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NULATO RIVER SALMON ESCAPEMENT PROJECT, 1996

by

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABSTRACT

Prior to 1994, salmon escapements to the Nulato River were indexed by aerial surveys. Beginning in 1994, a cooperative project was formed by the Tanana Chiefs Council and ADF&G to count salmon escapement from counting towers. Continuing in 1996, from towers situated on each bank of the mainstem of the Nulato River, daily passage of summer chum salmon (*Oncorhynhcus keta*) and chinook salmon (*O. tshawytscha*) were estimated from visual observations during the period 21 June to 19 July, 1996. Counting was interrupted from 28 June until mid-day on 30 June by high, muddy water, and counts were interpolated for that missed period. Total estimated escapement during the period that the tower was in operation was 129,694 chum and 756 chinook salmon. Observations on commercial fisheries catches, some aerial survey data and other system escapements indicate that chinook salmon runs to the lower Yukon River were generally weak and escapements goals were probably not reached in systems below the Tanana River. Summer chum salmon runs were strong as anticipated and escapement goals for that species were met throughout the Yukon River drainage for the third consecutive year.

INTRODUCTION

Two distinct runs of chum salmon (*Oncorhynchus keta*) occur in the Yukon River, a summer and a fall run, along with chinook (*O. tshawytscha*), coho (*O. kisutch*) and pink salmon (*O. gorbuscha*). Successfully managing the harvest and escapement of these stocks over such a large river basin requires reliable information from locations along the mainstem Yukon River to indicate strength of the runs as they move up the river and through the fishing districts. Main river sonar, test fishing, age composition information, commercial fisheries catches, and subsistence harvest provide considerable information, but there are relatively few projects that provide spawning stock escapement information. Historically most information on escapements came from aerial surveys, and while this information was used to make relative comparisons between years, variations between skill and experience of surveyors and pilots, timing of the surveys, and survey conditions such as weather and water clarity made the quality of aerial indices from year to year very questionable or even unusable as a management database. Counting towers and sonar projects provide total population estimates, and are far more consistent than aerial surveys. Such projects are utilized in key tributary rivers as funding and personnel make such projects possible. In recent years, involvement and participation by federal agencies, and private groups with funds from the Bering Sea Fishermen's Association (BSFA), have increased coverage of spawning streams with projects such as this one on the Nulato River, and are making significant contributions to the database available for management of the Yukon River salmon resources.

The Anvik River, in the middle Yukon River at river km (rkm) 512, is the largest producer of summer chum salmon in the Yukon River drainage. Prior to 1994, Lower Yukon River test fishing CPUE estimates, in-season passage estimates of summer chum salmon from the Yukon River sonar project at rkm 198, and the Anvik River sonar project provided much of the available information used to make management decisions concerning the commercial harvest of summer chum salmon in District 4 (Figure 1), or between the confluence of the Anvik and Tanana Rivers. There was need for an inseason escapement-monitoring project for summer chum salmon within the upper portion of District 4 that would serve as an index for the size and quality of spawning escapements in that portion of the middle Yukon River area. In addition, genetic stock identification sampling of escapements could contribute to attempts to apportion summer chum salmon fishery harvests to stock of origin. The Nulato River, by location and historical magnitude of aerial spawning escapements, was chosen as representative of that portion of the middle Yukon River area. The Nulato River is believed to be the largest producer of summer chum salmon upriver of the Anvik River (Sandone 1995). Chinook occur in the Nulato River coincidentally with summer chum salmon. Some pink and coho salmon have also been reported to spawn in the Nulato River.

A thorough review of the Nulato River and probable contribution of salmon production from this stream to the Yukon River is presented in the 1994 season report for the counting tower project (Sandone 1995), which was the first year of operation. The 1995 field project data was reported only as a brief summary by Paul Headlee, Water Resource Specialist, Tanana Chiefs Conference, Inc. (Headlee 1996) This report is written to present the information gathered in 1996 and make it available for reference. A more thorough analysis of data from the Nulato River would be advisable after a complete brood–year cycle has been monitored with the counting tower methodology.

Harvest of Nulato River Salmon

Nulato River salmon are probably harvested in commercial and subsistence fisheries throughout the mainstem Yukon River from the coast of the delta to the mouth of the Nulato River. That section of river includes Districts 1,2,3 and most of District 4. Large test net catches early in June in 1996 indicated the summer chum run was both unusually early and above average in abundance. After 13 June, however, commercial harvests and test fishing CPUE were generally lower than average.

Primarily because of the poor summer chum salmon flesh market, the 1996 Lower Yukon Area summer chum salmon harvest was below the lower end of the guideline harvest range. Fish taken commercially in the lower districts are usually sold in the round, and in 1996 several buyers had expressed interest in buying summer chums. Because of declining market conditions, however, summer chum salmon were not targeted during the entire season. District 3 was opened for the taking of summer chum salmon for roe after interest was expressed by fishermen and buyers. The total combined commercial summer chum salmon harvest in Districts 1 and 2 of 123,000 fish was 39% below the recent 5-year average and 51% below the lower end of the guideline harvest range. The Nulato River flows into the Yukon River near the upper end of Subdistrict 4-A. District 4 was opened to commercial fishing on 23 June. With the large summer chum salmon run and the low harvest in the lower river, a harvestable surplus of summer chum salmon was available in Subdistrict 4-A. Because of this large surplus, the sale of summer chum salmon roe in Subdistrict 4-A and in the Anvik River Management Area was allowed to reach near the roe caps. In Subdistrict 4-A 181,000 pounds of summer chum salmon roe was sold, while an additional 76,000 pounds were sold in the Anvik River management area (JTC 1996).

Escapement Assessment

The Nulato River is one of the department's primary aerial survey index areas for assessment of the relative magnitude of summer chum and chinook salmon spawning escapement within the Yukon Area. Nulato River escapement goals are based on aerial survey salmon index counts. Escapement goals have been established for the Nulato River beginning in 1981, and at present the summer chum salmon aerial survey goal for the North Fork only is set at 53,000 fish (Sandone 1995). In those years when aerial surveys were conducted, that escapement objective has not been achieved since 1977. Based on the ratio of the aerial survey figure to that of the tower count in 1995, the only year with comparable data from both sources, the aerial escapement goal for summer chum salmon probably would not have been achieved in 1996, although the run and escapements throughout that area of the Yukon River were considered strong. The possibility exists that the broad variance in accuracy that can occur between aerial survey estimates of summer chum salmon might make use of that information misleading in determining acceptable levels of escapement. The current counting tower project is expected to gather much more reliable data. Summer chum salmon runs were anticipated to be average to above average in strength for 1996, and based on commercial harvest and escapements in selected spawning areas, escapement goals appear to have been met throughout the Yukon River drainage for the third consecutive year (JTC 1996).

There have also been chinook salmon escapement goals established for the Nulato River since 1981 (Sandone 1995). Most recently, chinook salmon escapement goals for Yukon River stocks were reevaluated in the spring of 1991 and made effective for the 1992 season (Buklis 1993). Minimum interim escapement goals for chinook salmon, based on aerial survey counts, were established for both forks of the Nulato River as part of that effort. In 1996, however, only the South Fork of the Nulato River was surveyed for chinook salmon with no aerial survey of chum salmon. The aerial survey index count of chinook salmon was one of the lowest since the program was initiated in 1974, estimating only 100 fish in the area below the confluence of the North and South Forks and in the South Fork, well below the minimum aerial survey escapement goal for the South Fork of 500 chinook salmon. The aerial escapement survey goal for the North Fork Nulato River is 800 chinook salmon. The North Fork Nulato River was not surveyed because of poor weather. In general, chinook salmon escapements in the lower and portions of the middle Yukon River were weak, and a majority of chinook salmon escapements below the Tanana River did not appear to reach minimum goals (JTC 1996).

Study Area

The Nulato River is a narrow runoff stream with a substrate mainly of gravel and cobble. The river is formed from two main branches, the North and South Fork, that converge approximately 9 km above its mouth. Both forks of the Nulato River originate at an elevation of approximately 600 m. From its source, the South Fork flows in a

northeasterly and easterly direction about 98 km to the confluence with the North Fork. From its source, the North Fork, for the most part, also flows in a northeasterly and easterly direction. The North Fork drainage includes the Kalasik Creek (Figure 2) drainage. The mainstem Nulato River joins the Yukon River at rkm 777 at an approximate elevation of 33 m (Sandone 1995).

The Nulato River tower site is located approximately 5 km upstream of the confluence of the Nulato and Yukon Rivers. The water is typically clear with some brown staining from peat and organic material along the watershed. Practically all chum salmon spawning areas appear to be upstream of the tower site.

Objectives

The objectives of this project are:

1. estimate total escapement of summer chum and chinook salmon into the Nulato River from mid-June through the end of July using tower-counting methodology;

2. estimate the age and sex composition of the summer chum spawning population;

3. monitor climatological and hydrological conditions at the tower site.

METHODS

Site Selection and Preparation

The site was selected after completion of a reconnaissance of the mainstem Nulato River in 1994. The criteria used for selection included: 1. Location well below most, if not all, chum salmon spawning areas, 2. Single, relatively narrow channel, and 3. Relatively shallow river depth so that migrating salmon could be observed from the towers. The south side of the river is a wide gravel bar with gradual drop-off. The north side is a cut-bank with a rapid drop-off, with the deepest part of the river channel close to that bank. At the start of the project the maximum depth was about 2.5 m on the north side of the channel and the stream width at the tower site was approximately 49 m.

On the north side of the river a tower about 3.0 m (10 feet) high, of steel scaffolding material, was erected on the cut-bank. On the south side of the river two sections of tower material were combined to make the height 6.1 m (20 feet) and the tower placed out in the stream in about 0.5 m of water depth to decrease the span of the river in which fish were to be counted. A diversion weir of wire fencing and T-stakes extended about 15 m from the edge of the water to the outer limit of the tower to prevent fish from passing under and behind the tower where they might not be counted. To make the fish easier to see, light-

colored, empty sandbags were attached to a cable that reached from bank to bank and was sunk to the bottom of the river with sand bags filled with gravel. This light-colored background made a strong contrast with the passing salmon and improved the ability of the crew to see and count fish. Keeping the reflective panels and cable on the bottom was difficult near the north bank, and on the first day of operation fish were seen to pass under the cable. Additional gravel-filled bags placed on the cable solved the problem. While counting, observers wore polaroid glasses to reduce glare. During the darkest hours several lights suspended on a line across the river illuminated the counting area.

Tower-Count Sampling

Tower counting operations were conducted 7 days a week, 24 hours a day, for a 15-minute count each hour on each bank. The north bank count period was at the top of the hour and the south bank was at the bottom of the hour. The observer counted fish passage by species and recorded those that were moving upstream and downstream. Counts were kept on a hand-held tally counter then transferred onto data forms immediately after completing the count on each tower. Counts were expanded for each hour, for each bank, by dividing the count by the proportion of the hour counted. Missed counts were estimated by averaging the counts for the hours before and after the missed hourly count. When salmon were not counted for a portion of a day, the expanded daily count total for that day was estimated by dividing the expanded partial daily count by the mean proportion of expanded counts for the corresponding hours for the first day before and after having full 24-hour counts. When counting was not conducted for a full day the salmon passage estimate for that day was calculated as the mean salmon passage for the day before and after. When counting was not conducted for more than one full day, the passage estimate for those days was estimated by interpolating between the last full day of counts and first full day after resumption of counts.

The daily passage for each bank was calculated by summing the expanded hourly counts for each species, for each bank. The total daily passage estimate for each species was the sum of the expanded count for each bank.

Age-Sex-Size Sampling

When the Nulato project was initiated in 1994, dates needed to be established to define sampling strata for collecting age-sex-length (ASL) information. Daily passage timing information did not exist for the Nulato River. Aerial survey information seemed to indicate, however, that historically the timing of peak abundance for summer chum salmon in the Nulato River was similar to that of the Anvik River for which sonar daily passage estimates were available dating back to 1979. Strata periods were selected for the Nulato that were identical to those on the Anvik River, and described as: early, 20 June-3 July; early-middle, 4-8 July; late-middle, 9-13 July; and late, 14-26 July (Sandone 1995).

A beach seine 31 m long, 66 meshes deep of 6.35 cm mesh, was used to catch salmon for ASL samples. Captured salmon were identified for species and sex, measured for length from mid-eye to fork of tail to the nearest 5 mm, and on chum salmon a single scale was taken for determining age. The scale was taken from an area posterior to the base of the dorsal fin and above the lateral line on the left side of the fish. The adipose fin was removed to identify sampled fish so they would not be re-sampled should they be caught in a subsequent seine set. Three scales were taken from chinook salmon. Scales were wiped clean to remove slime and tissue and affixed to a gum-surfaced scale card with numbers that match those on the recording form. The scales are later pressed with heat into acetate to make a print of the growth rings and permit aging of the sampled fish with a microfische reader.

