990	8/06	Minard		4,500		
1991	8/20	Russell		1,655		Pre-peak. Still many fish schooled & waiting.

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(Continued)

Appendix Table 3. (Continued)

Year	Count Dates	Surveyors	Actual Weir Count <sup>1</sup>	Non-expanded Aerial Index Count	Expanded Aerial Index Estimate <sup>2</sup>	Comments
1992	8/21	Regnart		877		Water clarity poor in deeper pools.
	8/27	Regnart		1,550		At Peak...all fish on redds.
1993	8/23	Regnart		5,520		Near peak. Still some fish schooled.
1994	8/24	Regnart		5,970		Near peak. Most on redds.
1995	8/21	Regnart		2,790		Near peak. Most on redds.
1996	8/21	Regnart		2,965		At Peak...all fish on redds.
1997	8/16	Regnart		7,520		Near peak. Most on redds.
1998	8/18	Regnart		2,150		At Peak...all fish on redds.
Mean			3,124	2,779		

<sup>1</sup> Weir count did not account for estimated 15-20% of chinook that spawn downstream of weir site. Also does not account for fish that migrated upstream past the weir site before and after weir operation.

<sup>2</sup> Surveyor's subjective estimate of instantaneous population of chinook salmon spawners in the river at time of aerial survey, based on survey conditions, river area coverage, water clarity, etc. Does not include expansion for earlier or later run fish not available for counting at time of survey.

**Appendix Table 4.** Chinook salmon escapement survey history, Big Creek, Naknek River Drainage, 1963-1998.

Year	Count Dates	Surveyors	Float Count	Non-expanded Aerial Index Count	Expanded Aerial Index Estimate <sup>1</sup>	Comments
1963	8/01	Paddock		362		Covered only half stream length. Helicopter.
	8/13	Paddock		1,345	2,690	Spawning near peak. Good survey.
1964	7/31	Paddock		484		Survey too early.
	8/15	Siedelman & Williamson		636		Survey fair to good. Near peak. Helicopter.
	8/15-8/18	Siedelman & Williamson	1,130			Peak of spawning over.
1965	8/05-8/08	Andrews	578			Fair survey. Began below Index Area No. 1.
1966	8/13-8/16	Redick	979			Spawning at peak. Included Index Area No. 1. Count affected by rain/turbid water in lower areas.
1967	8/10-8/14	Whitehead & Bury	1,129			Upstream redds occupied while those in the lower stream area were abandoned.
1968	8/10-8/14	Meyers & Preyer	3,827			Counting conditions fair to poor.
1969	8/12-8/14	Parkinson & Faro	1,012			High murky waters hampered float count.
	Mid-Aug.	??			5,000	Flown due to poor count conditions during float.
1970	7/19	Whitehead		825		
	8/15-8/17	Parkinson & Brooks	1,601			High murky waters in lower 2/3 of stream.

(Continued)

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Appendix Table 4. (Continued)

Year	Count Dates	Surveyors	Float Count	Non-expanded Aerial Index Count	Expanded Aerial Index Estimate <sup>1</sup>	Comments
1971	8/13	Cunningham		490	1,200	Only upper 1/3 of stream surveyed due to murky water in lower 2/3.
1972	8/28	Siedelman		277		Past peak. Survey affected by winds of 30+ mph.
	8/08	Cunningham		695		Pre-peak.
	8/18	Siedelman		1,060		Post-peak.
1973	8/17	Russell		1,106	850	At peak of spawning. Many fish beaten up (fungus).
1974	8/01	Russell		520		Pre-peak. No dead chinook. Lots dead chums.
	8/11	Russell		860	1,250	Didn't survey lower 8 miles of creek 8/11. Could add 150 fish to survey as Russell saw that many in the unsurveyed portion from skiff 8/10. Near peak.
1975	8/09	Russell		779		Survey pre-peak.
1976	8/13	Bill		970	1,400	Not total stream coverage due to winds & low fuel.
1983	8/14	Bill		4,220	9,000	
	8/08	Bill		3,420	8,800	At peak of spawning.
1984	8/08	Bill			2,900	Survey conditions..high water & gusty winds.
1985	8/06	Bill		1,542	6,000	Excellent conditions. Fish at spawning peak.
1986	8/08	Meyer		1,353		
1987	8/21	Meyer		3,600	2,500	
1988	8/09	Minard		860		
1989	8/14	Minard		2,000		
1990	8/06	Minard		2,340		At spawning peak..all fish on redds, only 20 dead.
1991	8/12	Regnart		895		Est. 5-6 days post-peak. Count includes 125 dead.
1992	8/18	Regnart				

(Continued)

Appendix Table 4. (Continued)

Year	Count Dates	Surveyors	Float Count	Non-expanded Aerial Index Count	Expanded Aerial Index Estimate <sup>1</sup>	Comments
1993	8/17	Regnart		1,710		Estimated survey 3-4 days past peak.
1994	8/16	Regnart		2,531		Est. 2-3 days post-peak. Count includes 159 dead.
1995	8/15	Regnart		1,905		Estimate survey was several days past peak.
1996	8/12	Regnart		1,576		At spawning peak....38 dead observed
1997	8/7	Regnart		1,783		At spawning peak....48 dead observed
1998	8/18	Regnart		2,085		At spawning peak...no carcasses present.
Mean			1,465	1,456		

<sup>1</sup> Surveyor's subjective estimate of instantaneous population of chinook salmon spawners in the river at time of aerial survey, based on survey conditions, river area coverage, water clarity, etc. Does not include expansion for earlier or later run fish not available for counting at time of survey.

Appendix Table 5. Chinook salmon escapement survey history, King Salmon Creek, Naknek River drainage, 1964-1998.

Year	Count Dates	Surveyors	Float Count	Non-expanded Aerial Index Count	Expanded Aerial Index Estimate <sup>1</sup>	Comments
1964	7/31	Paddock		378		Survey conditions fair. Helicopter.
	8/11	Paddock		55		Visibility poor. Helicopter.
	8/11-8/14	Paddock & Siedelman	104			Peak of spawning long past. Poor survey (turbid).
1966	7/31-8/03	Redick	633			Spawning at or near peak.
1967	7/24-7/26	Paddock	289			Poor visibility. Estimated 600 fish present.
1968	7/17	Whitehead		282		Pre-peak. Helicopter.
	7/17	Meyers		242		Pre-peak. Helicopter.
	7/20	Whitehead		868		Optimum conditions. Count from H-21 Helicopter.
	7/20	Meyers		575		Optimum conditions. Count from H-21 Helicopter.
	7/20-7/23	Whitehead & Meyers	2,204			Counting conditions optimum.
1969	7/23-7/25	Parkinson & Berry	2,722			Pre-peak. Count fair-to-poor last 2 days (weather).
1970	7/19	Whitehead		260		Counting conditions poor. Pre-peak.
1971	7/28	Cunningham		704		Visibility was good.
1972	7/29	Siedelman		1,224		Peak of spawning.
1973	8/01	Siedelman		115		Visibility only fair. Survey possibly post-peak.
1974	7/15	Russell		164	350	Pre-peak. Many fish holding in pools.
	7/28	Russell		495	625	At or near peak. Only one carcass obsd. Good vis.
1975	7/28	Russell		279	375	Survey pre-peak. Good viewing conditions.
	8/10	Russell	67			Floated only lower 12 miles of creek.
	8/17	Russell		0		Excellent viewing conditions. Spawning is done.
1976	8/03	Bill		180	400	Peak within next 3 days.
1977	7/29	Russell		1,860	2,350	At peak of spawning.

