TAKOTNA RIVER SALMON COUNTING TOWER

PROJECT SUMMARY, 1995-1999

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OEO/ADA STATEMENT

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ABSTRACT

Students and staff of Takotna Charter School and Training Center began operating a salmon counting tower in 1995 to estimate the annual escapement of chinook and chum salmon passing upstream of their community on the Takotna River. The school received funding for the project from a grant administered by the Bering Sea Fishermen's Association. Staff from the Alaska Department of Fish and Game assisted with planning and annual operations. The project emerged from the perception that salmon returns to the Takotna River were improving following decades of near absence. Included in the evidence was a 1994 aerial survey in which a biologist reported seeing several thousand chum salmon in Fourth-of-July Creek, a tributary of the Takotna River. Efforts were made to operate the counting tower every year from 1995 to 1999; however, operations were successful only in 1996 and 1997. Escapement estimates in those two years consisted of 401 and 1,176 chinook salmon, and 2,794 and 1,794 chum salmon. The primary impediment to operations over the past five years has been inadequate water clarity caused by the suspended material associated with frequent high water events and the tannin coloration of the water. To address these and other impediments, the cooperators intend to convert the project from a counting tower to a resistance board weir.

KEY WORDS: Kuskokwim, Innoko Mining District, escapement, Athabaskan, weirs.

INTRODUCTION

This report documents the development and operation of the Takotna River counting tower, 1995 through 1999, which was operated to estimate salmon escapement in the river. The counting tower was designed and operated as a cooperative project between Takotna Charter School and Training Center (TCSTC) and the Alaska Department of Fish and Game (ADF&G). The school receives funding for the project from a grant to the Iditarod Area School District issued by the U.S. Bureau of Indian Affairs and administered by the Bering Sea Fishermen's Association (BSFA).

The Commercial Fisheries Division of ADF&G is responsible for managing the subsistence and commercial salmon fisheries of the Kuskokwim River for sustainable yield. The approach used to achieve this goal is to ensure that adequate numbers of salmon escape the fisheries to spawn (Burkey et al. 1999). However, ADF&G has lacked the necessary tools to adequately assess the abundance and distribution of salmon escapements in the Kuskokwim River basin. The area for which information is most lacking is the upper Kuskokwim River (Figure 1). Prior to 1995, the only thorough escapement monitoring project ever operated in the upper half of the Kuskokwim River basin was a weir on the South Fork Salmon River at approximately river mile (rm) 587 (river kilometer (rkm) 945). The weir was operational in 1981 and 1982 and focused on chinook salmon (Schniederhan 1982a and 1982b). Since 1982, escapement monitoring has been limited to, at most, one annual aerial survey flown over a portion of the Salmon River during the estimated peak of chinook spawning (Burkey and Cappiello 1996). Part of the intent for developing the Takotna River counting tower was to help fill the information void in the upper Kuskokwim River basin by providing managers with a reliable monitoring project that can serve as an index for the area and promote more informed management actions.

Another interest in monitoring salmon returns to the Takotna River is that these populations appear to be in a state of recovery or restoration following near extirpation earlier in this century (Stokes 1985; Appendix A). Native Athabaskans who lived in the upper Kuskokwim River basin before the early twentieth century harvested salmon from the Takotna River, including residents of *Tagholjitdochak*' which was located near the confluence of Fourth-of-July Creek and the Takotna River (Hosley 1966, Stokes 1985, Anderson 1977, BLM 1984). Hosley (1966) and Stokes (1983) reported that people from the Vinasale and Tatlawiksuk Athabaskan bands also fished in the Takotna River. The numbers of salmon that were harvested is unknown, but interviews with elderly Nikolai residents who have first hand knowledge of the area recall the existence of fairly strong chinook and chum runs in the Takotna River until the early 1900s (Stokes 1985).