Sample goals for each species were based on 95% precision with a 10% accuracy for each time stratum. The season ASL sample goal is set at 640 chum salmon and all chinook salmon, with 160 chum salmon sampled in each of the strata described above. Beyond the required ASL sample, beach seining is continued until an additional 200 fish per stratum are caught and observed for male-female ratio. The additional 200 fish per strata combined with the 160 summer chum salmon per strata will give a total sex ratio sample of 1,480 fish for the season on the Nulato River to define the quality of the escapement. For chinook salmon escapement a sample size of 198 was the season goal, in a single stratum, based on the number of age classes that were expected in the run (Bromaghin 1993). While beach seine catches were expected to yield the desired total chum salmon sample, there was almost no probability that the chinook salmon sample would be achieved.

Hydrological and Climatological Sampling

Climatological data were collected at approximately 1800 hours each day at the campsite. Relative river depth was monitored on a staff gauge marked in 0.01-ft increments. Change in water depth was converted to centimeters and presented as negative or positive increments from the initial reading of 0.0 cm. Water temperature was measured in degrees centigrade near shore at a depth of about 0.5 m. Daily maximum and minimum air temperatures were recorded in degrees centigrade. Subjective notes were kept by the crew describing wind speed and direction, cloud cover, and precipitation. At about the mid-point of the season a depth profile of the river was constructed by taking depth measurements to the nearest 1 cm at 3 m intervals across the entire channel, and the relative depth on the water gauge recorded at the same time so relative daily depths can be defined for the season as needed.

RESULTS AND DISCUSSION

Escapement Estimation

The counting towers were operated on each bank of the Nulato River from 21 June to 19 July. In the normal course of the season in that area, the rivers are usually highest in the spring, then continue to drop as the dry summer weather begins. The stream, similar to the Anvik, shows rapid changes in water depth when summer storms occur and bring rainfall to the watershed. Such flood conditions make counting difficult or impossible because of suspended solids, detritus, staining and increases in depth. In 1996 the counting was interrupted from midnight 28 June to 1300 hours on 30 June while the river was muddy, obscuring passing salmon. An estimate of the number of chum salmon missed during the uncounted hours on 30 June was made from the average proportion of the daily passage that occurred from midnight to 1300 hours on 26-27 June and on 1 July (Appendix Tables 3 and 4). The estimated total passage for summer chum salmon on 30 June was then used with the 27 June daily expanded counts to make a linear interpolation of missed daily expanded counts for 28-29 June (Table 1). Appendix Tables 5 and 6, presenting expanded hourly counts for chinook salmon, show a total expanded count of only eight fish during the period from midnight to 1300 hours on 26-27 June and 1 July. With so few chinook salmon passing during that time period on adjacent days, no estimate was made for missed fish on 30 June, and a linear interpolation was made for 28 and 29 June from the chinook daily total on 27 June and the partial daily count on 30 June (Table 2) without expansion of the latter.

During the time the camp and towers were being constructed, the water in the lower river below the site was very clear, and the on-site crew noted that the first salmon was observed in the stream at about the same time as the project became operational.

Spatial distribution of summer chum salmon is usually close to the river bank, bringing them close to the towers where they are available to the observer for counting. Over the course of the season the counts of summer chum salmon are thought to be a good estimate of total escapement passage. Sandone (1995) observed that chinook salmon travel in the deepest part of the channel, or near the middle of the river, where many were probably not seen and counted, and the counts of that species were probably substantially below the actual escapement in 1994. In 1996, the middle area of the river was also out of range for reliable counting from the towers.

Summer Chum Salmon

The counts of summer chum salmon from the towers were expanded for each hour and tabulated daily. Raw (unexpanded) counts and expanded data is presented for each bank in Table 1. The estimated summer chum salmon escapement count from 21 June through 19 July when the project was concluded was 129,694. This was the smallest total estimated

escapement of the three years of counting tower operation (Table 3). The run was earliest of the three years of tower operations, with the mid-point of the run occurring on 3 July, compared to 7 July in 1995 and 9 July in 1994. Quartile days were 27 June, 3 July and 8 July, each occurring 2 days later than the Anvik River quartile days for summer chum salmon in 1996 (Fair 1997). The three years of counting tower project data that now exist for the Nulato River was compared to the historical sonar project information on the Anvik River to determine if, based on those three years, there was any trend in run timing that would indicate the necessity to change strata sampling dates for the Nulato River. Based upon data from 1994-1996, the quartile dates on the two rivers were only identical for the last quartile date in 1994, 11 July. In all other comparisons, the Nulato was one to three days later. From those three years of information, the Nulato River first quartile and the mid-point quartile passage dates have averaged two days later, and the last quartile averaged one day later than the Anvik River.

Nulato escapement ASL sampling in 1996 was completed on 522 summer chum salmon that were captured with the beach seine. Sampling was done at a site about 100 m upstream from the north (left) bank tower for most of the season, but an optional site had to be found late in the run because adequate numbers of fish were no longer available at the original site, due perhaps to changes in flow and water depth. For the pooled sample for the season, the escapement of summer chum salmon was equally split between age 0.3 fish and age 0.4 fish at 47% each, with the remainder being age 0.5 (Price 1997). The sex ratio for the season escapement was 52% female, very comparable to 1995 that had 51% female fish. The 1994 escapement sampling indicated only 42% females, but the project that year started, it was thought, after a portion of the run had passed the tower site (Sandone 1995). ASL sampling on 1996 commercial fishwheel-caught summer chum salmon in the Nulato area gave a season pooled sample age distribution of 55% age 0.3, 42% age 0.4, and 3% age 0.5 summer chum salmon.

The distribution of 1996 counts by day seems to verify the observations by on-site crew that the preponderance of the run passed the tower site during counting operations, with counts increasing during the first few days and tapering off during the last week (Table 2). Daily passage estimates of summer chum salmon reached about 7,000 fish on 23 June and counts of that magnitude continued to occur until 10 July when the run began to taper off. On the Anvik River, passage of summer chum salmon reached above 30,000 on 21 June and continued to reach counts of this relative magnitude until 8 July, showing again in this general comparison, a 2-day lag in the timing of summer chum salmon to the Nulato River relative to the Anvik River (Fair 1997).

A comparison of Nulato River summer chum salmon timing for the years 1994-1996 is presented in Figure 5. In 1996, an early pulse of fish occurred between 23 June and 26 June at the counting tower site, the highest counts recorded for those dates during the three years this project has been in operation. The data illustrates that the escapement timing in 1996 was earlier than 1994 and 1995, and was characterized by several pulses of nearly

similar magnitude. Daily passage rates, however, did not reach the magnitude recorded in either 1994 or 1995, and upstream migration was essentially over by 16 July.

Passage of summer chum salmon up the Nulato River in 1996 demonstrated a distinct diurnal pattern as has been recorded in this system and on the Anvik River in the past (Sandone 1995). Figure 3 illustrates this pattern with the hourly counts picking up steadily after noon on the South bank to a peak average passage rate at 1900 hours, and dropping off to the lowest passage rate period between 0500 and noon. The slow passage rate period is longer on the North bank running from 0500 to about 1600, with the peak passage rate for that side of the river occurring at 2200 hours.

As in 1994, the largest number of summer chum salmon passed the tower on the south side of the river. In 1994, passage on that side of the river accounted for 80.2% of the total estimated escapement (Sandone 1995). In 1996, omitting the interpolated days of 28 June and 29 June which were not apportioned by hour, the south bank passage was estimated at 74,814 and the north bank at 45,526, thus indicating a season passage of 62% on the south side of the river (Table 1). A dominant bank migrational pattern has also been observed on the Anvik River and cited in numerous reports (Sandone 1995). On both the Nulato and the Anvik rivers, the dominant passage is on the inside of a bend with a gradually sloping bottom compared to a cut-bank, deeper channel on the opposite side of the river. It is apparently common for migrating chum salmon to choose a course upstream that favors the side of the channel with the least water velocity.

Escapement data from other projects on Kaltag Creek, the Gisasa River and at Clear Creek on the Hogatza River have been gathered since 1994 by weir and tower counts. While the summer chum salmon escapement to the Nulato River in 1996 was estimated at 55% of the run in 1995, the other systems mentioned in that general area of the Yukon River had relatively larger escapements compared to 1995. Kaltag Creek summer chum escapement in 1996 was estimated to have reached 66% of the 1995 passage, Clear Creek reached 87% and Gisasa River 115% of the 1995 passage estimates respectively (Appendix Table 1).

Historical Nulato River summer chum salmon data from the three years that the counting tower project has been in operation is presented in Figure 7. While the counts during the first few days in 1996 indicated a strong and/or early run, the rate was not sustained, and without the higher daily peak passage rates experienced in 1994 and 1995, the escapement estimate ended up below either of the previous years. The early indications of a strong and/or early run were similar to information from test fishing catches discussed earlier relating to the harvest of Nulato River salmon.

The estimated total Nulato summer chum salmon escapement from the counting tower data could not be compared with aerial survey estimates in 1996. An aerial survey of the South Fork Nulato River and mainstem below the forks was flown on 20 July under fair conditions, resulting in a count of only 8,490 summer chum salmon. The survey, however,

was conducted well after the peak of spawning and the North Fork Nulato River was not surveyed because of poor weather (JTC 1996). Data in Appendix Table 1 indicate that with only a couple of exceptions, 1990 and 1991, the North Fork escapement estimates have exceeded those of the South Fork Nulato. If the ratio in 1996 was similar to 1995, where the South Fork escapement estimate by aerial survey was 36.3% of the North Fork figure, the North Fork escapement would have been about 30,000 fish, well below the interim escapement objective of 53,000 summer chum salmon that has been set for the North Fork Nulato River. With additional information from the tower counting project it may be possible in the near future to re-evaluate the escapement objective for the Nulato River. As indicated in Appendix Table 1 the current goal for the North Fork has only been reached twice since 1974.

Chinook Salmon

The estimated chinook salmon escapement into the Nulato River during the period 21 June through 19 July was 756 fish. As illustrated by the expanded daily chinook count data in Table 2, a number of chinook salmon was observed on the first day of tower operation, and while the numbers observed were at higher sustained levels during the period 30 June to 16 July, there could have been some additional chinook salmon past the tower site prior to tower operation. The data in Table 2 also shows nearly identical counts for each bank. In 1994, 53% of the chinook salmon were recorded from the south bank tower.

During the 1996 season the chinook salmon also demonstrated diurnal migratory behavior, but less distinct than chum salmon. Fish generally continued to move upriver during most of the day. The highest average passage occurred between 1600 and 2100 hours, with peak rates ending about two hours earlier than for chum salmon (Figure 4). Passage in 1994 (Sandone 1995) followed the same pattern, with most chinook salmon migrating past the tower site in mid-afternoon and evening hours.

The first quartile day of passage occurred on 2 July, four days earlier that in 1994 and 1995. The median day occurred on 6 July and the last quartile was reached on 10 July, one day earlier than the median date in 1995 (Table 4). While the peak passage rate occurred early in the 1994 season, with median quartile reached only 11 days into the season, median was reached 21 days into the time period that the 1995 project was operated. There is a possibility that the 1995 season terminated before the very last of the chinook run was past the site, since double-digit counts were still being recorded on the last day of operation.

The 1994-1996 chinook daily escapement data presented in Figure 6 indicates that in 1996 daily passage rates during the first few days exceeded 1995, but the maximum daily passage rates did not reach the magnitude of either of the previous years. The chinook escapement in 1996 peaked and ended earlier than in 1994 or 1995. The season cumulative escapement data for the three years of counting tower operation (Figure 8) shows that until

4 July the chinook escapement passage rate on the Nulato River was at, or slightly above, the previous two years. After that date, however, the data mirrors that of Nulato River chum salmon, without dominant peak passage days, and a smaller total estimated escapement than might have been expected from the first two weeks of data.

An aerial survey was made on the Nulato River in 1996 on 20 July under fair survey conditions. On that survey, 100 chinook salmon were counted in the mainstem below the confluence of the North and South Forks and in the South Fork Nulato River. The aerial survey count was well below the minimum aerial survey escapement goal of 500 for the South Fork. The North Fork was not surveyed because of poor weather. Minimum aerial survey escapement goal is 800 chinook salmon for the North Fork The chinook salmon escapement was generally weak throughout much of the Lower Yukon River (Appendix Table 2). The total season tower count of 756 fish was only about half of the count in 1995 when 1,412 were estimated to have passed the counting towers.