(Continued)

Appendix Table 5. (Continued)

Year	Count Dates	Surveyors	Float Count	Non-expanded Aerial Index Count	Expanded Aerial Index Estimate <sup>1</sup>	Comments
1978	8/09	Gwartney			350	Past peak. Viewing good. Most fish dead or spent.
1979	??	Gwartney			1,750	
1980	8/08	Bill				Creek too high & muddy to census.
1981	7/30	Russell		591	1,500	Peak of spawning in progress. Vis = fair-to-poor.
1982	8/07	Bill		980	3,920	Good visibility.
1983	8/14	Bill		460	1,400	Poor visibility. Muddy. 30% spawners dead already.
1984	8/08	Bill		385	1,155	
1988	8/08	Minard		600		At peak.
1989	8/14	Minard		100		Past peak.
1990	8/06	Minard		350		
1991	7/30	Russell		100		Pre-peak and water clarity only "Fair".
	8/05	Russell		275		Est. at spawning peak, most fish on redds, 2 dead.
1992	8/09	Russell		158		Post-peak as 47 dead counted & aband. redds numerous.
1993	7/31	Russell		700	900	Slightly pre-peak. Most fish on redds. Water clear.
1994	7/29	Russell		974		Slightly pre-peak. Most fish on redds. Only 6 carcasses.
1995	8/05	Russell		239		A little past peak. Several singles on redds. Vis. only
1996	8/05	Regnart		312		Slightly post peak. 26 dead counted.
1997	7/18	Regnart		902		Pre-peak and water clarity "Good".
1998	8/18	Regnart		1,060		Est. at spawning peak.
Mean			1,190	496		

<sup>1</sup> Surveyor's subjective estimate of instantaneous population of chinook salmon spawners in the river at time of aerial survey, based on survey coverage, water clarity, etc. Does not include expansion for earlier or later run fish not available for counting at time of survey.

Appendix Table 6. Chinook salmon escapement survey history, Paul's Creek, Naknek River drainage, 1971-1998.

Year	Count Dates	Surveyors	Non-expanded Aerial Index Count	Expanded Aerial Index Estimate <sup>1</sup>	Comments
1971	7/28	Cunningham	52		
1972	7/28	Siedelman	156		Prior to peak.
1973	8/01	Siedelman			Too murky to survey.
1974	7/15	Russell	2		
	7/26	Russell	91	250	Prior to spawning peak.
1975	7/28	Russell	144	225	Prior to peak. Good conditions.
1976	8/03	Bill	31	100	Poor conditions. Fish paired & spawning.
1977					No count.
1978	8/09	Gwartney		300	Past peak. 75% of fish dead.
1979					No count.
1980	8/08	Bill	17		All carcasses. Creek high & muddy.
1981					No count.
1982	8/07	Bill	340	1,020	Good visibility. Spawning near peak.
1983	8/14	Bill	290	800	Poor visibility.
1984	8/08	Bill	400	800	Fair visibility. About 25% dead already.
1985	8/06	Bill		170	Pre-peak.
1986	8/08	Meyer	73	236	Approximately 30% dead already.
1987	8/13	Russell	7		Poor survey conditions. Past peak.
	??	Meyer		400	Estimate 400 present based on jet boat surveys.
1988	8/08	Minard	150		At peak.
1989	8/14	Minard	50		Past peak. Excellent visibility.
1990	8/06	Minard	150		Excellent survey conditions.

(Continued)

Appendix Table 6. (Continued)

Year	Count Dates	Surveyors	Non-expanded Aerial Index Count	Expanded Aerial Index Estimate <sup>1</sup>	Comments
1991	7/30	Russell	121		Slightly pre-peak. Only 1 carcass noted.
1992	8/01	Russell	88		Slightly pre-peak. Stream clarity only "Fair".
1993	7/31	Russell	86	140	Slightly pre-peak. Overflow approx 60% of stream.
1994	7/29	Russell	203	300	Pre-peak...but many fish on redds.
1995	8/05	Russell	26		Water clarity poor. 5 carcasses noted
1996	8/05	Regnart	157		Peak of spawning. 12 dead counted.
1997	7/18	Regnart	248		Pre-peak. Excellent visibility
1998	8/18	Regnart	210		
Mean			134		

52

<sup>1</sup> Surveyor's subjective estimate of instantaneous population of chinook salmon spawners in the river at time of aerial survey, based on survey conditions, river area coverage, water clarity, etc. Does not include expansion for earlier or later run fish not available for counting at time of survey.

Appendix Table 7. Chinook salmon escapement survey history, Alagnak River, 1963-1998.

Year	Count Dates	Surveyors	Float Count	Non-expanded Aerial Index Count	Expanded Aerial Index Estimate <sup>1</sup>	Comments
1963	8/12	Siedelman		551		Excellent conditions. No side channels flown.
1966	8/06	Redick		13		Poor conditions.
	8/06-8/10	Redick	238			Nonvianuk & mainstem portions only (not Kukaklek).
	8/11	Redick		1,465		Pre-peak. Still many fish upmigrating.
1967	8/16	VanValin		1,250		
1968	8/18	Siedelman		6,717	8,500	Fairly good survey.
1969	8/19	Siedelman		4,781	6,000	Marginal survey conditions, (20kn NW winds).
1970	8/22	Siedelman		5,250	5,000	Peak of spawning. Visibility good
	8/22	Whitehead		4,590		Peak of spawning. Visibility good
53 1971	8/25	Siedelman		1,420	1,500	Water high, but count okay.
	8/25	Cunningham		1,475		
1972	8/23	Cunningham		2,256	2,400	Past peak. Many dead. Many unoccupied redds.
1973	8/16	Russell		824	1,250	Near peak of spawning. No dead though.
1974	8/13	Russell		1,411	1,700	Pre-peak.
	8/19	Russell		1,596	1,900	Spawning near peak.
1975	8/17	Russell		6,620	7,250	About a week pre-peak. Some large groups holding.
1976	8/16	Bill		7,593	8,750	Pre-peak. Not many dead yet.
1977	8/18	Bill		3,634	12,000	Pre-peak. Didn't count river below Pfaff Pond.
	8/18	Sanders		9,425		Pre-peak. Didn't count river below Pfaff Pond.
1978	8/24	Bill		11,650	25,100	
1979						No survey.
1980	8/08	Bill		2,020	5,090	Pre-peak. Fog over lower river.
	8/21	Bill		2,930	5,860	
1981	8/26	Bill		2,430	8,540	

(Continued)

Appendix Table 7. (Continued)