Historically, weirs fitted with fish traps were a common method for harvesting salmon (Figure 2). At least four weir sites have been documented as having existed on the Takotna River (Stokes 1983). These were abandoned no later than the mid-1920s according to oral history and first hand knowledge of Nikolai elders. One of these sites was located on the Nixon Fork of the Takotna River, near the West Fork River. The other locations included a site on the main river a short distance above the community of Takotna, one near Big Creek, and another near or within

Fourth-of-July Creek. According to an elder who fished the Nixon Fork weir, the abandonment of these sites was the result of the coalescence of the area's Athabaskan population and the booming mining industry. Several epidemics ravaged the area's Native populations in the late nineteenth and early twentieth centuries. Between 1908 and 1910, a wave of epidemic, primarily diphtheria, forced the remnant population at *Tagholjitdochak'* to abandon the site (BLM 1984).

Gold was discovered in the Innoko mining district in 1906, and the Takotna River was transformed into a major access route to the gold fields (Brown 1983). The community of Takotna (Figure 3) developed as a supply point and staging area for the miners. Dog teams were the primary means of winter transportation and their growing numbers were fed dried salmon that were likely harvested from the Takotna River and other local streams. Steamboats loaded with tons of mining supplies navigated the Takotna River from the mouth to near the current town of Takotna. In the early 1920s, small temporary dams were built on the river to facilitate steamboat passage (Kusko Times 1921). At some point, salmon populations became depleted. The timing and cause of the decline are unclear (Stokes 1985), but were likely due to a combination of over fishing and activities associated with mining development.

Area residents and local biologists described the Takotna River as being almost void of salmon during the 1960s and 1970s (Appendix A). By the 1980s, however, Takotna residents began to notice adult salmon in the river again. During a survey in 1994, an experienced ADF&G fishery biologist observed several thousand chum and some chinook salmon in Fourth-of-July Creek, a clear water tributary of the Takotna River (Appendix B: Burkey and Cappiello 1996). In recent years, sport fishers have also begun to catch coho salmon while pike fishing (personal communication, Dick Newton, local resident).

The apparent increase in salmon abundance in the Takotna River prompted students and staff of TCSTC to begin monitoring salmon passage by establishing a counting tower in 1995. Involvement by Takotna Traditional Council has been interwoven in the annual project operations and design. Staff from ADF&G have served as advisors to the school and provided annual on-site visits of one to three weeks during the salmon run. The primary goal of the project was to estimate the annual spawning escapement of chinook and chum salmon in order to document the recovery of the local salmon populations. These tower counts are also the only representation of Upper Kuskokwim River salmon populations available to salmon managers other than sporadic aerial surveys.

Objectives

1. Install the counting tower by mid June of each year and operate the tower through late July.
2. Estimate daily and total season escapement of chum and chinook salmon in the Takotna River upstream of the community of Takotna.
3. Estimate the run timing of chum and chinook salmon to the Takotna River.
4. Monitor climatological and hydrological conditions at the tower site.

5. Collect baseline water quality information.

Study Area

The Takotna River originates in the northern half of the mineral rich Kuskokwim Mountains. Formed by the confluence of Moore Creek and Little Waldren Fork, the river flows in a northeasterly direction past the community of Takotna at rm 50 (rkm 80.5) before swinging southeasterly near the confluence of the Nixon Fork River at rm 15 (rkm 24.2; Brown 1983: Figure 3). Another tributary, the Tatalina River, flows into the Takotna River at rm 3 (rkm 4.8). The Takotna River empties into the Kuskokwim River across from McGrath at rm 507 (rkm 815. Burkey et al. 1999).

The Takotna River is about 100 mi (161 km) in length and the entire basin drains an area of 2,180 square miles (5,668 square kilometers, Brown 1983). The river is shallow and winding from its head to the town of Takotna, but gradually becomes deeper downstream of that point. especially after the confluence of the Nixon Fork. The current is sluggish and the channel width in the lower reaches ranges from 400 to 500 ft (122 to 152 m). The river slope as reported by Brown (1983) is approximately 4.7 feet per mile (0.89 m per kilometer).

At normal flow, the river has a nominal load of suspended matter, but the water has a high level of color due to organic leaching. The Nixon Fork and Tatalina River drain extensive bog flats and swampy lowlands, but the remainder of the basin is mostly upland spruce-hardwood forest (Brown 1983, Selkregg 197?). White spruce with scattered birch or aspen is common on moderate south-facing slopes, while black spruce is more characteristic on northern exposures and poorly drained areas. The understory consists of spongy moss and low brush on the cool moist slopes, grasses on dry slopes, and willow and alder in the higher open forest near timberline.