Too few chinook salmon were caught in the beach seines to make an analysis of age and sex composition of the chinook run, and since no carcass sampling was conducted on the Nulato River, no age and sex information is available on the escapement.

Hydrological and Climatological Sampling

As with most streams tributary to the Yukon River, it seems common for the water to be highest during or shortly after breakup, then generally continue to drop during the summer with surges of runoff following rainfall. Storage capacity of the Nulato River watershed, similar to the Anvik, appears to be minimal and has limited retention for rainfall contributions to the upper areas of the drainage. Rainfall can be expected to produce rapid changes in water level within 48 hours, bringing with it silt, dirt, staining and all manner of detritus from the forests and sloughs upstream. On the Anvik River in 1996 a heavy downpour on 25 June brought the water level up 0.6 ft overnight (Fair 1997). On the Nulato River, rainfall in the watershed at about the same time raised the water as noted in Table 5 and turned the water muddy by 27 June so fish could not be counted until mid-day on 30 June. Highest recorded water level was on 28 June. That same high water event, from 27 June through 29 June, also had the coldest water temperatures. Minimum air temperature recorded in 1994 was 8° C. During the period from 28 June-3 July in 1996, air temperatures ranging from 2° to 5° C.

Run Timing

In the 1994 Nulato River tower project report, the author evaluated timing information from test fishing, Yukon River sonar, and escapements to the Anvik, Kaltag and Nulato Rivers to determine timing relationships for summer chum salmon migrating up the Nulato River (Sandone 1995). At that time, with only relative abundance on aerial surveys

for historical reference with the one season's tower data on the Nulato River, it was anticipated that timing to the Nulato would be similar to the Anvik River, and even more similar to Kaltag Creek, since that system joins the Yukon River only 58 km from the Nulato confluence. In that comparison, with the observation that some early fish on the Nulato River were not counted, the timing of all three systems was thought to be similar. Further analysis of run timing from the lower mainstem sonar project to the Anvik River sonar counting site was completed, and a 10-day timing lag between those sites was indicated for the 1994 season. The report (Sandone 1995) cites other timing analysis between the Lower Yukon River sonar project and the Anvik River site, that had provided the estimated average travel speed for summer chum salmon of 42 km/day. Using that statistic, there was indication that the fish spawning farthest upstream passed through the main river sonar site earliest and those spawning farther downstream entered the river later. This probability is enhanced when the Andreafsky River is also included with similar peak run timing, because these tributary systems enter the main channel of the Yukon River over a distance in excess of 600 km.

The comparison of the Nulato River tower counting data with sonar escapement count data from the Anvik River for 1994-1996 (Fair 1997) shows that, on the average, first and middle quartile dates have been two days later on the Nulato River, and the last quartile date has lagged by one day. In this comparison the individual respective quartile dates ranged from 1 to 3 days later on the Nulato River, and none occurred earlier on the Nulato River during that three-year period.

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TABLES

Table 1. Nulato River expanded summer chum salmon tower counts and percent passage by date, 1996.

Date	North (left) Bank				South (right) Bank				Entire River				
	Raw Daily Count	Minutes Counted	Expanded Daily Count	Percentage of Season Total	Raw Daily Count	Minutes Counted	Expanded Daily Count	Percentage of Season Total	Raw Daily Count	Expanded Daily Count	Cumulative Total	Daily Percent	Cumulative Percent
21-Jun	48 [a]	66	192	0.4%	127 [a]	66	508	0.7%	175	700	700	0.5%	0.5%
22-Jun	427	360	1,708	3.8%	494	360	1,976	2.6%	921	3,684	4,384	2.8%	3.4%
23-Jun	816	360	3,264	7.2%	837	360	3,348	4.5%	1,653	6,612	10,996	5.1%	8.5%
24-Jun	967	360	3,868	8.5%	703	360	2,812	3.8%	1,670	6,680	17,676	5.2%	13.6%
25-Jun	870	360	3,476	7.6%	930	360	3,720	5.0%	1,800	7,196	24,872	5.5%	19.2%
26-Jun	1,127	360	4,508	9.9%	571	360	2,284	3.1%	1,698	6,792	31,664	5.2%	24.4%
27-Jun	276	360	1,094	2.4%	250	360	988	1.3%	526	2,082	33,746	1.6%	26.0%
28-Jun			[c]	0.0%			[c]	0.0%		3,812 [d]	37,558	2.9%	29.0%
29-Jun			[c]	0.0%			[c]	0.0%		5,542 [d]	43,100	4.3%	33.2%
30-Jun	587 [b]	180	3,840	8.4%	648 [b]	180	3,431	4.6%	1,235	7,271	50,371	5.6%	38.8%
01-Jul	1,006	360	4,024	8.8%	770	360	3,080	4.1%	1,776	7,104	57,475	5.5%	44.3%
02-Jul	626	360	2,504	5.5%	893	360	3,572	4.8%	1,519	6,076	63,551	4.7%	49.0%
03-Jul	331	360	1,324	2.9%	575	360	2,300	3.1%	906	3,624	67,175	2.8%	51.8%
04-Jul	363	360	1,212	2.7%	1,068	360	4,272	5.7%	1,431	5,484	72,659	4.2%	56.0%
05-Jul	527	360	2,108	4.6%	1,553	360	6,212	8.3%	2,080	8,320	80,979	6.4%	62.4%
06-Jul	319	360	1,276	2.8%	923	360	3,692	4.9%	1,242	4,968	85,947	3.8%	66.3%
07-Jul	419	360	1,676	3.7%	1,446	360	5,784	7.7%	1,865	7,460	93,407	5.8%	72.0%
08-Jul	332	360	1,288	2.8%	1,110	360	4,440	5.9%	1,442	5,728	99,135	4.4%	76.4%
09-Jul	216	360	864	1.9%	700	360	2,800	3.7%	916	3,664	102,799	2.8%	79.3%
10-Jul	480	360	1,920	4.2%	1,296	360	5,184	6.9%	1,776	7,104	109,903	5.5%	84.7%
11-Jul	314	360	1,256	2.8%	722	360	2,888	3.9%	1,036	4,144	114,047	3.2%	87.9%
12-Jul	203	360	812	1.8%	853	360	3,412	4.6%	1,056	4,224	118,271	3.3%	91.2%
13-Jul	196	360	784	1.7%	776	360	3,104	4.1%	972	3,888	122,159	3.0%	94.2%
14-Jul	187	360	748	1.6%	596	360	2,384	3.2%	783	3,132	125,291	2.4%	96.6%
15-Jul	180	360	720	1.6%	300	360	1,200	1.6%	480	1,920	127,211	1.5%	98.1%
16-Jul	103	360	412	0.9%	126	360	504	0.7%	229	916	128,127	0.7%	98.8%
17-Jul	77	360	308	0.7%	92	360	368	0.5%	169	676	128,803	0.5%	99.3%
18-Jul	55	360	220	0.5%	75	360	300	0.4%	130	520	129,323	0.4%	99.7%
19-Jul	16	150	120	0.3%	25	150	251	0.3%	41	371	129,694	0.3%	100.0%
Total	11,068	9,036	45,526 [e]		18,459	6,810	74,814 [e]		29,527	129,694			

[a] Counting initiated at 21:00.

[b] Missed counts interpolated from proportion passing during those hours on previous and following days with complete counts.

[c] Counting interrupted by high muddy water; interpolation made for both banks combined.

[d] Missed daily counts imterpolated from counts 27 June and estimated total counts 30 June (see footnote b).

[e] Does not include estimates for 28 and 29 June.

Table 2. Nulato River counting tower daily chum and chinook salmon counts by bank and total by day, 1996.

Date	Chum salmon expanded counts			Chinook salmon expanded counts		
	S. bank	N. bank	Total	S. bank	N. bank	Total
21-Jun	508	192	700	12	0	12
22-Jun	1,976	1,708	3,684	4	8	12
23-Jun	3,348	3,264	6,612	0	8	8
24-Jun	2,812	3,868	6,680	0	4	4
25-Jun	3,720	3,476	7,196	4	4	8
26-Jun	2,284	4,508	6,792	12	0	12
27-Jun	988	1,094	2,082	4	4	8
28-Jun			3,812 a			13 a
29-Jun			5,542 a			19 a
30-Jun	3,431	3,840	7,271 b	8	16	24
1-Jul	3,080	4,024	7,104	28	20	48
2-Jul	3,572	2,504	6,076	24	16	40
3-Jul	2,300	1,324	3,624	4	4	8
4-Jul	4,272	1,212	5,484	8	4	12
5-Jul	6,212	2,108	8,320	52	56	108
6-Jul	3,692	1,276	4,968	20	16	36
7-Jul	5,784	1,676	7,460	40	40	80
8-Jul	4,440	1,288	5,728	24	28	52
9-Jul	2,800	864	3,664	28	20	48
10-Jul	5,184	1,920	7,104	0	16	16
11-Jul	2,888	1,256	4,144	16	20	36
12-Jul	3,412	812	4,224	32	32	64
13-Jul	3,104	784	3,888	8	8	16
14-Jul	2,384	748	3,132	12	4	16
15-Jul	1,200	720	1,920	12	12	24
16-Jul	504	412	916	12	12	24
17-Jul	368	308	676	0	8	8
18-Jul	300	220	520	0	0	0
19-Jul	251	120	371	0	0	0
Totals	74,814	45,526	129,694	364	360	756

a Interpolated estimates from total counts on previous and following days.
b Missed hourly counts interpolated from proportion passing during those hours on previous and following days with complete counts.

Table 3. Historic daily and cumulative Nulato River summer chum salmon escapement, 1994-1996.

	1994 [a]					1995					1996				
Date	Daily Counts	Cumulative Counts	Cumulative Proportion	% Female	n	Daily Counts	Cumulative Counts	Cumulative Proportion	% Female	n	Daily Counts	Cumulative Counts	Cumulative Proportion	% Female	n
6/21						452	452	0.00			700	700	0.01		
6/22						692	1,144	0.00			3,684	4,384	0.03	29%	63
6/23						1,056	2,200	0.01			6,612	10,996	0.08	44%	100
6/24						1,880	4,080	0.02			6,680	17,676	0.14	44%	100
6/25						1,612	5,692	0.02			7,196	24,872	0.19	40%	119
6/26				48%	52	2,044	7,736	0.03			6,792	31,664	0.24		
6/27				51%	61	10,884	18,620	0.08			2,082	33,746	0.26	49%	41
6/28				41%	54	5,196	23,816	0.10			3,812 [c]	37,558	0.29	46%	74
6/29	2001	2,001	0.01			9,184	33,000	0.14			5,542 [c]	43,100	0.33		
6/30	8355	10,356	0.07			7,188	40,188	0.17			7,271 [b]	50,371	0.39	49%	102
7/1	7898	18,254	0.12			9,716	49,904	0.21	43%		7,104	57,475	0.44	57%	295
7/2	9604	27,858	0.19			15,110	65,014	0.27	48%	100	6,076	63,551	0.49	51%	126
7/3	7601	35,459	0.24			9,068	74,082	0.31			3,624	67,175	0.52		
7/4	6708	42,167	0.28			11,064	85,146	0.36	51%	133	5,484	72,659	0.56		
7/5	10188	52,355	0.35	34%	76	12,700	97,846	0.41			8,320	80,979	0.62		
7/6	8092	60,447	0.41			18,504	116,350	0.49	53%	130	4,968	85,947	0.66	67%	63
7/7	7,008	67,455	0.45	45%	96	10,704	127,054	0.54			7,460	93,407	0.72	35%	54
7/8	4,704	72,159	0.49			11,960	139,014	0.59			5,728	99,135	0.76	55%	115
7/9	9,232	81,391	0.55			14,008	153,022	0.65	52%	200	3,664	102,799	0.79	64%	280
7/10	10,744	92,135	0.62	20%	64	14,004	167,026	0.71	56%	100	7,104	109,903	0.85	50%	84
7/11	8,776	100,911	0.68			13,684	180,710	0.76	47%	100	4,144	114,047	0.88		
7/12	7,327	108,238	0.73	48%	75	11,356	192,066	0.81	48%	100	4,224	118,271	0.91	57%	87
7/13	6,931	115,169	0.77	38%	88	8,660	200,726	0.85	53%	100	3,888	122,159	0.94	73%	48
7/14	6,535	121,704	0.82			5,172 [b]	205,898	0.87			3,132	125,291	0.97		
7/15	6,140	127,844	0.86			4,232 [b]	210,130	0.89			1,920	127,211	0.98	54%	65
7/16	4,440	132,284	0.89			6,728	216,858	0.92			916	128,127	0.99	69%	101
7/17	3,211	135,495	0.91			6,464	223,322	0.94			676	128,803	0.99		
7/18	3,332	138,827	0.93	42%	139	3,716	227,038	0.96			520	129,323	1.00		
7/19	2,215	141,042	0.95	50%	116	4,400	231,438	0.98	70%	112	371	129,694	1.00		
7/20	1,712	142,754	0.96			3,368	234,806	0.99							
7/21	1,208	143,962	0.97			2,084	236,890	1.00							
7/22	2,808	146,770	0.99												
7/23	1,992	148,762	1.00												

a Project started late because of high water; an estimated 36,000 summer chum salmon were missed (Sandone, 1995).

b Missed hourly counts interpolated from proportion passing during those hours on previous and following days with complete counts.

c Interpolated estimates from total counts on previous and following days.