Year	Count Dates	Surveyors	Float Count	Non-expanded Aerial Index Count	Expanded Aerial Index Estimate <sup>1</sup>	Comments
1982	8/09	Bill		3,400	4,700	At least a weak too early.
	8/19	Bill		3,350	5,480	Peak survey.
1983	8/15	Bill		2,980	3,500	At peak of spawning.
1984	8/14	Bill		6,090	9,135	
1985	8/17	Bill		3,920	9,518	About peak for chinook spawning. 30% dead already.
1986	8/11	Bill		3,090	7,200	Peak of spawning.
1987	8/22	Bill		2,420		
1988	8/12	Bill		4,600		
1989	8/15	Bill		3,650		
54 1990	8/08	Bill		1,720		
1991	8/09	Regnart		2,023		Pre-peak. Most fish schooled yet. Few on redds.
	8/19	Regnart		2,531		Near peak. Most fish on redds.
1992	8/10	Regnart		3,042		Pre-peak. Most fish still schooled.
	8/21	Regnart		2,275		Near peak...but water clarity worse than earlier.
1993	8/09	Regnart		10,170		Near peak. Most on redds.
1994	8/08	Regnart		8,480		About half the fish on redds. Others schooled.
1995	8/10	Regnart		6,860		About 2/3 of chinook noted on redds.
1996	8/12	Regnart		9,885		Near peak. Most on redds.
1997	8/7	Regnart		15,210		Peak. Excellent visibility
1998	8/12	Anderson		4,148		About 1/3 of braids poor light; most on redds.
Mean			238	4,280		

<sup>1</sup> Surveyor's subjective estimate of instantaneous population of chinook salmon spawners in the river at time of aerial survey, based on survey conditions, river area coverage, water clarity, etc. Does not include expansion for earlier or later run fish not available for counting at time of survey.

Appendix Table 8. Chinook salmon escapement survey history, Kvichak River, 1932-1998.

Year	Count Dates	Surveyors	Weir Count	Non-expanded Aerial Index Count	Expanded Aerial Index Estimate <sup>1</sup>	Comments
1932	6/28-8/5		5,753			Peak count was on 7/05 (1,168
1976	8/16	Bill		35	45	Survey timed to count pink salmon.
1980 <sup>a</sup>	8/08	Bill		900	1,000	Chinook actively spawning.
1984	8/14	Bill		200		
1988	8/13	Bill		190	570	Nearly all on redds.
1989	8/16	Bill		100	260	
1990	8/19	Bill		170	510	
1992	8/13	Regnart		264		All fish on redds in Kaskanak Flats.
1993	8/16	Regnart		115		All fish on redds in Kaskanak Flats.
1994	8/12	Regnart		306		
1995	8/14	Regnart		96		
1996	8/18	Regnart		132		
1997	8/15	Regnart		103		
1998	8/14	Anderson		187		All fish on redds in Kaskanak Flats.
Mean			5,753	215		

<sup>1</sup> Surveyor's subjective estimate of instantaneous population of chinook salmon spawners in the river at time of aerial survey, based on survey conditions, river area coverage, water clarity, etc. Does not include expansion for earlier or later run fish not available for counting at time of survey.

<sup>a</sup> Peck's Creek, a Kvichak River tributary, was float surveyed 7/30-8/03, 1980 by R. Russell and 99 spawning chinook salmon were counted.

Appendix Table 9. Chinook salmon escapement data, Naknek-Kvichak District, 1970-1998.

Year	Non-expanded Escapement Indices by Drainage <sup>1</sup>			Total
	Naknek	Alagnak	Kvichak	
1970	4,145 <sup>a</sup>	5,250		9,395
1971	2,885	1,420		4,305
1972	2,791	2,256		5,047
1973	2,536 <sup>a</sup>	824		3,360
1974	1,446 <sup>b</sup>	1,596		3,042
1975	3,452	6,620		10,072
1976	7,131	7,593	35	14,759
1977	6,690 <sup>a</sup>	3,634		10,324
1978		11,650		11,650
1979				0
1980	347 <sup>d</sup>	2,930	900	4,177
1981	4,271 <sup>a</sup>	2,430		6,701
1982	8,610	3,400		12,010
1983	7,830	2,980		10,810
1984	4,995	6,090	200	11,285
1985	590 <sup>e</sup>	3,920		4,510
1986	3,917	3,090		7,007
1987	4,450	2,420		6,870
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
Mean	5,120	5,126	104	10,349

<sup>1</sup> Includes aerial indices from all streams surveyed in drainage.

<sup>a</sup> No index count for Paul's Creek.

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

<sup>c</sup> No non-expanded index counts exist for this year.

<sup>d</sup> Includes only index counts for mainstem Naknek River, Paul's Creek, & Big Creek.

<sup>e</sup> Naknek River mainstem only.

<sup>f</sup> Sum of mean indices.

Appendix Table 10. Chum salmon escapement survey history, Alagnak River, 1961-1998.

Year	Count Dates	Surveyors	Tower Counts	Non-expanded Aerial Index Count	Expanded Aerial Index Estimate <sup>1</sup>	Comments
1961			18,906			
1962			3,846			
1963	8/12	Siedelman	20,124	4,120		
1964			2,562			
1965			132			
1966			9,990			
1967			72			
1968			210			
1969			5,790			
1970			402			
1971			48			
1972						
1973						
1974						
1975					5,250	
1976	8/16	Bill		2,125		
1977	8/18	Bill		35,000		
1978	8/24	Bill		9,900		
1979				7,300	14,600	
1980	8/21	Bill		75,000	75,000	
1981	8/26	Bill		14,000	42,000	
1982	8/09	Bill		12,000	30,000	
	8/19	Bill				Pre-peak.
1983	8/15	Bill		8,800		

(Continued)

Appendix Table 10. (Continued)

Year	Count Dates	Surveyors	Tower Counts	Non-expanded Aerial Index Count	Expanded Aerial Index Estimate <sup>1</sup>	Comments
1984	8/14	Bill		48,000	87,500	
1990	8/08	Bill		8,500	30,000	Pre-peak.
	8/18	Bill		48,800		Close to peak of spawning.
1991	8/09	Regnart		43,000		Pre-peak.
	8/19	Regnart		64,300		Peak of spawning.
1992	8/10	Regnart		114,000		Near Peak.
1993	8/09	Regnart		4,600		Near Peak.
1994	8/08	Regnart		62,900		Near Peak.
1995	8/10	Regnart		132,000		Near Peak.
1996	8/12	Regnart		145,000		Near Peak
1997	8/7	Regnart		37,800		Near Peak
1998	8/12	Anderson		3,150		Poor survey conditions
Mean			3,575	41,919		

<sup>1</sup> Surveyor's subjective estimate of instantaneous population of chum salmon spawners in the river at time of aerial survey, based on survey conditions, coverage, water clarity, etc. Does not include expansion for earlier or later run fish not available for river area counting at time of survey.

Appendix Table 11. Pink salmon escapement survey history, Alagnak River, 1968-1998.