The project site is located adjacent to the community of Takotna were the river channel is divided by a large wooded island measuring approximately 0.25 mi (0.4 km) long and 0.1 mi (0.16 km) wide. The island divides the river into a North and South Channel. The North Channel is adjacent to town and relatively shallow. Much of the soft bottom consists of organic detritus, but the upstream portion is interspersed with gravel and cobble riffles. The North Channel is approximately 70 to 100 ft (21.3 to 30.5 m) in width. As measured by ADF&G during low flow conditions, the maximum depth was 1.3 ft (0.4 m), average velocity was 1.42 ft/s (0.43 m/s), and the estimated discharge was 85.3 ft^3/s (2.4 m^3/s; Appendix C).

The South Channel is the primary route used by migrating salmon. At the tower site, the South Channel is about 130 ft (39.6 m) in width and the substrate consists of small to medium size cobble. At normal flow, the maximum depth is about 3.0 ft (0.91 m). During low flow conditions the maximum depth was reported as 2.1 ft (0.65 m) with an average velocity of 3.31 ft/s (1.01 m/s), and an estimated discharge of 533.8 ft^3/s (15.1 m^3/s; Appendix C).

METHODS

A counting tower made of logs and dimensional lumber was erected on the south shore of the South Channel (GPS coordinates N 62° 59.2', W 156° 03.5'). The site is on a wooded cut bank seven feet in height. The viewing platform of the tower is approximately 20 ft (6.1 m) above the water surface. Flash panels extend from the south shore to three-quarters the width of the South Channel (Figure 4). The panels provide a contrasting background to aid in fish detection and species identification. A partial weir has been erected in recent years that extends from the north shore of the channel and across a shallow span of water. The weir ends at the edge of the flash panels. An array of five 500-watt lights was suspended near the tower to aid during night counts. These lights remained on throughout the night-time.

The North Channel was easily viewed from the 25 ft (7.7 m) bluff at the edge of town which is where the counting station was located. Local residents expressed the view that few fish travel up the North Channel. The most rigorous North Channel counts occurred in 1996, but few salmon were observed, so monitoring of the North Channel was reduced in subsequent years. In most recent years, concern about accounting for possible fish passage in the North Channel was addressed by placing a weir across the channel, which eliminated the need for a North Channel counting schedule.

Field preparations start about 10 June when the crew leader and students begin placing flash panels in the river, performing tower repairs and installing weirs. Spot counts are begun about 15 June through 25 June or until salmon are first observed. Spot counts were generally 1 to 2 hours in duration, and conducted two or three times each day. After the first salmon is observed the counting shifts to a 24-hour schedule. During the 24-hour schedule, counts are done for 20 minutes each hour, starting at the top of each hour, twenty-four hours a day. The actual number of fish counted in each 20-minute period is multiplied by three to produce the expanded hourly counts for each species. The expanded hourly counts are summed each day to produce a daily passage estimate. Several times each week the daily and cumulative passage estimates for each species are relayed to the ADF&G project leader in Bethel by telephone or fax. An ADF&G fisheries biologist is on site to advise the TCSTC crew leader and assist in training for one to three weeks in late June and early July. Counting ends for the season on about 31 July.

The crew consisted of four to six students from TCSTC, scheduled in either six-hour or eight-hour shifts, with rotating days off. Commuting between Takotna and the South Channel tower site required crossing the two channels. Transportation options include wading, canoeing or motorized skiff. Depending on water levels, the North Channel could be easily waded, but the South Channel usually required a canoe or skiff. An adult project leader and crew leader supervise the students and are responsible for preseason installation, postseason dismantling and storage, scheduling, logistics and relaying updated reports to Bethel. Staff from ADF&G advise on project design, compile data, estimate missed data and provide onsite quality control checks as resources allow.

For occasions when one or more hours are not counted, salmon passage estimates are made for that time period by a simple linear interpolation of passage using counts from the same time period the day before and the day following the missed time period. In those instances when one or more days are not counted, passage is estimated as the average of the two days bracketing the missed period.

Deviations from the methods described above do occur depending on various circumstances that exist each season. Details about these deviations are described below.