Table 4. Historic daily and cumulative Nulato River chinook salmon escapement, 1994-1996.

Date	1994 [a]			1995			1996		
	Daily Counts	Cumulative Counts	Cumulative Proportion	Daily Counts	Cumulative Counts	Cumulative Proportion	Daily Counts	Cumulative Counts	Cumulative Proportion
6/21				4	4	0.00	12 [d]	12	0.02
6/22				4	8	0.01	12	24	0.03
6/23				0	8	0.01	8	32	0.04
6/24				0	8	0.01	4	36	0.05
6/25				0	8	0.01	8	44	0.06
6/26				8	16	0.01	12	56	0.07
6/27				0	16	0.01	8	64	0.08
6/28				12	28	0.02	13 [e]	77	0.10
6/29	0	0	0.00	24	52	0.04	19 [e]	96	0.13
6/30	3	3	0.00	64	116	0.08	24	120	0.16
7/1	6	9	0.01	44	160	0.11	48	168	0.22
7/2	72	81	0.05	36	196	0.14	40	208	0.28
7/3	72	153	0.09	8	204	0.14	8	216	0.29
7/4	60	213	0.12	16	220	0.16	12	228	0.30
7/5	216	429	0.24	52	272	0.19	108	336	0.44
7/6	208	637	0.35	100	372	0.26	36	372	0.49
7/7	120	757	0.42	52	424	0.30	80	452	0.60
7/8	84	841	0.47	112	536	0.38	52	504	0.67
7/9	92	933	0.52	84	620	0.44	48	552	0.73
7/10	100	1,033	0.58	56	676	0.48	16	568	0.75
7/11	112	1,145	0.64	60	736	0.52	36	604	0.80
7/12	92 [b]	1,237	0.69	164	900	0.64	64	668	0.88
7/13	96 [b]	1,333	0.74	56	956	0.68	16	684	0.90
7/14	100 [b]	1,433	0.80	56 [c]	1,012	0.72	16	700	0.93
7/15	104	1,537	0.86	76 [c]	1,088	0.77	24	724	0.96
7/16	44	1,581	0.88	92	1,180	0.84	24	748	0.99
7/17	51	1,632	0.91	56	1,236	0.88	8	756	1.00
7/18	40	1,672	0.93	28	1,264	0.90	0	756	1.00
7/19	43 [b]	1,715	0.96	72	1,336	0.95	0	756	1.00
7/20	28 [b]	1,743	0.97	48	1,384	0.98			
7/21	12	1,755	0.98	28	1,412	1.00			
7/22	8	1,763	0.98						
7/23	32	1,795	1.00						
Total	1,795			1,412			756		

a Counting delayed until 18:00 on 29 June due to high, muddy water.
b Counts include proportional expansion for missed hours and linear interpolation for missed days.
c Counts interpolated from expanded daily counts on 13 July and 16 July due to high, muddy water.
d Counting initiated at 18:00 on 21 June.
e Counts interpolated from daily expanded counts on 27 June and 30 June.

Table 5. Nulato River tower project climatological and hydrological observations, 1996.

Date		Precipitation	Wind Direction and	Sky	Temperature (°C) Air	Air		Water Gauge	Water Color	
1996	Time	(code\amt)	Velocity	(code)	Min	Max	Water	(ft)	(code)	Remarks
19-Jun	1500	I	0	3				1.7	Dk grn	some showers
20-Jun	1500	none	0	2				1.6	Dk grn	
21-Jun	2100	none	SW 5	1	5	22	10	1.5	Lt grn	started counting at 2100
22-Jun	2100	none	calm	1	6	22	8	1.4	Lt grn	
23-Jun	2100	none	E 10	1	8	21	11	1.4	Lt grn	
24-Jun	2100	1.25"	S 20	4	12	23	10	1.3	Lt grn	start clearing a 2300
25-Jun	2100	1.50"	calm	4	11	20	10	1.5	Lt grn	windy 1500-1900
26-Jun	2100	1.25"	S 5	2	9	23	10	1.6	Tr	water rose to 1.7 by 2300
27-Jun	2100	I, 1.25"	N 10	4	7	14	8	1.6	Dk grn	muddy after 0100, 6/28
28-Jun	2100	I, .12"	calm	1	4	17	8	2.0	Br	muddy,uncountable
29-Jun	2100	I, .12"	W 15-20	2	4	15	8	1.8	Br	still uncountable
30-Jun	2100	none	NW 15	2	2	23	10	1.4	Dk grn	water clearing, count after1300
01-Jul	2100	I, .12"	NW 20	1	3	23	11	1.4	Lt grn	water clearing, spawners above
02-Jul	2100	none	N 5	3	3	22	11	1.2	Lt grn	fewer fish today
03-Jul	2100	none	W 5	1	5	21	10	1.2	Lt grn	spawning in area
04-Jul	2100	none	calm	3	10	28	12	1.1	Lt grn	sunny, clear water
05-Jul	2100	none	N 20	3	10	24	12	1.1	Lt grn	wind S AM, N PM
06-Jul	2100	none	SW 10	1	10	24	13	1.1	Lt grn	gusty wind
07-Jul	2100	none	calm	1	10	28	13	1.0	Lt grn	warm and sunny
08-Jul	2100	none	E 5	1	10	28	13	1.0	Lt grn	clear. warm
09-Jul	2100	1.25"	calm	3	13	24	10	0.1	Lt grn	cloudy, rain
10-Jul	2100	1.25"	gusty, S 10	3	13	25	10	0.9	Lt grn	gusty wind, showers
11-Jul	2100	I	S 15	3	13	24	10	0.9	Lt grn	cold wind
12-Jul	2100	none	S 5	3	10	24	11	0.9	Lt grn	cold again
13-Jul	2100	none	S 15	2	12	25	11	0.9	Lt grn	gusty wind
14-Jul	2100	1.25"	S 10	3	10	25	11	0.9	Lt grn	clear early, then rain
15-Jul	2100	none	S 5	2	10	24	11	0.9	Lt grn	clear water
16-Jul	2100	none	S 5	1	10	24	10	0.8	Lt grn	fall weather
17-Jul	2100	1.25"	calm	3	11	25	10	0.8	Lt grn	foggy morning
18-Jul	2100	none	S 5	1	10	24	11	0.8	Lt grn	warm morning
19-Jul	2100	1.25"	S 10	3	11	24	11	0.8	Lt grn	stop counting at 1200
20-Jul	1400	1.12"	S 5	2	11	24	11	0.8	Lt grn	closed camp at 1400

Codes

SKY

0	No observation made.
1	Clear sky, not over 10% cloud cover.
2	Cloud cover not over 50%.
3	Cloud cover over 50% of sky.
4	Completely overcast.
5	Fog or thick haze or smoke.

PRECIPITATION

I	Intermittent rain
R	Continuous rain
S	Snow
S&R	Mixed snow and rain
H	Hail
T	Thunder showers

WATER COLOR

Clr	Clear
Dk grn	Dark green
Lt grn	Light green
Br	Brown
Dk	Dark Brown
Tr	Turbid: murky or glacial

FIGURES

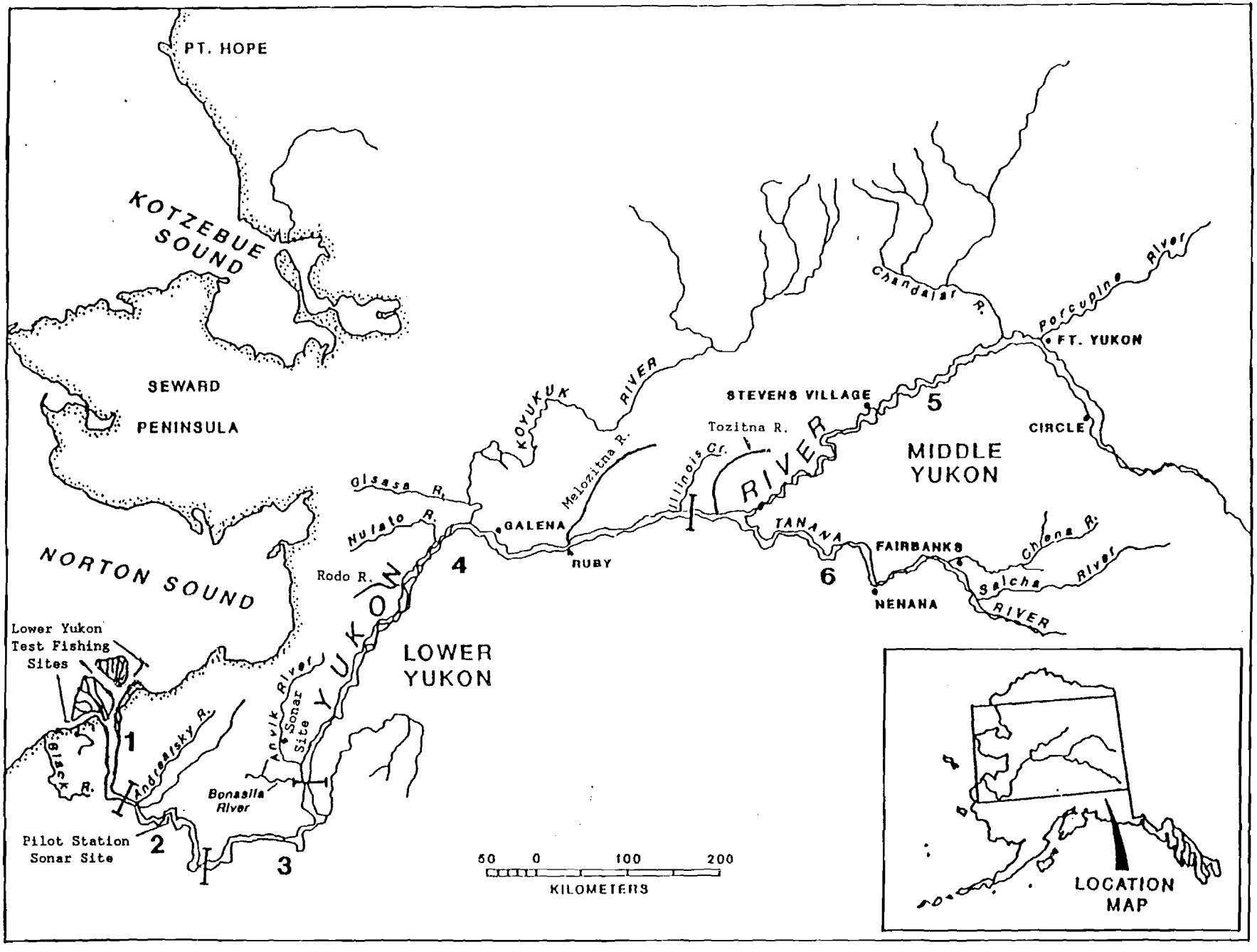


Figure 1. Alaskan portion of the Yukon River showing fishing district boundaries.