Year	Count Date	Surveyor	Non-expanded Aerial Index Count	Expanded Aerial Index Estimate <sup>1</sup>	Comments
1968	8/27	Siedelman	97,000	125,000	
1970					No survey.
1972					No survey.
1974	8/14	Bill	20,600		Big schools. Pre-peak.
1976	8/16	Bill	6,375	13,000	Pre-peak.
1978	8/24	Bill	330,300	736,000	Just starting to spawn. Many still in lower river.
1980	8/21	Bill	121,000	242,000	
1982	8/09	Bill	21,300	63,900	
	8/19	Bill	24,800	43,000	Pre-peak.
1984	8/14	Bill	296,500	567,100	Survey too early for peak. Most fish schooled.
1986	8/11	Bill	48,600	145,800	
1988	8/12	Bill	415,000	620,000	Pre-peak.
1990	8/08	Bill	45,100		
	8/18	Bill	240,500		Estimated to be about 1 week pre-peak.
1992	8/10	Regnart	15,000		Pre-peak.
1993	8/09	Regnart			No pinks noted.
1994	8/08	Regnart			No pinks noted.
1995	8/10	Regnart			No pinks noted.
1996	8/12	Regnart			No pinks noted.
1997	8/7	Regnart			No pinks noted.
1998	8/12	Anderson	3,200		High water and poor light conditions
Mean			146,880		

<sup>1</sup> Surveyor's subjective estimate of instantaneous population of pink salmon spawners in the river at time of aerial survey, based on survey conditions, river area coverage, water clarity, etc. Does not include expansion for earlier or later run fish not available for counting a time of survey.

Appendix Table 12. Pink salmon escapement survey history, Kvichak River, 1966-1998.

Year	Count Dates	Surveyor	Non-expanded Aerial Index Count	Expanded Aerial Index Estimate <sup>1</sup>	Comments
1966		Robertson		67,500	
1968	8/26	Siedelman		88,000	
1970					No survey.
1972					No survey.
1974	8/14	Bill		30,560	
1976	8/16	Bill		16,100	Most still schooled.
1978	8/28	Bill	88,000	440,000	Still numerous fish migrating & some schooled.
1980	8/08	Bill	7,000	25,000	Still schooled.
1982					No Survey.
1984	8/14	Bill	111,000	165,000	
1986					No survey.
1988	8/13	Bill	94,000		
1990	8/19	Bill	25,300	47,000	
1992					No survey.
1993					No survey.
1994					No survey.
1995					No survey.
1996					No survey.
1997					No Survey
1998					No Survey
Mean			65,060		

<sup>1</sup> Surveyor's subjective estimate of instantaneous population of pink salmon spawners in the river at time of aerial survey, based on survey conditions, river area coverage, water clarity, etc. Does not include expansion for earlier or later run fish not available for counting at time of survey.

Appendix Table 13. Pink salmon escapement survey history, Naknek River, 1974-1998.

Year	Count Dates	Surveyor	Non-expanded Aerial Index Count	Expanded Aerial Index Estimate <sup>1</sup>	Comments
1974	8/14	Bill	161,800	362,000	
1976	8/13	Bill	94,600	110,000	Just pre-peak. Many still schooled.
1978	8/24	Bill	312,000	780,000	
1980	8/08	Bill	80,000	160,000	Pre-peak.
1982	8/19	Bill	33,600	34,000	Pre-peak.
1984	8/14	Bill	27,000	125,000	
1986	8/18	Russell	286,000	375,000	Most fish still schooled and holding. Pre-peak.
1988	8/24	Russell	187,000		
1990	8/18	Bill		65,000	
1992					No survey.
1993					No survey.
1994					No survey.
1995					No survey.
1996					No survey.
1997					No survey.
1998					No survey.
Mean			147,750		

<sup>1</sup> Surveyor's subjective estimate of instantaneous population of pink salmon spawners in the river at time of aerial survey, based on survey conditions, river area coverage, water clarity, etc. Does not include expansion for earlier or later run fish not available for counting at time of survey.

Appendix Table 14. Aerial survey counts of chinook salmon escapement, Egegik District, 1981-1998. <sup>a</sup>

Year	Egegik River	Shosky Creek	Whale Mountain Creek	Mossy Creek	Mink Creek	Gerrude Creek	Kaye's Creek	Takayoto Creek	Angle Creek	Contact Creek	King Salmon River	Total
1981						515						515
1982		300				900				300		1,500
1983						860		380		375		1,615
1984		40	300			600		350		110		1,400
1985		75	80	0	15	260	230	315		95		1,080
1986		65	150	48	0	150	46	40	18	15	532 <sup>b</sup>	1,322
1987		15	174	2	74	408	284	232	2	88		1,279
1988		50	151	0	12	248	120	177		110		868
1989		14	90	13	43	310	120	300		100		997
1990		24 <sup>c</sup>	85	7	35	260	175	175		205		968
1991		0 <sup>c</sup>	62	60	30	83	117	95		73		553
1992 <sup>d</sup>		15	143	52	54	416	320	190		296		1,508
1993		80	58	6	38	350	170	200		235		1,143
1994 <sup>d</sup>		66 <sup>c</sup>	48	32	118	840	214	230		705		2,330
1995 <sup>d</sup>		60 <sup>c</sup>	32	10	53	456	248	130		275		1,367
1996		42 <sup>c</sup>	102	8	38	230	74	123	6	203		846
1997		30 <sup>c</sup>	39	2	18	260	173	374		740		1,646
Average	58	108	18	41	24	420	176	221	4	246		1,185
1998	0 <sup>e</sup>	29	45	55	320	165	120	329				1,063
Deviation <sup>e</sup>	-100%	-73%	144%	35%	-24%	-6%	-46%	34%				-10%

<sup>a</sup> Peak aerial counts unless otherwise noted. Data not expanded.  
<sup>b</sup> Survey 10-14 days later than normal.  
<sup>c</sup> Tower count.  
<sup>d</sup> Helicopter surveys.  
<sup>e</sup> 1998 deviation from 1981-1997 average.

Appendix Table 15. Aerial survey counts of chum salmon escapement, Egegik District, 1982-1998. <sup>a</sup>

Year	Egegik River	Shosky Creek	Whale Mountain Creek	Mossy Creek	Mink Creek	Gertrude Creek	Kaye's Creek	Takayoto Creek	Angle Creek	Contact Creek	King Salmon River	Total
1982						12,000				2,000		14,000
1983	6 <sup>b</sup>					5,000		3,500		6,000		14,500
1984	800	200				13,000		2,400		10,000		26,400
1985	400	0	600	200	35	2,600	800	0		500	50	5,185
1986	0	0	6,025			140	3	5	0	15	25	6,213 <sup>c</sup>
1987	150	0	19,000	16	1,000	3,770	2,780	0		2,850		29,566
1988	500	50	4,400	100	50	5,200	1,600	0		3,200	14	15,100
1989	0	10	3,200	25	100	1,100	0	0		200		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>d</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>d</sup>	42 <sup>b</sup>	0	1,700	5	7	760	175	30		260		2,979
1995 <sup>d</sup>	144 <sup>b</sup>	2	395	15	30	560	162	5		600		1,913
1996	12	0	438	4	20	530	0	24	0	633		1,661
1997	0 <sup>b</sup>	0	220	8	10	495	290	60		640		1,723
Average	162	19	3,168	39	127	3,337	505	402	0	1,991	72	8,990
1998	17 <sup>b</sup>	8	1,480	4		920	4	4		140		2,577

<sup>a</sup> Peak aerial counts unless otherwise noted. Data not expanded.