1995

The intention in 1995 was to locate an appropriate tower site and begin enumerating chinook and chum salmon early enough to account for the entire run of each species. The South Channel tower site was selected on 7 July. Two chinook salmon were observed migrating upstream during the site selection process. Proximity to the village of Takotna was the prime reason the tower site was chosen. During the next several days, Mr. Terry Huffman of Takotna supervised tower construction using logs, lumber and plywood. White canvas was cut for flash panels and weighted down with iron bars and sandbags. White polyethylene panels (1/8 in x 4 ft x 8 ft) arrived within a few days and replaced the canvas flash panels. Up to six 4-ft iron bars were wired to each polyethylene panel to hold the panel down in the swift current. Sandbags were then placed on top of the panels as needed. The line of panels extended the entire width of the South Channel in 1995.

A location was also chosen on the north shore of the river to enumerate salmon passage in the North Channel. The site was located near the edge of town and commanded an excellent view of the channel approximately 25 ft (7.7 m) above the streambed. Use of this station in 1995 was mostly limited to occasional spot counts.

The crew in 1995 consisted of students and staff from TCSTC as well as several students from McGrath who were participating in the project as part of a science camp.

No estimates were made for periods not counted in 1995 due to the frequent missed counts.

1996

Attention focused on counting both the North and South Channels during the second year of operation. Mr. Errol Miller, a Takotna high school teacher, was the designated crew leader. A smaller crew of students was employed than in 1995, and greater emphasis was placed on thoroughly training the crew in species identification.

Many improvements simplified and streamlined operations in 1996. Mr. Huffman was instrumental in constructing a shelter overlooking the North Channel to improve the counting conditions. He also

built a suspension bridge across the North Channel to allow for easier access to the island and the South Channel canoe launch site. Mr. Huffman designed a better method to hold the panels in place, which entailed using 2-ft lengths of iron bar each with a short crosspiece welded near one end. Six holes were drilled in each panel and the iron bars were put through the holes then driven into the riverbed. The crosspiece helped keep the panels down and the bars were driven in at an angle. Sandbags were then placed on the panels. This method was used to install panels across the entire width of both the South and North Channels (Figure 4). Other improvements included trail clearing on the island and equipping the tower with a CB radio that allowed for communication with the school. Vegetation was cleared along a line of site between the tower and the school to allow for easier and more effective crew monitoring, plus a 2500-watt generator was used to power an array of 500-watt lights for night counts. The lights were affixed to planks nailed to trees about 20 ft (6.1 m) above the water surface.

Estimates for blocks of hours not counted were calculated using the average hourly proportion from the complete 24-hour counts that occurred from 4 through 10 July. The counts from this block of days were used to calculate the average proportion of fish passage for each hour of the day. Total daily estimates were calculated by dividing the fish passage during the counted hours by the sum of the average hourly proportions for the counted hours. Daily estimates for hours not counted were calculated by multiplying the total daily estimate by the sum of the average hourly proportions for the hours not counted.

1997

During the third year of operation, the North Channel had a full weir precluding the need for regular counts. A partial weir was placed in the South Channel directing salmon towards the flash panels. The suspension bridge was washed out so students again needed to wade across the North Channel to access the canoe launch site on the South Channel. Mr. Steve Howe supervised a crew of four to six students. Counting methods for the South Channel were similar to 1996. The few missed counts were linearly interpolated from the same time period one day before and one day after the missed counts.

1998

During the fourth year of operation. Mr. Jim Newman. a Takotna high school teacher, was the designated crew leader. The crew consisted of four to six students who were to conduct counts using methods similar to 1997. The limited counts attained are expanded but estimates are not calculated for any missed times.

1999

High water conditions during much of the early part of the season prohibited effective counting so the tower project was not operated in 1999.

Climatological and Hydrological Conditions

Surface water temperature (°C), air temperature (°C), and water level (cm on a staff gauge) were to be recorded at approximately 0800 hours each day. Measurements were taken near the South Channel tower site.

Stream flow rate was estimated at various points in the drainage basin on an opportunistic basis. Measurements and calculations were done using standard methods described by the U. S. Geological Survey (Rantz 1982). Velocities were determined using a Price AA current-meter with a top-setting wading rod, and all measurements were collected by wading in the stream. Typically, the six-tenths-depth method was used; however, the two-point method was sometimes followed in water over 3 feet in depth. Stream discharge was calculated using the conventional current-meter method.