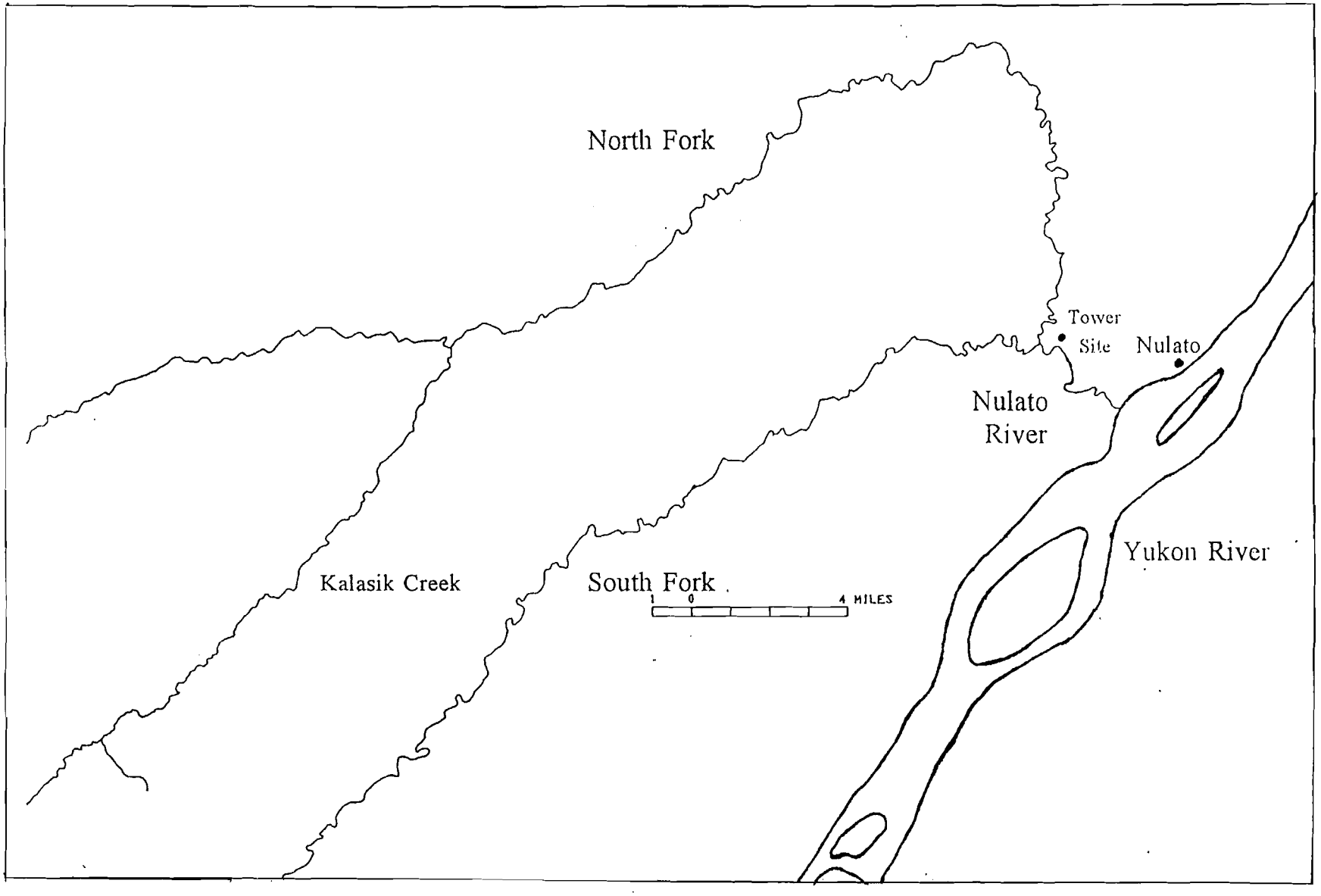


Figure 2. The Nulato River drainage showing the counting tower site

Figure 3. Nulato River total summer chum salmon counts by hour, North and South bank, 1996.

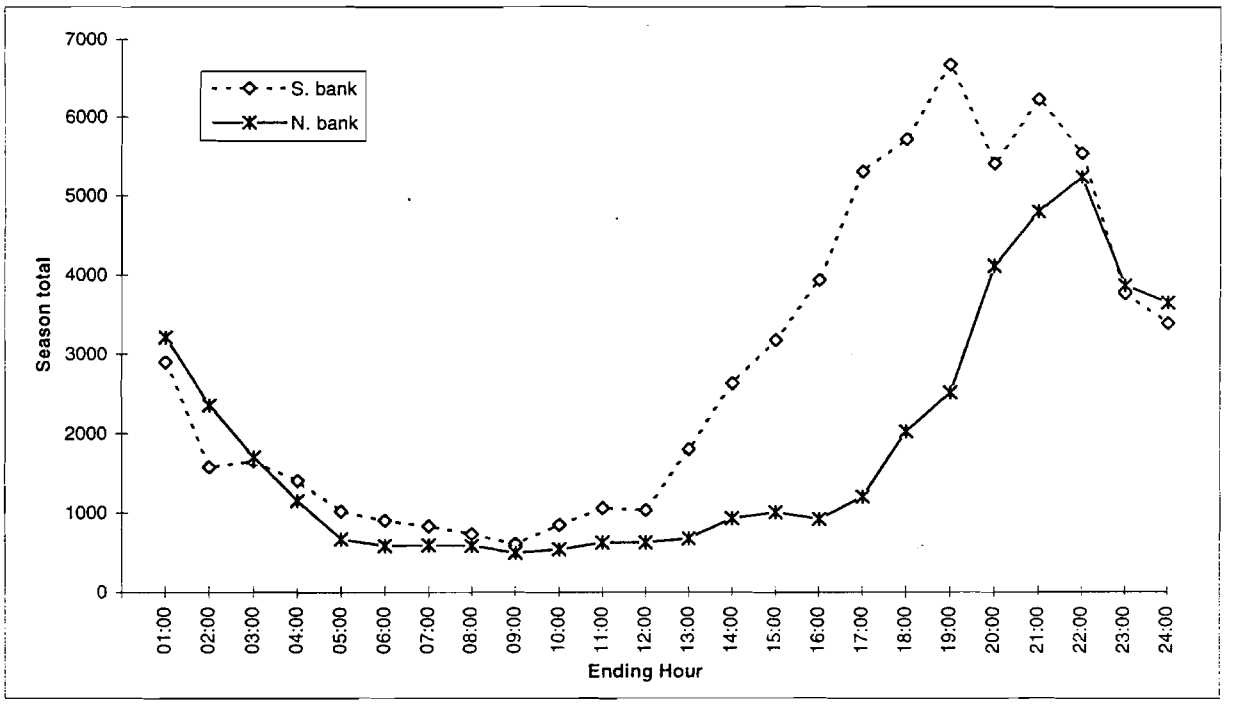


Figure 4. Nulato River total chinook salmon counts by hour, North and South bank, 1996.

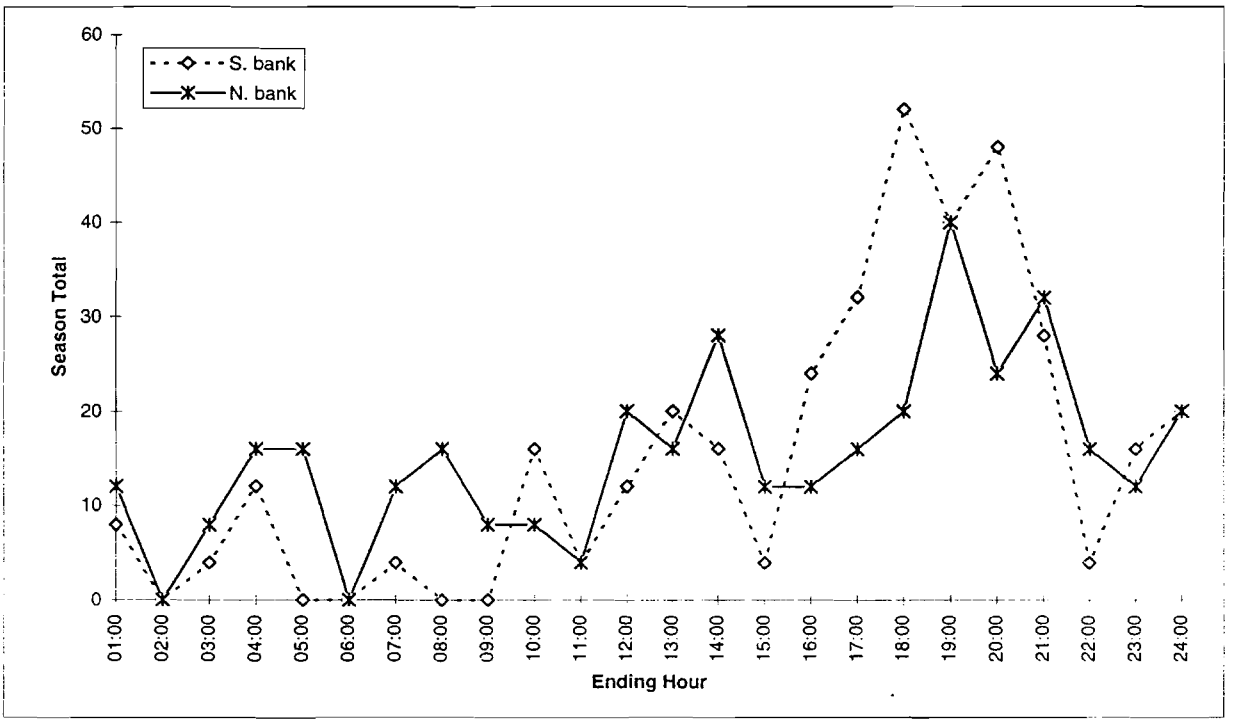


Figure 5. Nulato River historical daily summer chum salmon counts, 1994-1996.

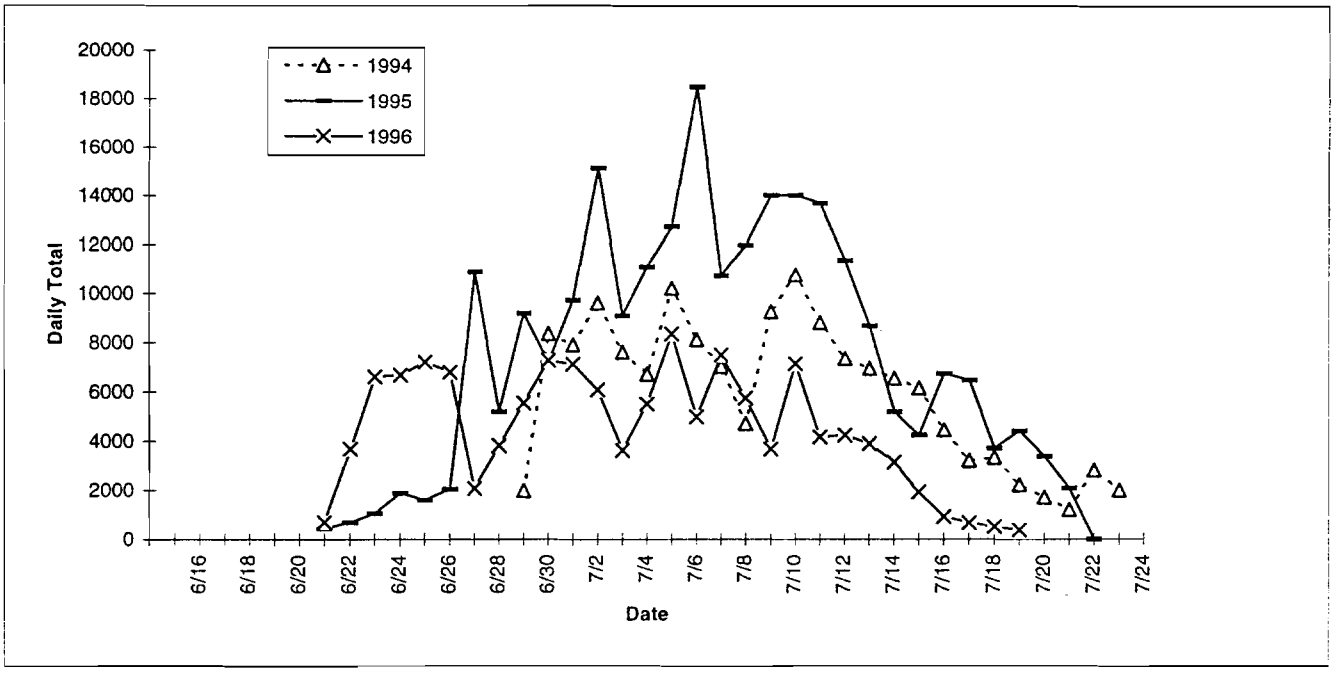


Figure 6. Nulato River historical daily chinook salmon counts, 1994-1996.