<sup>b</sup> Tower count.

<sup>c</sup> Survey 10-14 days later than normal.

<sup>d</sup> Helicopter surveys.

Appendix Table 16. Aerial survey counts of pink salmon escapement, Egegik District, 1974-1998.<sup>a</sup>

Year	Egegik River	Whale Mountain Creek	Gertrude Creek	Contact Creek	Takayoto Creek	Kaye's Creek	Other	Total
1974	3,912 <sup>b</sup>							3,912
1976	0 <sup>b</sup>							0
1977	84 <sup>b</sup>							84
1980	0 <sup>b</sup>							0
1982	15,000							15,000
1983			58 <sup>c</sup>					58
1984	17,000							17,000
1985								
1986	2,500							2,500
1987								
1988	23,000							23,000
1989	300							300
1990	17,000		40 <sup>c</sup>					17,040
1991		88 <sup>d</sup>	24 <sup>d</sup>	36 <sup>d</sup>				148
1992 <sup>e</sup>	6 <sup>b</sup>	10					3	13
1993	50							50
1994	21,282 <sup>b</sup>							21,282
1995	24 <sup>b</sup>							24
1996	103,116 <sup>b</sup>							103,116
1997	0 <sup>b</sup>		1,290 <sup>f</sup>					1,290
Average	15,634	49	353	36			3	11,379
1998	2 <sup>b</sup>		2,487 <sup>f</sup>					

<sup>a</sup> Non-expanded aerial peak counts unless otherwise noted.

<sup>b</sup> Tower counts.

<sup>c</sup> Float count.

<sup>d</sup> Foot survey (USFWS).

<sup>e</sup> Helicopter surveys.

<sup>f</sup> Gertrude Creek Weir count.

Appendix Table 17. Aerial survey counts of coho salmon escapement, Egegik District, 1981-1998.

Year	Number of Surveys	Coho Salmon Count	Comments
1981	1 <sup>a</sup>	4,000	Only Becharof tributaries surveyed.
1982	1	20,000	Surveyed on August 20.
1983	0	0	No surveys done.
1984	3	43,225	40,000 counted in Egegik Lagoon on August 15.
1985	3	5,260	Peak surveys on August 26.
1986	1	12,575	Surveyed August 19.
1987	6	6,930	Included King Salmon River & tributaries.
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>b</sup>	0	200	Incidental observation in Egegik River August 6.
1993	0	1,130	Incidental observation from Egegik River August 16.
1994 <sup>b,c</sup>	2	7,412	Included King Salmon River & tributaries.
1995 <sup>d</sup>	2	5,258	Included King Salmon River & tributaries.
1996 <sup>e</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.

<sup>a</sup> Survey done by USFWS personnel.

<sup>b</sup> Helicopter surveys.

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

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

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

Appendix Table 18. Aerial survey counts of chinook salmon escapement, Ugashik District, 1980-1998.

Year	Ugashik River	Dog <sup>1</sup> Salmon River	King Salmon	Painter Creed	Pumice Creek	Old Creek	Total
1980	0 <sup>a</sup>		900	1,000			1,900
1981	18 <sup>a</sup>		50	300			368
1982	0 <sup>a</sup>		700	700			1,400
1983	50 <sup>a</sup>	1,635	525	635	1,800	660	5,305
1984	108 <sup>a</sup>	836	4,100	1,875	1,100	880	8,899
1985	150 <sup>b</sup>	560	4,600	410	930	410	7,060
1986	66 <sup>b</sup>	252	1,777	646	705	739	4,185
1987	54 <sup>a</sup>	751	981	1,051	1,602	1,155	5,594
1988	249 <sup>c</sup>	900	5,820	1,170	1,025	660	9,824
1989	226 <sup>bc</sup>	848	1,670	1,030	510	520	4,804
1990	67 <sup>ac</sup>	540	1,500	590	450	610	3,757
1991	131 <sup>ac</sup>	449	700	365	375	420	2,440
1992 <sup>d</sup>	260 <sup>ac</sup>	821	1,260	855	750	815	4,761
1993	188 <sup>ac</sup>	579	1,970	865	450	635	4,687
1994 <sup>d</sup>	233 <sup>ac</sup>	1,741	2,225	1,005	2,530	1,490	9,224
1995	149 <sup>ac</sup>	882	440	366	501	505	2,843
1996	76 <sup>ac</sup>	1,079	1,200	403		30 <sup>f</sup>	2,788
1997	839 <sup>ac</sup>	906	802	525	536	558	4,166
Average	159	852	1,734	766	947	672	4,667
1998	458 <sup>ac</sup>	1,411	883	1,230	352	438	4,772
Deviation <sup>e</sup>	188%	66%	-49%	61%	-63%	-35%	2%

<sup>1</sup> Includes Figure-Eight, Goblet, Oldham, and Wandering Creeks.

<sup>a</sup> Tower counts

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

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

<sup>d</sup> Helicopter surveys.

<sup>e</sup> 1998 deviation from 1980-1997 average.

<sup>f</sup> Water was too turbid to see fish.

Appendix Table 19. Aerial survey counts of chum salmon escapement, Ugashik District, 1980-1998.

Year	Ugashik River	Dog <sup>1</sup> Salmon River	King Salmon River	Painter Creek	Pumice Creek	Old Creek	Other	Total
1980	18 <sup>a</sup>		7,000	3,000				10,018
1981	0 <sup>a</sup>		200					200
1982	12 <sup>a</sup>		19,000	35,000			650	54,662
1983	0 <sup>a</sup>	1,650	2,700	4,000	20,000 <sup>b</sup>	3,300		31,650
1984	132 <sup>a</sup>	750	119,000	16,000	16,000	14,500	2,500	168,882
1985	42 <sup>c</sup>	350	20,000	1,925	6,000	670	300	29,287
1986	0 <sup>c</sup>	120	8,650	1,200	2,000	630	125	12,725
1987	130 <sup>c</sup>	340	9,750	2,290	10,340	2,090	40	24,980
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>a,c</sup>	851	9,150	1,625	12,750	6,975	150	31,567
1995	6 <sup>a,c</sup>	160	3,900	1,370	2,600	1,800	0	9,836
1996	138 <sup>a</sup>	85	16,500	700	7,400	2,500	0	27,323
1997	100 <sup>a,c</sup>	450	10,500	4,200	5,300	9,480	115	30,145
Average	179	652	15,999	5,419	7,764	4,581	374	32,438 <sup>f</sup>
1998	607 <sup>a,c</sup>	840	10,600	3,800	2,000	4,350	224	22,421
Deviation <sup>g</sup>	239%	29%	-34%	-30%	-74%	-5%	-40%	-31%

<sup>1</sup> Includes Figure-Eight, Goblet, Oldham, and Wandering Creeks.

<sup>a</sup> Tower counts

<sup>b</sup> Float count done from a raft.

<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> 1998 deviation from 1980-1997 average.

Appendix Table 20. Aerial survey counts of pink salmon escapement, Ugashik District, 1980-1998.