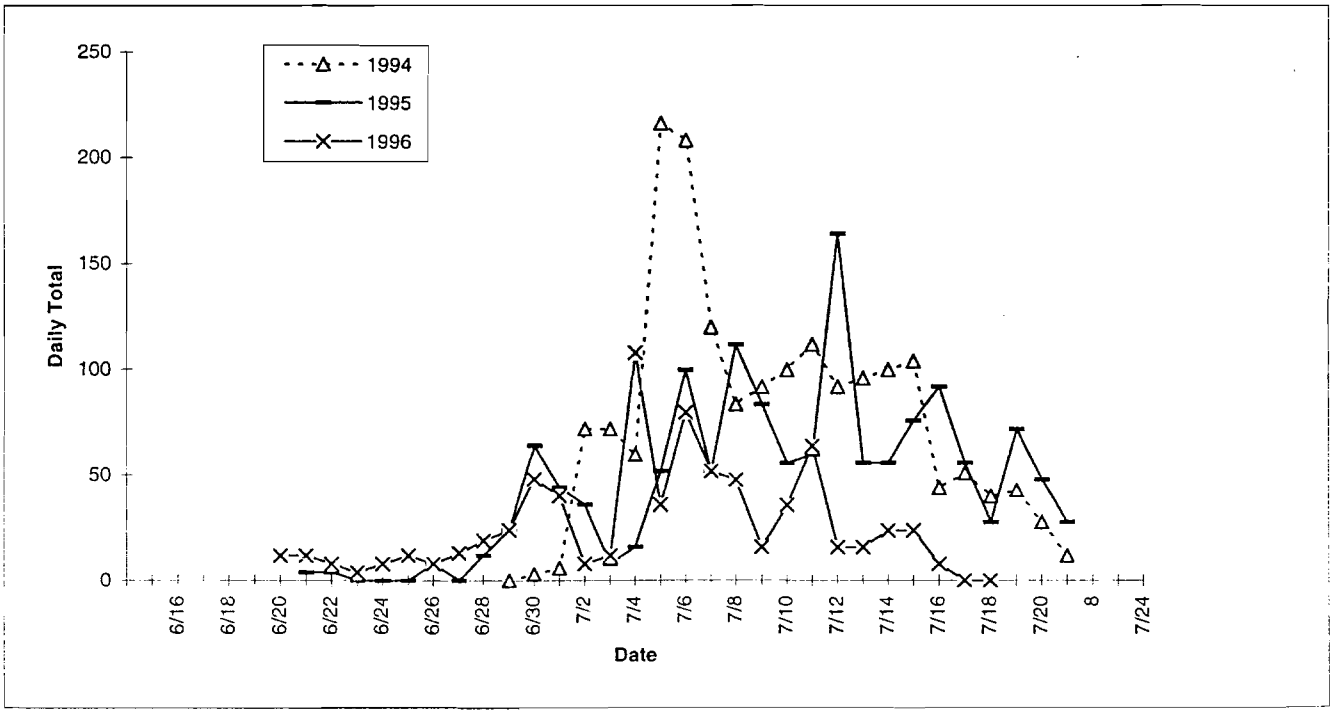


Figure 7. Historical Nulato River cumulative daily chum salmon escapements, 1994-1996.

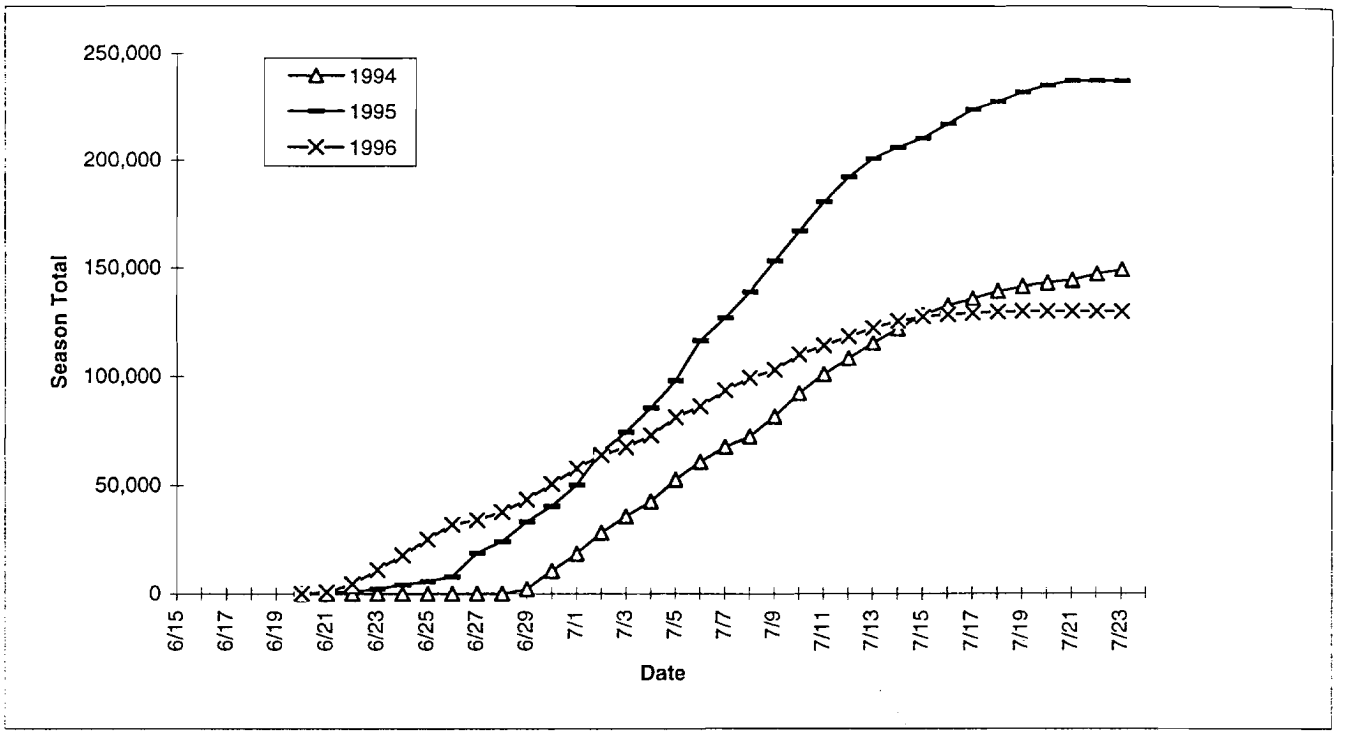
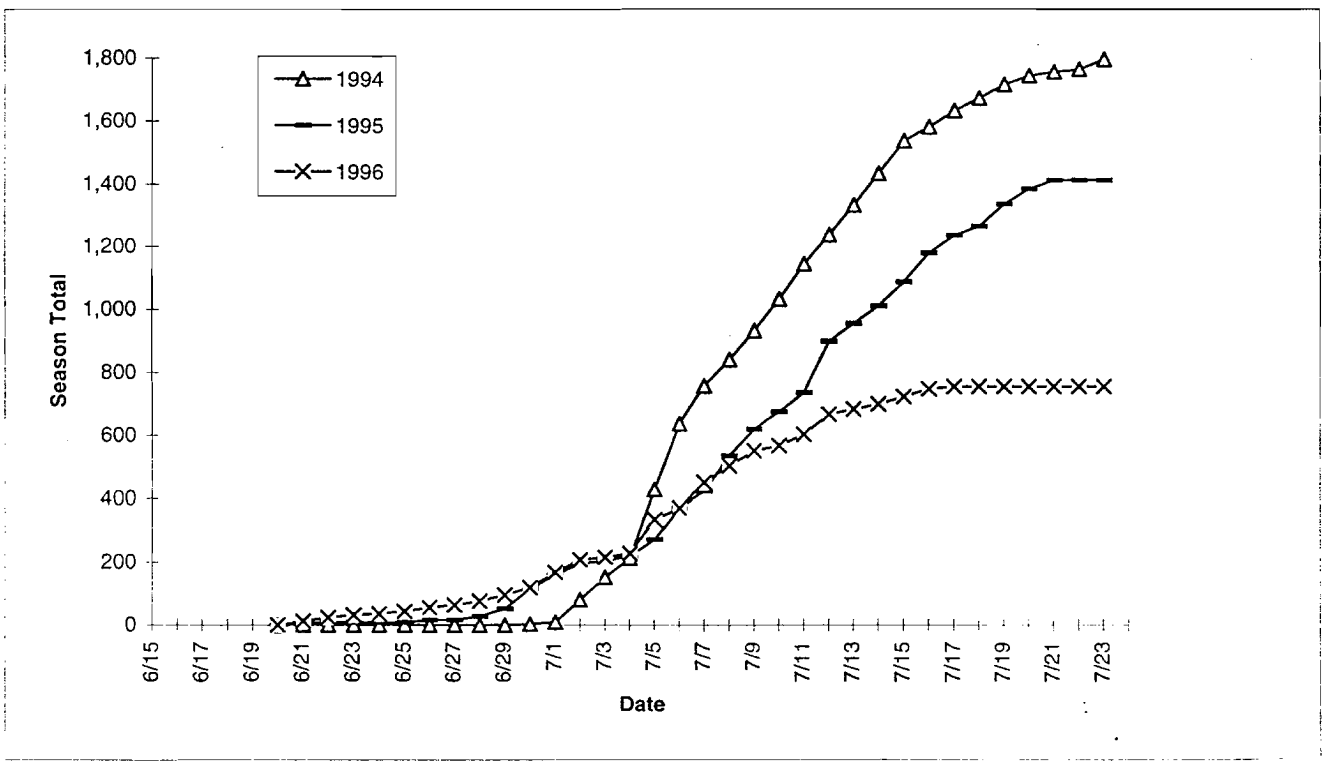


Figure 8. Historical Nulato River cumulative daily chinook salmon escapements, 1994-1996.



APPENDICES

Appendix Table 1. Summer chum salmon escapement counts for selected spawning areas in the Alaskan portion of the Yukon River drainage, 1973-1996.

Year	Andreafsky River			Anvik River		Rodo	Kaltag Cr.	Nulato River			Gisasa River		Hogatza River		Tozitna	Chena River		Salcha River	
	East Fork							Aerial		Mainstem			Clear & Caribou Cr.	Clear Creek					
	Aerial[a]	Sonar, Tower, or Weir Cnts	West Fork[a]	Tower & Aerial[b]	Sonar	River[a]	Tower Counts	South Fork	North Fork[c]	Tower Counts	Aerial	Weir	Aerial	Tower Counts	River[a]	Aerial	Tower	Aerial	Tower
1973	10,149 [d]		51,835	249,015												79 [d]		290	
1974	3,215 [d]		33,578	411,133		16,137		29,016	29,334		22,022				1,823	4,349		3,510	
1975	223,485		235,954	900,967		25,335		51,215	87,280		56,904		22,355		3,512	1,670		7,573	
1976	105,347		118,420	511,475		38,258		9,230 [d]	30,771		21,342		20,744		725 [d]	685		6,484	
1977	112,722		63,120	358,771		16,118		11,385	58,275		2,204 [d]		10,734		761 [d]	610		677 [d]	
1978	127,050		57,321	307,270		17,845		12,821	41,659		9,280 [d]		5,102		2,262	1,609		5,405	
1979	66,471		43,391		280,537			1,506	35,598		10,962		14,221			1,025 [d]		3,060	
1980	36,823 [d]		114,759		492,676			3,702 [d]	11,244 [d]		10,388		19,786		580	338		4,140	
1981	81,555	147,312 [f]			1,486,182			14,348								3,500		8,500	
1982	7,501 [d]	181,352 [f]	7,267 [d]		444,581						334 [d]		4,984 [d]		874	1,509		3,756	
1983		110,608 [f]			362,912			1,263 [d]	19,749		2,356 [d]		28,141		1,604	1,097		716 [d]	
1984	95,200 [d]	70,125 [f]	238,565		891,028								184 [d]			1,861		9,810	
1985	66,146		52,750		1,080,243	24,576		10,494	19,344		13,232		22,566		1,030	1,005		3,178	
1986	83,931	167,614 [g]	99,373		1,189,602			16,848	47,417		12,114				1,778	1,509		8,028	
1987	6,687 [d]	45,221 [g]	35,535		455,876			4,094	7,163		2,123		5,669 [d]			333		3,657	
1988	43,056	68,937 [g]	45,432		1,125,449	13,872		15,132	26,951		9,284		6,890		2,983	432		2,889 [d]	
1989	21,460 [d]				636,906											714 [d]		1,574 [d]	
1990	11,519 [d]		20,426 [d]		403,627	1,941 [d]		3,196 [d, h]	1,419 [d]		450 [d]		2,177 [d]		36	245 [d]		450 [d]	
1991	31,886		46,657		847,772	3,977		13,150	12,491		7,003		9,947		93	115 [d]		154 [d]	
1992	11,308 [d]		37,808 [d]		775,626	4,465		5,322	12,358		9,300		2,986		794	848 [d]		3,222	
1993	10,935 [d]		9,111 [d]		517,409	7,867		5,486	7,698		1,581				970	168	5,487	212	5,563
1994		200,981 [j, k]			1,124,689		47,295			148,762 [m]	6,827	51,116 [n]	8,247 [o]			1,137	9,984	4,916	39,450
1995		172,148 [j]			1,339,418	12,849	77,193	10,875	29,949	236,890	6,458	136,886		116,735	4,985	185 [d]	3,519 [q]	934 [d]	30,784
1996 [w]		108,450 [j]			933,240	4,380	51,284	8,490 [d, h]		129,694		157,459	27,090 [o]	101,250	2,310	2,061	12,162	9,722	74,912
E.O.[r]	>109,000		>116,000		>500,000[e]				>53,000[t]				>17,000[v]					>3,500	

[a] Data obtained by aerial survey unless otherwise noted. Only peak counts are listed. Latest table revision :December 12, 1996.
[b] From 1972-1979 counting tower operated; escapement estimate listed is the tower counts plus expanded aerial survey counts below the tower (see Buklis 1982).
[c] Includes mainstem counts below the confluence of the North and South Forks, unless otherwise noted.
[d] Incomplete survey and/or poor survey timing or conditions resulted in minimal or inaccurate count.
[f] Sonar count.
[g] Tower count.
[h] Mainstem counts below the confluence of the North and South Forks Nulato River included in the South Fork counts.
[j] Weir Count
[k] Weir installed on June 29. First full day of counts occurred on June 30.
[m] Tower counts delayed until June 29 because of high, turbid water. First full day of counts occurred on June30.
[n] Weir installed on July 11. First full day of counts occurred on July 12.
[o] BLM helicopter survey.
[q] Tower operations were severly hampered because of high, turbid water which prohibited observations from the tower. Tower operated during the periods July 10 - 15 and from July 19 - 30, 1995.
[r] Interim escapement objective.
[e] The Anvik River Escapement Objective was rounded upward to 500,000 from 487,000 in March, 1992.
[t] Interim escapement objective for North Fork Nulato River only.
[v] Consists of Clear and Caribou Creeks interim escapement objectives of 9,000 and 8,000, respectively.
[w] Preliminary.