Year	Number of Surveys <sup>a</sup>	Pink Salmon Count	Comments
1980	1	2,000	
1982	1	6,000	4,000 in King Salmon River, 2,000 in Painter Creek.
1983	2	803	Survey of Dog Salmon River conducted by USFWS.
1984	3	656	650 counted in King Salmon River during September 21 float
1985	3	0	
1986	1	350	Observed in King Salmon River on August 19.
1987	2	1	
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.

<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.

Appendix Table 21. Aerial survey counts of coho salmon escapement, Ugashik District, 1981-1998.

Year	Number of Surveys	Coho Salmon Counts	Comments
1981	1	13,300	Surveyed on September 7.
1982	1	10,000	Surveyed on August 26.
1983	0		
1984	1	6,100	Surveyed on August 31.
1985	2	18,880	16,500 in King Salmon River on September 12.
1986	2	8,455	Surveyed on August 19 and 25.
1987	2	17,000	16,700 in King Salmon River on August 23.
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.

<sup>a</sup> Helicopter survey.

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

Appendix Table 22. Spawner distribution and total escapement estimates of sockeye salmon, Wood River system, 1959-1998.

Year	Spawner Distribution (%)			Total Escapement <sup>1</sup>
	Creeks	Beaches	Rivers	
1959	32.8	50.3	16.9	2,209,300
1960	27.4	55.5	17.1	1,016,100
1961	11.4	32.3	56.3	460,700
1962	24.0	65.2	10.8	873,900
1963	12.1	68.5	19.4	721,400
1964	18.9	64.0	17.1	1,076,100
1965	40.6	11.1	48.3	675,100
1966	16.4	54.9	28.7	1,208,700
1967	9.3	66.2	24.5	515,800
1968	9.9	50.8	39.3	649,300
1969	8.6	42.4	49.0	604,300
1970	14.0	52.4	33.6	1,162,000
1971	11.2	56.8	32.0	851,200
1972	17.4	45.1	37.5	430,600
1973	11.5	23.9	64.6	330,500
1974	14.1	63.9	22.0	1,708,800
1975	14.5	34.4	51.1	1,270,100
1976	12.7	33.5	53.8	817,000
1977	11.3	39.5	49.2	561,800
1978	14.2	51.3	34.5	2,267,200
1979	7.3	60.4	32.3	1,706,400
1980	20.8	24.5	54.7	2,969,000
1981	23.0	20.7	56.3	1,233,000
1982	14.0	17.2	68.8	976,400
1983	14.3	60.9	24.8	1,361,000
1984	11.4	27.6	61.0	1,002,800
1985	18.6	22.2	59.1	939,000
1986	16.1	23.3	60.6	819,000
1987	27.6	56.1	16.3	1,337,000
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
Mean	19.0	44.0	36.5	1,134,266
1998	20.0	66.2	13.8	1,755,800

<sup>1</sup> Estimated from Wood River tower counts. Rounded to the nearest hundred.

Appendix Table 23. Total escapement estimates of pink salmon, Nushagak and Togiak Districts, 1962-1998.<sup>a</sup>

Year	Nushagak District <sup>1</sup>	Togiak District <sup>2</sup>
1962	543,000	
1964	910,560	
1974	585,520	8,620 <sup>d</sup>
1976	863,430	37,570
1978	9,386,480	150,000 <sup>d</sup>
1980	2,785,200	102,820
1982	1,656,660	44,300
1984	2,926,450	269,950
1986	72,190 <sup>b</sup>	80,000 <sup>d</sup>
1988	494,610 <sup>b</sup>	142,500 <sup>d</sup>
1990	801,730 <sup>b</sup>	207,000
1992	<sup>c</sup>	235,000 <sup>d</sup>
1994	192,780 <sup>b</sup>	88,000 <sup>d</sup>
1996	821,312 <sup>b</sup>	<sup>c</sup>
Mean	1,695,379	124,160
1998	132,400 <sup>b</sup>	134,780

<sup>1</sup> Includes Wood, Igushik, Snake, Nushagak, and Nuyakuk Rivers, and Ice, Youth, and Sunshine Creeks, unless otherwise noted.

<sup>2</sup> Includes Togiak, Matogak and Osviak Rivers; 1982, 1990 and 1998 also include Slug River.

<sup>a</sup> Only those years of comprehensive aerial survey coverage are included: even years only; all counts rounded to the nearest 10 fish.

<sup>b</sup> Sonar estimate of Nushagak-Mulchatna Rivers only.

<sup>c</sup> No escapement estimate.

<sup>d</sup> Togiak River estimate only.

Appendix Table 24. Aerial estimates of sockeye salmon escapements, Togiak District, 1978 - 1998.<sup>a</sup>

Year	Togiak River & Tributaries <sup>1</sup>	Kulukak Systems <sup>2</sup>
1978	30,600	33,900
1979	23,700	26,600
1980	50,700	45,700
1981	39,700	58,800
1982	25,300	52,800
1983	13,200	27,000
1984	30,900	49,800
1985	8,800	36,600
1986	35,000	42,800
1987	28,600	37,800
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	19,420	29,700
1995	25,500	14,600
1996	30,200	19,000
1997	20,600	8,000
<hr/>		
1978-97 Mean (20-Year)	26,881	32,865
1978-87 Mean (10-Year)	28,650	41,180
1988-97 Mean (10-Year)	25,112	24,550
<hr/>		
1998	21,900	13,000

<sup>1</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 1977-94 data as reported in Bristol Bay Data Reports 73 and 81.

<sup>2</sup> Includes Kulukak River, Kulukak Lake, and Tithe Creek Ponds.

<sup>a</sup> All counts are rounded to the nearest hundred.

Appendix Table 25. Peak aerial counts of five sockeye salmon, Togiak River drainage, 1978 - 1998.

Year	Togiak Mainstem	Gechak River	Pungokepuk River	Nayorurun River	Kemuk River	Ongivunuck River	Total
1978	10,000	2,020	1,200		4,620		17,840
1979	7,100	520	750	500	3,200	2,800	11,170
1980	18,600	3,200	2,500			2,000	30,000
1981	14,100	2,700	3,150			3,400	23,350
1982	2,300	3,600	2,500	0	100	4,800	13,300
1983	4,800	1,100	700	0	0	1,200	7,800
1984	10,550	2,800	2,450	0	0	2,300	18,100
1985	1,800	400	500	0	0	1,700	4,400
1986	13,500						13,500
1987	5,200	3,600	600	0	0	4,900	14,300
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
Mean	7,538	2,080	1,510	65	995	2,692	14,879 <sup>a</sup>
%	50.7%	14.0%	10.1%	0.4%	6.7%	18.1%	100.0%

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

Appendix Table 26. Peak aerial counts of live sockeye salmon, Togiak District, 1978-1998.

Year	Togiak River <sup>1</sup>	Kulukak River <sup>2</sup>	Tithe Creek Ponds	Quigmy River	Matogak River	Osviak River	Slug River	Negukthlik River	Ungalikthluk River	Total
1978	17,840	8,100	11,800						1,000	38,740
1979	11,170	4,600	10,800		200	200		600	700	28,270
1980	30,000	12,200	14,200		500	200	1,900			63,500
1981	23,350	15,700	18,250		700	6,400	5,900	3,900	12,800 <sup>a</sup>	74,200
1982	13,300	11,900	19,300		0	1,000	5,500	300	2,400	53,700
1983	7,800	8,430	2,720		80	20	2,000	230	940	22,220
1984	18,100	7,400	14,000		200	6,800		100	5,200	51,800
1985	4,400	6,700	11,600		0	200	2,300	260	1,310	26,770
1986	13,500	10,900	14,000							38,400
1987	14,300	10,500	8,400							33,200
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 <sup>b</sup>		360	780	1,045	1000 <sup>b</sup>		26,785
1997	13,750	2,300	3,000		360	780	1,045	1,000		22,235 <sup>b</sup>
Mean	14,085	8,320	8,925	172	377	1,870	3,078	2,126	2,507	41,460 <sup>c</sup>
%	34.0%	20.1%	21.5%	0.4%	0.9%	4.5%	7.4%	5.1%	6.0%	100.0%
1998	10,950	2,175	4,300	20	900	2,600	5,010	2,300	240	28,495

<sup>1</sup> Includes all surveyed sections of Togiak River proper and all tributaries to the Togiak River.

<sup>2</sup> Includes surveys of Kulukak Lake. Counts prior to 1977 include Kulukak Lake only and are not included in the mean.

<sup>a</sup> Includes a combined count for the Negukthlik and Ungalikthluk of 4,500 fish.

<sup>b</sup> Complete count not available

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

Appendix Table 27. Peak aerial counts of live chinook salmon, Togiak River drainage, 1978-1998.

Year	Togiak River Section <sup>1</sup>						Pungokepuk River		Kemuk River	Ongivinuck River	Total	
	A	B	C	D	E	F	Gechiak River	Nayorurun River				
1978	940	1,240	1,390	810	1,060	1,850	2,150	590	780	220	220	11,250
1979	370	250	330	150	560	890	1,060	360	250	170	220	4,610
1980	180	120	340	230	120	140	910	200	510	170	190	3,110
1981	420	390	500	200	300	740	980	310	370	390	290	4,890
1982					80	320	470	170	190	130	470	1,830
1983	120	220	370	290	360	850	820	240	340	430	350	4,390
1984	250	560	900	560	820	1,920	760	580	270	580	430	7,630
1985	270	320	640	340	470	970	470	250	290	310	460	4,790
1986	150	80	160	30	110	350						880
1987	20	70	170	120	200	480	610	180	100	120	320	2,390
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>a</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
Mean	231	265	520	280	484	910	644	233	247	274	257	4,344 <sup>b</sup>
%	5.3%	6.1%	12.0%	6.4%	11.1%	21.0%	14.8%	5.4%	5.7%	6.3%	5.9%	100.0%
1998	10	20	250	50	400	1200	400	150	275	140	275	3,170

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<sup>1</sup> Section A; Togiak Bay - Gechiak River  
 Section B; Gechiak River - Pungokepuk River  
 Section C; Pungokepuk River - Nayorurun River  
 Section D; Nayorurun River - Kemuk River  
 Section E; Kemuk River - Ongivinuck River  
 Section F; Ongivinuck River - Togiak Lake

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

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

Appendix Table 28. Peak aerial counts of live chinook salmon, Togiak District, 1978-1998.

Year	Togiak River <sup>1</sup>	Quigny River	Kulukak River	Matogak River	Osviak River	Slug River	Negukthlik River	Ungalikthluk River	Total
1978	11,250		2,720	150	250		1,020	110	15,500
1979	4,610	20	2,260	100	210		850	130	8,180
1980	3,110	0	700	70	40		260	160	4,340
1981	4,890	0	1,290	470	1,730	350	1,460	180	10,370
1982	1,830	90	1,690	290	320		1,600	280	6,100
1983	4,390	40	2,460	190	120		1,080	260	8,540
1984	7,630	30	1,190	150	360		680	20	10,060
1985	4,790	0	540	100	50		80	90	5,650
1986	880								880
1987	2,390		300	30	40		660	80	3,500
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	<sup>a</sup>	3,771
1997	5,150	10	310	50	65	33		10	5,628
Mean	4,058	24	1,010	112	215	67	778	108	6,372 <sup>b</sup>
%	63.7%	0.4%	15.9%	1.8%	3.4%	1.1%	12.2%	1.7%	100.0%
1998	3,170	45	375	92	58	39	75	25	3,879

<sup>1</sup> Includes all surveyed sections of Togiak River proper and all tributaries to the Togiak River.

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

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

Appendix Table 29. Peak aerial counts of live chum salmon, Togiak River drainage, 1978-1998.

Year	Togiak River Section <sup>1</sup>						Pungokepek River		Kemuk River		Ongivinuck River	Total
	A	B	C	D	E	F	Gechiak River	Nayorurun River				
1978	24,500	7,400	7,500	1,600	15,200	3,300	6,300	2,500	7,300	1,800	8,100	85,500
1979	14,000	2,800	3,300	800	6,600	10,400	3,500	1,000	2,500	500	200	45,600
1980	41,300	11,000	9,200	900	6,000	3,100	10,200	2,700	10,100	800	3,500	98,800
1981	11,800	4,500	2,400	1,000	3,000	6,000	3,100	500	4,300	1,700	4,200	42,500
1982				200	1,200	2,500	500	400	1,300	100	1,000	7,200
1983	8,160	3,050	3,780	1,100	2,780	6,070	150	140	5,560	570	3,790	35,150
1984	3,900	6,300	800	0	2,600	6,400	3,700	2,000	4,200	700	3,500	34,100
1985	8,300	6,500	3,200	900	6,700	10,200	4,100	600	9,600	1,800	8,300	60,200
1986 <sup>a</sup>												
1987	12,000	9,400	2,700	500	13,200	33,000	2,600	1,200	4,100	700	13,100	92,500
1988	10,000				4,900	3,800	3,700	5,000	3,500	200	3,800	34,900
1989		2,600	2,100		5,000	8,100	290	700			1,200	19,990
1990	2,200	1,275	1,350	400	650	4,200	3,150	1,150	3,400	250	125	18,150
1991	10,200	3,900	2,800	600	5,500	6,000	2,300	500	3,500	800	3,480	39,580
1992 <sup>b</sup>	1,800	1,800	300	100	1,200	1,500	2,000	500	1,800	900	800	22,700 <sup>c</sup>
1993	6,500	3,500	2,300	60		4,400 <sup>d</sup>	1,950	450	4,380	620	3,500	23,260
1994				1,300	5,200	10,400	900	2,400	7,100	900	5,700	33,900
1995	15,700	7,100	4,700	1,800	6,800	5,900	4,800	1,900	9,700	2,700	8,200	69,300
1996	3,700	10,250	5,500	1,300	5,750	8,250	2,600	750	900	550	3,400	42,950
1997	3,900	3,100	3,800	2,750	7,100	4,550	3,200	800	4,750	1,800	3,900	39,650
Mean	11,744	5,512	3,695	951	5,775	7,343	3,169	1,372	5,070	970	4,389	49,989 <sup>e</sup>
%	23.5%	11.0%	7.4%	1.9%	11.6%	14.7%	6.3%	2.7%	10.1%	1.9%	8.8%	100.0%
1998	2,300	1,400	2,750	1,300	4,300	8,950	3,600	1,050	3,000	250	1,650	30,550

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<sup>1</sup> Section A; Togiak Bay - Gechiak River  
 Section B; Gechiak River - Pungokepek River  
 Section C; Pungokepek River - Nayorurun River  
 Section D; Nayorurun River - Kemuk River  
 Section E; Kemuk River - Ongivinuck River  
 Section F; Ongivinuck River - Togiak Lake

<sup>a</sup> No aerial surveys conducted.