Appendix Table 2. Chinook salmon escapement counts for selected spawning areas in the Alaskan portion of the Yukon River drainage, 1961-1996 [a]

Year	Andreafsky River			Anvik River		Nulato River			Gisasa River		Chena River			Salcha River		
	East Fork		West Fork	Aerial		Aerial		Mainstem Tower Counts			Pop. Est. or Tower Counts	Aerial		Pop. Est. or Tower Counts	Aerial	
	Aerial	Tower or Weir Cnt	Aerial	River [b]	Index Area [b]	North Fork [c]	South Fork		Aerial	Weir		River	Index Area [d]		River	Index Area [f]
1961	1,003			1,226		376 [g]	167		266 [g]						2,878	
1962	675 [g]		762 [g]									61 [g,h]			937	
1963												137 [g]				
1964	867		705												450	
1965			344 [g]	650 [g]											408	
1966	361		303	638											800	
1967			276 [g]	336 [g]												
1968	380		383	310 [g]											739	
1969	274 [g]		231 [g]	296 [g]											461 [g]	
1970	665		574 [g]	368								6 [g]			1,882	
1971	1,904		1,682									193 [g,h]			158 [g]	
1972	798		582 [g]	1,198								138 [g,h]			1,193	1,034 1,034
1973	825		788	613								21 [g]			391	352 [i] 352
1974			285	471 [g]		55 [g]	23 [g]		161			1,016 [h]	959 [h]		1,857	1,620 2,579
1975	993		301	730		123	81		385			316 [h]	262 [h]		1,055	950 [i] 1,212
1976	818		643	1,053		471	177		332			531	496		1,641	1,473 1,969
1977	2,008		1,499	1,371		286	201		255			563			1,202	1,052 1,052
1978	2,487		1,062	1,324		498	422		45 [g]			1,726			3,499	3,258 3,258
1979	1,180		1,134	1,484		1,093	414		484			1,159 [g]			4,789	4,310 [i] 4,310
1980	958 [g]		1,500	1,330	1,192	954 [g]	369 [g]		951			2,541			6,757	6,126 6,126
1981	2,146 [g]		231 [g]	807 [g]	577 [g]		791					600 [g]			1,237	1,121 1,121
1982	1,274		851						421			2,073			2,534	2,346 2,346
1983				653 [g]	376 [g]	526	480		572			2,553	2,336		1,961	1,803 4,139
1984	1,573 [g]		1,993	641 [g]	574 [g]							501	494		1,031	906 1,400
1985	1,617		2,248	1,051	720	1,600	1,180		735			2,553	2,262		2,035	1,860 4,122
1986	1,954	1,530 [k]	3,158	1,118	918	1,452	1,522		1,346		9,065 [m]	2,031	1,935		3,368	3,031 [i] 4,966
1987	1,608	2,011 [k]	3,281	1,174	879	1,145	493		731		6,404 [m]	1,312	1,209	4,771 [m]	1,898	1,671 2,880
1988	1,020	1,339 [k]	1,448	1,805	1,449	1,061	714		797		3,346 [m]	1,966	1,760	4,562 [m]	2,761	2,553 4,313
1989	1,399		1,089	442 [g]	212 [g]						2,666 [m]	1,280	1,185	3,294 [m]	2,333	2,136 3,321
1990	2,503		1,545	2,347	1,595	568 [g]	430 [g,n]		884 [g]		5,603 [m]	1,436	1,402	10,728 [m]	3,744	3,429 4,831
1991	1,938		2,544	875 [g]	625 [g]	767	1,253		1,690		3,025 [m]	1,277 [g]	1,277 [g]	5,608 [m]	2,212 [g]	1,925 [g] 3,202
1992	1,030 [g]		2,002 [g]	1,536	931	348	231		910		5,230 [m]	825 [g]	799 [g]	7,862 [m]	1,484 [g]	1,436 [g] 2,235
1993	5,855		2,765	1,720	1,526	1,844	1,181		1,573		12,241 [k]	2,943	2,660	10,007 [k]	3,636	3,562 6,222
1994	300 [g]	7,801 [p,r]	213 [g]		913 [g]	843	952	1,795 [s]	2,775	2,888 [p,t]	11,881 [k]	1,570	1,570	18,404 [k]	11,823	11,189 12,759
1995	1,635	5,841	1,108	1,996	1,147	968	681	1,412	410	4,023	9,680 [m]	3,575	3,039	13,643 [k]	3,978	3,734 6,773
1996 [v]		2,955	624	839	709		100 [n]	756		1,945	6,833 [m]	2,233	2,112	7,958 [m]	4,866	4,800 6,912
E.O. [w]	>1,500		>1,400	>1,300 [x]	>500 [x]	>800	>500		>600				>1,700			>2,500

continued

Appendix Table 2. (page 2 of 2).

[a] Data obtained by aerial survey unless otherwise noted. Only peak counts are listed. Survey rating is fair to good, unless otherwise noted. Latest table revision: 03-Sep-97
[b] From 1961-1970, river count data are from aerial surveys of various segments of the mainstem Anvik River. From 1972-1979, counting tower operated; mainstem aerial survey counts below the tower were added to tower counts. From 1980-present, aerial survey counts for the river are best available minimal estimates for the entire Anvik River drainage. Index area counts are from the mainstem Anvik River between the Yellow River and McDonald Creek.
[c] Includes mainstem counts below the confluence of the North and South Forks, unless otherwise noted.
[d] Chena River index area for assessing the escapement objective is from Moose Creek Dam to Middle Fork River.
[f] Salcha River index area for assessing the escapement objective is from the TAPS crossing to Caribou Creek.
[g] Incomplete and/or poor survey conditions resulting in minimal or inaccurate counts.
[h] Boat survey.
[i] Data unavailable for index area. Calculated from historic (1972-91) average ratio of index area counts to total river counts (0.90:1.0).
[k] Tower Counts
[m] Population estimate
[n] Manistem counts below the confluence of the North and South Forks Nulato River included in the South Fork counts.
[p] Weir Counts
[r] Weir installed on June 29; first full day of counts June 30.
[s] Tower counts delayed until June 29 because of high, turbid water. First full day of counts occurred on June 30.
[t] Weir installed on July 11; first full day of counts July 12.
[v] Preliminary.
[w] Interim escapement goals. Established March, 1992.
[x] Interim escapement goal for the entire Anvik River drainage is 1,300 salmon. Interim escapement objective for mainstem Anvik River between the Yellow River and McDonald Creek is 500 salmon.

Appendix Table 3. South (right) bank Nulato River expanded summer chum salmon tower counts by hour and date, 21 June to 19 July, 1996.

Ending time	21-Jun [a]	22-Jun	23-Jun	24-Jun	25-Jun	26-Jun	27-Jun	28-Jun [b]	29-Jun [b]	30-Jun [b]	1-Jul	2-Jul	3-Jul	4-Jul	5-Jul
01:00		144	248	256	84	72	44				236	132	88	312	64
02:00		96	144	192	28	36	20				136	68	48	48	56
03:00		80	88	424	84	44	36				100	84	36	84	40
04:00		52	16	296	36	24	24				92	96	36	56	32
05:00		28	24	160	24	48	4				36	48	44	32	52
06:00		28	8	48	12	28	36				24	68	52	12	84
07:00		16	28	60	12	20	32				0	12	44	48	64
08:00		16	96	16	12	4	0				12	8	60	44	60
09:00		16	12	16	4	0	8				0	20	36	20	32
10:00		28	12	24	4	4	12				20	8	48	40	124
11:00		0	24	16	16	44	20				24	44	64	64	144
12:00		28	8	8	36	60	24				16	36	44	36	124
13:00		12	20	8	72	36	32			8	32	68	32	108	256
14:00		20	0	20	44	40	40			116	24	88	140	204	244
15:00		28	16	12	68	68	44			68	72	60	188	264	448
16:00		32	0	104	104	136	32			160	108	184	124	440	460
17:00		72	12	24	260	164	52			152	244	208	168	456	708
18:00		132	16	72	152	104	52			260	304	244	260	428	640
19:00		104	284	220	252	240	32			288	364	208	284	220	804
20:00		72	612	132	228	264	28			324	344	460	140	364	720
21:00	68	264	376	288	444	232	232			388	236	712	160	436	432
22:00	108	292	284	76	1,244	248	92			344	264	240	56	308	400
23:00	128	228	492	208	300	160	68			236	296	348	48	172	124
24:00	204	188	528	132	200	208	24			248	96	128	100	76	100
Total	508	1,976	3,348	2,812	3,720	2,284	988			3,431 [c]	3,080	3,572	2,300	4,272	6,212

-Continued-

Appendix Table 3. (page 2 of 2)

Ending time	6-Jul	7-Jul	8-Jul	9-Jul	10-Jul	11-Jul	12-Jul	13-Jul	14-Jul	15-Jul	16-Jul	17-Jul	18-Jul	19-Jul
01:00	252	328	264	100	84	84	12	16	244	168	32	16	8	0
02:00	44	208	188	124	168	16	0	24	80	48	20	20	0	4
03:00	60	120	96	160	92	16	20	12	44	64	12	8	16	4
04:00	40	84	40	260	60	24	32	12	60	76	16	0	4	0
05:00	32	116	4	96	64	8	16	32	48	84	24	12	16	16
06:00	52	88	20	80	48	24	28	48	36	52	4	32	8	12
07:00	56	96	28	88	40	20	20	44	60	40	0	20	8	12
08:00	92	32	36	76	12	72	12	36	32	44	20	32	16	0
09:00	76	20	44	48	20	84	8	52	20	48	16	8	4	24
10:00	36	76	68	40	36	60	36	28	52	48	20	12	28	16
11:00	60	72	84	36	40	68	64	48	48	52	16	4	16	12
12:00	44	48	80	64	60	112	72	60	28	36	4	24	12	
13:00	36	56	380	44	164	128	192	44	36	44	20	0	4	
14:00	72	440	364	104	212	88	120	84	60	56	28	12	24	
15:00	48	520	392	52	248	204	252	80	20	40	12	4	4	
16:00	96	492	332	84	196	104	240	340	44	92	8	20	32	
17:00	112	404	324	144	688	164	612	284	32	36	20	16	24	
18:00	252	688	436	100	676	284	360	260	40	40	16	28	12	
19:00	464	572	464	380	604	444	344	300	48	20	68	36	12	
20:00	372	232	304	80	372	268	316	208	104	40	76	8	16	
21:00	480	252	232	120	268	240	272	316	360	24	44	36	12	
22:00	304	308	52	288	328	148	240	252	280	16	12	12	12	
23:00	252	284	132	132	236	132	84	216	296	12	4	4	8	
24:00	360	248	76	100	468	96	60	308	312	20	12	4	4	
Total	3692	5784	4440	2800	5184	2888	3412	3104	2384	1200	504	368	300	251 [d]

a Counting initiated at 21:00

b Counting interrupted by high, muddy water.

c Expanded for missed hours based on average proportion of daily passage on 27 June, 1 and 2 July during missed hours.

d Missed counts 11:00 to midnight estimated from average percent passage during those hours July 16, 17 and 18.