<sup>b</sup> Counts by section are not representative due to post-peak survey, and are not included in the mean.

<sup>c</sup> Preferred total estimate; management survey count conducted 7/15/92.

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

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

Appendix Table 30. Peak aerial counts of live chum salmon, Togiak District, 1978-1998.

Year	Togiak River <sup>1</sup>	Quigmy River	Kulukak River	Matogak River	Osviak River	Slug River	Negukthlik River	Ungalikthluk River	Total
1978	85,500	9,400	24,200	15,000	17,500	6,400	7,600	8,000	173,600
1979	45,600	11,000	16,400	13,400	36,200	4,000	3,800	6,600	137,000
1980	98,800	2,700	27,300	5,700	29,500	6,700	18,500	15,000	204,200
1981	42,500	10,800	11,200	21,700	53,000	3,900	3,800	14,600	161,500
1982	7,200	1,300	8,300	3,100	5,500	2,400	160	1,270	29,230
1983	35,150	4,900	12,960	7,600	11,900	1,210	300	7,360	81,380
1984	34,100	6,300	8,500	10,200	18,400		2,100	3,000	82,600
1985	60,200	1,800	7,800	2,860	5,460	8,800	130	14,650	101,700
1986 <sup>a</sup>									
1987	92,500	1,500	22,000	2,300	2,160				120,460
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	<sup>a</sup>	<sup>a</sup>	53,290
Mean	48,402	4,147	12,447	6,541	12,664	4,319	2,201	6,024	96,743 <sup>d</sup>
%	50.0%	4.3%	12.9%	6.8%	13.1%	4.5%	2.3%	6.2%	100.0%
1998	30,550	2,630	2,700	4,980	3,870	1,060	150	1,300	47,240

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<sup>1</sup> Includes all surveyed sections of Togiak River proper and tributaries to the Togiak River.

<sup>a</sup> No aerial surveys conducted.

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

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

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

Appendix Table 31. Peak aerial counts of live coho salmon, Togiak River drainage, 1980-1998.

Year	Togiak River Section <sup>1</sup>						Gechiak River	Pungokepuk River	Nayorurun River	Kemuk River	Ongivinuck River	Total
	A	B	C	D	E	F						
1980	3,620	1,010	1,740	1,270	5,080	1,860	3,460	760	1,310	860	740	21,710
1981	9,280	580	100	800	370	750	520	360	230	210	1,300	14,500
1982	2,200	1,500	150	100	1,400	1,700	1,930	1,740	510	200	11,870	23,300
1983 <sup>a</sup>												
1984	1,440	1,190	200	120	620	1,480	4,750	2,240	990	1,110	6,140	20,280
1985	800 <sup>b</sup>	660 <sup>b</sup>	110 <sup>b</sup>	70 <sup>b</sup>	150	820	1,340	750	40	80	6,250	9,430
1986			60	400	100	400					2,560	3,520
1987	340	500	250	200	240	530	1,020	70			1,060	4,210
1988	950	370		140	210	360	1,530				4,100	8,590
1989 <sup>a</sup>												
1990	1,650	390	400	0	540	660	920	450	260	130	1,730	7,130
1991	4,900 <sup>c</sup>	400 <sup>c</sup>	700 <sup>c</sup>	600 <sup>c</sup>	1,680 <sup>c</sup>	140					100 <sup>c</sup>	140 <sup>c</sup>
1992	4,420	1,120	1,180	540	2,940	3,080	5,240	1,440	780	1,500	4,460	26,700
1993 <sup>a</sup>												
1994 <sup>a</sup>							1,290 <sup>c</sup>	220 <sup>c</sup>	120 <sup>c</sup>	95 <sup>c</sup>	1,930	
1995 <sup>a</sup>							1,450			200	1,180	
1996	2,550	1,090	150	250	1,600	5,020	2,080	1,170	575	725	6,450	21,660
1997	600	200	400	100	400	1,800	1,000	650	350	475	900	6,875
Mean	2,459	723	421	327	1,138	1,538	1,942	875	505	499	3,619	13,992 <sup>d</sup>
%	17.6%	5.2%	3.0%	2.3%	8.1%	11.0%	13.9%	6.3%	3.6%	3.6%	25.9%	100.0%
1998	460	625	100	100	310	1,075	2,550	575	400	500	1,750	8,445

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<sup>1</sup> Section A; Togiak Bay - Gechiak River  
 Section B; Gechiak River - Pungokepuk River  
 Section C; Pungokepuk River - Nayorurun River  
 Section D; Nayorurun River - Kemuk River  
 Section E; Kemuk River - Ongivinuck River  
 Section F; Ongivinuck River - Togiak Lake

<sup>a</sup> No aerial surveys conducted.

<sup>b</sup> Proportional estimates based on 1984 data.

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

Appendix Table 32. Peak aerial counts of live coho salmon, Togiak District, 1980-1998.

Year	Togiak River <sup>1</sup>	Quigmy River	Kulukak River	Matogak River	Osviak River	Slug River	Negukthlik River	Ungalikthluk River	Creek	Total
1980	21,710		10,300							32,010
1981	14,500		3,790				100	840	1,080	20,310
1982	23,300		3,380							26,680
1983 <sup>a</sup>										
1984	20,280		10,750	1,850	1,080	670				34,630
1985	9,430	200	7,790	610	420					18,450
1986	3,520									3,520
1987	4,210	30	910	440	120			130		5,840
1988	8,590	460	1,840	310	490	470	370	3,170		15,700
1989 <sup>a</sup>										
1990	7,130	1,029	5,195	2,675	1,491	810		4,153		22,483
1991	140 <sup>b</sup>		4,200 <sup>b</sup>							0
1992	26,700		12,640							39,340
1993 <sup>a</sup>										
1994 <sup>a</sup>										
1995		855	1,185	1,392	1,080	1,149		5,196 <sup>c</sup>		
1996	21,660	1,211	10,290	3,062	2,805	1,944	851	5,917	<sup>f</sup>	47,740
1997	6,875	325	1,675	150	1,046	1,397		1,690		13,158
Mean	13,992	587	5,812	1,311	1,067	1,073	440	2,271	540	23,322 <sup>d</sup>
%	60.0%	2.5%	24.9%	5.6%	4.6%	4.6%	1.9%	9.7%	2.3%	100.0%
1998	8,445	390	3,650	1,785	2,001	523	<sup>f</sup>	2,770		19,564

<sup>1</sup> Includes all surveyed sections of Togiak River proper and tributaries to the Togiak River. See Appendix Table 34.

<sup>a</sup> No aerial surveys conducted.

<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> Only Togiak River tributaries surveyed; not included in the mean or percent.

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

<sup>e</sup> Negukthlik and Ungalikthluk Rivers combined.

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

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