Appendix Table 4. North (left) bank Nulato River expanded summer chum salmon tower counts by hour and date, 21 June to 19 July, 1996.

Ending time	21-Jun [a]	22-Jun	23-Jun	24-Jun	25-Jun	26-Jun	27-Jun	28-Jun [b]	29-Jun [b]	30-Jun [b]	1-Jul	2-Jul	3-Jul	4-Jul	5-Jul
01:00		88	108	628	228	200	164				592	364	164	80	24
02:00		60	92	1032	52	84	68				384	120	72	32	8
03:00		72	72	684	40	76	48				216	108	32	24	12
04:00		72	92	352	12	32	52				68	72	24	28	68
05:00		16	36	120	4	12	36				52	64	36	4	48
06:00		60	12	68	20	20	4				44	44	16	8	40
07:00		36	36	52	12	8	20				20	16	28	24	28
08:00		32	24	36	20	12	12				8	4	12	36	36
09:00		16	20	24	4	4	4				4	0	16	28	24
10:00		12	0	28	12	8	16				12	24	24	32	24
11:00		0	4	32	28	4	12				8	8	36	44	56
12:00		0	8	12	24	20	28				12	28	28	56	40
13:00		8	0	4	44	28	20			52	32	48	16	48	96
14:00		0	8	0	20	36	44			164	12	32	40	32	116
15:00		0	4	4	92	72	52			108	16	52	36	40	104
16:00		16	0	0	100	20	36			100	8	64	24	36	64
17:00		4	4	36	96	60	44			76	104	52	52	20	96
18:00		32	0	16	288	152	28			212	68	136	72	68	192
19:00		152	44	40	248	332	36			96	244	128	36	92	192
20:00		144	456	84	408	560	40			112	408	228	64	56	188
21:00	8	216	524	248	640	688	46			192	628	264	120	92	128
22:00	84	212	968	148	616	760	132			356	476	196	140	156	148
23:00	60	304	316	56	228	808	100			368	316	220	108	104	168
24:00	40	156	436	164	240	512	52			512	292	232	128	72	208
Total	192	1,708	3,264	3,868	3,476	4,508	1,094			3,840 [c]	4,024	2,504	1,324	1,212	2,108

-Continued-

Appendix Table 4. (page 2 of 2)

Ending time	6-Jul	7-Jul	8-Jul	9-Jul	10-Jul	11-Jul	12-Jul	13-Jul	14-Jul	15-Jul	16-Jul	17-Jul	18-Jul	19-Jul
01:00	16	52	116	12	92	100	36	16	44	60	12	8	0	4
02:00	8	80	40	8	96	12	4	4	36	32	28	4	0	0
03:00	8	64	24	16	68	32	8	8	28	44	8	0	8	8
04:00	4	56	36	20	44	4	16	0	40	36	12	4	4	0
05:00	12	52	12	28	36	12	4	4	16	48	4	8	4	0
06:00	20	28	8	12	52	32	8	24	8	32	0	12	0	8
07:00	24	32	16	52	28	20	8	12	24	36	8	28	4	16
08:00	56	12	12	32	32	36	28	40	12	32	4	28	20	4
09:00	68	16	28	24	32	68	16	32	4	20	16	16	0	12
10:00	48	8	36	16	44	80	24	20	16	12	24	0	12	4
11:00	40	28	48	20	48	100	20	12	12	8	12	12	20	8
12:00	52	16	56	12	32	64	44	24	4	16	20	16	8	
13:00	36	12	32	28	24	36	12	20	20	24	12	8	12	
14:00	64	32	88	8	36	48	20	32	8	20	24	40	8	
15:00	56	12	56	16	72	32	56	36	16	32	20	20	0	
16:00	32	20	72	24	88	56	48	48	24	16	4	4	16	
17:00	44	76	64	20	76	28	72	76	16	36	12	32	4	
18:00	96	96	96	16	180	60	48	76	24	12	20	8	28	
19:00	112	172	96	52	148	84	72	32	20	28	24	12	20	
20:00	140	432	144	108	132	96	80	36	36	24	88	20	16	
21:00	56	124	124	140	124	96	80	68	76	44	32	16	12	
22:00	128	100	40	80	156	68	36	40	124	24	16	8	12	
23:00	88	76	20	72	188	40	32	64	64	40	8	0	8	
24:00	68	80	24	48	92	52	40	60	76	44	4	4	4	
Total	1,276	1,676	1,288	864	1,920	1,256	812	784	748	720	412	308	220	120 [d]

a Counting initiated at 21:00.
b Counting interrupted by high, muddy water.
c Expanded for missed hours based on average proportion of daily passage on 27 June, 1 and 2 July during missed hours.
d missed counts 11:00 to midnight estimated from average percent passage during those hours July 16, 17 and 18.

Appendix Table 5. South (right) bank Nulato River expanded chinook salmon tower counts by hour and date, 21 June to 19 July, 1996.

Ending time	21-Jun [a]	22-Jun	23-Jun	24-Jun	25-Jun	26-Jun	27-Jun	28-Jun [b]	29-Jun [b]	30-Jun [b]	1-Jul	2-Jul	3-Jul	4-Jul	5-Jul
01:00		0	0	0	0	0	0				0	0	0	0	0
02:00		0	0	0	0	0	0				0	4	0	0	0
03:00		0	0	0	0	0	0				0	0	0	0	0
04:00		0	0	0	0	0	0				4	0	0	0	0
05:00		4	0	0	0	0	0				0	0	0	0	0
06:00		0	0	0	0	0	0				0	0	0	0	0
07:00		0	0	0	0	0	0				0	0	0	0	0
08:00		0	0	0	0	0	0				0	0	0	0	0
09:00		0	0	0	0	0	0				0	0	0	0	0
10:00		0	0	0	0	0	0				0	0	0	0	0
11:00		0	0	0	0	0	0				0	0	0	0	0
12:00		0	0	0	0	0	0				0	0	0	0	4
13:00		0	0	0	0	0	0			0	8	4	0	0	0
14:00		0	0	0	0	0	0			0	0	0	0	0	4
15:00		0	0	0	0	0	0			0	0	0	0	0	4
16:00		0	0	0	0	0	0			0	0	4	0	0	4
17:00		0	0	0	0	0	0			0	0	4	0	0	8
18:00		0	0	0	0	0	0			0	0	0	4	4	8
19:00		0	0	0	0	0	0			0	0	4	0	4	4
20:00		0	0	0	0	8	0			0	12	0	0	0	4
21:00	0	0	0	0	0	0	4			4	0	0	0	0	8
22:00	0	0	0	0	0	0	0			0	0	0	0	0	0
23:00	0	0	0	0	0	4	0			0	4	4	0	0	4
24:00	12	0	0	0	4	0	0			4	0	0	0	0	0
Total	12	4	0	0	4	12	4			8	28	24	4	8	52

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Appendix Table 5. (page 2 of 2)

Ending time	6-Jul	7-Jul	8-Jul	9-Jul	10-Jul	11-Jul	12-Jul	13-Jul	14-Jul	15-Jul	16-Jul	17-Jul	18-Jul	19-Jul
01:00	0	0	0	4	0	0	0	0	0	0	0	0	0	0
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04:00	0	0	8	0	0	0	0	0	0	0	0	0	0	0
05:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:00	0	4	0	0	0	0	0	0	0	0	0	0	0	0
08:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
09:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10:00	0	0	0	4	0	0	4	4	0	4	0	0	0	0
11:00	0	0	4	0	0	0	0	0	0	0	0	0	0	0
12:00	0	0	0	0	0	0	8	0	0	0	0	0	0	0
13:00	0	0	0	0	0	8	0	0	0	0	0	0	0	0
14:00	4	0	4	0	0	4	0	0	0	0	0	0	0	0
15:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16:00	0	4	0	4	0	4	0	0	0	0	4	0	0	0
17:00	8	0	0	0	0	0	0	4	0	8	0	0	0	0
18:00	0	12	4	4	0	0	16	0	0	0	0	0	0	0
19:00	4	8	4	0	0	0	0	0	8	0	4	0	0	0
20:00	4	12	0	4	0	0	4	0	0	0	0	0	0	0
21:00	0	0	0	4	0	0	0	0	4	0	4	0	0	0
22:00	0	0	0	4	0	0	0	0	0	0	0	0	0	0
23:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	20	40	24	28	0	16	32	8	12	12	12	0	0	0

a Counting initiated at 21:00
b Counting interrupted by high, muddy water.

Appendix Table 6. North (left) bank Nulato River expanded chinook salmon tower counts by hour and date, 21 June to 19 July, 1996.

Ending	21-Jun [a]	22-Jun	23-Jun	24-Jun	25-Jun	26-Jun	27-Jun	28-Jun [b]	29-Jun [b]	Jun-30 [b]	1-Jul	2-Jul	3-Jul	4-Jul	5-Jul
time		0	0	0	0	0	0				0	0	0	0	0
01:00		8	0	0	0	0	0				0	0	0	0	0
02:00		0	0	0	0	0	0				0	0	0	0	0
03:00		0	0	0	0	0	0				0	0	4	0	0
04:00		0	4	0	0	0	4				0	0	0	0	8
05:00		0	0	0	0	0	0				0	0	0	0	0
06:00		0	0	0	0	0	0				0	0	0	0	0
07:00		0	0	0	0	0	0				0	0	0	0	0
08:00		0	0	0	0	0	0				0	0	0	0	0
09:00		0	0	0	0	0	0				0	0	0	0	0
10:00		0	0	0	0	0	0				0	0	0	0	0
11:00		0	0	0	0	0	0				0	0	0	0	4
12:00		0	0	0	0	0	0				0	4	0	0	0
13:00		0	0	0	0	0	0			0	0	0	0	0	4
14:00		0	0	0	0	0	0			8	0	0	0	0	8
15:00		0	4	0	0	0	0			0	0	0	0	0	4
16:00		0	0	0	0	0	0			0	0	0	0	0	8
17:00		0	0	0	0	0	0			0	0	0	0	0	4
18:00		0	0	0	0	0	0			4	0	0	0	0	0
19:00		0	0	0	0	0	0			0	0	8	0	0	4
20:00		0	0	0	0	0	0			0	4	0	0	0	8
21:00	0	0	0	0	0	0	0			0	12	4	0	0	4
22:00	0	0	0	4	0	0	0			0	4	0	0	0	0
23:00	0	0	0	0	0	0	0			4	0	0	0	0	4
24:00	0	0	0	0	4	0	0			0	0	0	0	4	4
Total	0	8	8	4	4	0	4			16	20	16	4	4	64

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Appendix Table 6. (page 2 of 2)

Ending	6-Jul	7-Jul	8-Jul	9-Jul	10-Jul	11-Jul	12-Jul	13-Jul	14-Jul	15-Jul	16-Jul	17-Jul	18-Jul	19-Jul
time	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01:00	0	0	0	0	4	0	0	0	0	0	0	0	0	0
02:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03:00	0	0	0	4	0	0	0	0	0	0	0	0	0	0
04:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05:00	0	8	4	0	0	0	0	0	0	0	0	4	0	0
06:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07:00	0	0	0	0	0	0	0	0	0	12	0	0	0	0
08:00	0	0	0	4	8	0	0	4	0	0	0	0	0	0
09:00	0	0	0	8	0	0	0	0	0	0	0	0	0	0
10:00	0	0	0	0	0	0	4	0	0	0	4	0	0	0
11:00	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12:00	4	8	0	0	0	4	0	0	0	0	0	0	0	0
13:00	0	0	4	0	0	0	4	0	0	0	0	4	0	0
14:00	0	8	4	0	0	0	0	0	0	0	0	0	0	0
15:00	0	0	0	0	0	0	4	0	0	0	0	0	0	0
16:00	0	0	0	0	0	0	0	4	0	0	0	0	0	0
17:00	0	4	0	0	0	8	0	0	0	0	0	0	0	0
18:00	8	4	0	0	0	0	4	0	0	0	0	0	0	0
19:00	4	4	12	0	0	0	4	0	0	0	4	0	0	0
20:00	0	0	4	0	0	0	4	0	0	0	4	0	0	0
21:00	0	0	0	0	0	8	0	0	4	0	0	0	0	0
22:00	0	4	0	0	0	0	4	0	0	0	0	0	0	0
23:00	0	0	0	0	4	0	0	0	0	0	0	0	0	0
24:00	0	0	0	4	0	0	4	0	0	0	0	0	0	0
Total	16	40	28	20	16	20	32	8	4	12	12	8	0	0

a Counting initiated at 21:00
b Counting interrupted by high, muddy water.