Water Chemistry

Water samples were collected from the Takotna River to provide a general profile of the water chemistry. Samples for general limnology processing were taken with a pre-cleaned 500-ml polyethylene bottle and stored in a cool and dark location until they could be sent to the ADF&G limnology laboratory. Samples for heavy metal analysis were taken using a 250-ml polyethylene bottle containing 0.5-ml of concentrated ultra-pure nitric acid. Acidified samples had a pH of <2 units. All samples were shipped immediately to the ADF&G limnology laboratory in Soldotna where they generally arrived within 48 to 72 hours of when the samples were collected.

General water analysis was done at the ADF&G limnology laboratory in Soldotna. Conductivity (temperature compensated to 25 °C) was measured using a YSI conductance meter equipped with a platinum electrode (cell constant = 1.0 cm^{-1}). The pH was measured with a Corning[2] pH/ion meter. Alkalinity was determined by acid titration to pH 4.5 using 0.2 N H_2SO_4 (APHA 1985). Turbidity, expressed as nephelometric turbidity units (NTU), was measured with a HF DRT-1000 turbidimeter after linear calibration. Color was determined on a filtered (Whatman GFF) sample by measuring the spectrophotometric absorbance at 400 nm and converting to equivalent platinum cobalt (Pt) units (Koenings et al. 1987). Calcium and magnesium were determined from separate EDTA (0.1 N) titrations after Golterman (1969), and total iron was

[2] Mention of trade names or vendors does not constitute endorsement by the Alaska Department of Fish and Game.

analyzed by reduction of ferric iron with hydroxylamine during hydrochloric acid digestion as described by Strickland and Parsons (1972). Reactive silicon was determined using the method of ascorbic acid reduction to molybdenum blue after Stainton et al. (1977).

Acidified (pH <2) samples were analyzed for multiple trace elements by Elemental Research, Inc., Vancouver, British Columbia, Canada using inductively coupled plasma mass spectrometry (ICP-MS). In essence, samples are converted into an aerosol that is injected into high temperature argon plasma. The aerosol is vaporized or decomposed into atoms. The concentration of trace elements is determined by measuring the amount of light absorption.

RESULTS

1995

The run timing for salmon in the Takotna River was unknown at the start of the 1995 season. As it turned out, both the chinook and chum salmon runs were well underway when counting began on 7 July. The cumulative season passages were 156 chinook salmon and 1,689 chum salmon (Tables 1 and 2). These passages do not include estimates for the missed counts or missed days, so the actual total escapements were greater. The actual number of fish observed included 62 chinook and 644 chum salmon (Tables 3 and 4).

The first chinook salmon was observed on 7 July and the first chum salmon on 8 July. Counts from 7 to 9 July occurred on an opportunistic basis while work was being done at the tower site. Regular scheduled counts began 10 July and continued until 1 September. Counts were usually for 20 minutes of every hour; however, crewmembers were encouraged to count longer when possible. Actual hourly counts ranged from 15 to 45 minutes with appropriate expansions for the hourly passage estimates. No estimates were made for hours or days not counted because of the frequency of missed counts. Early morning hours, 0000 hours to 0400 hours, were seldom counted due to darkness. Water level began to rise on 21 July and resulted in poor visibility from 22 July until 27 July when water level began to recede. Counts reported for this period represent minimum passage estimates. Periods of poor visibility also occurred in August.

Tables 5 and 6 show the expanded hourly and daily totals, without estimates for hours not counted. The daily peak count of 41 chinook salmon occurred on 11 July (Figure 5); the daily peak count of 222 chum salmon occurred on 10 July (Figure 6).

The counts reported above are all from the South Channel. Local residents stated that salmon did not travel up the North Channel as was confirmed by periodic spot counts. The most intensive counting effort for the North Channel occurred from 24 to 26 July when counts were done 10 to 16 hours a day. This period coincided with an increase in water level, but no salmon were observed.

1996

The rigor of the tower operations improved in 1996, as did the estimate of salmon passage. The cumulative season passage included 401 chinook salmon and 2,794 chum salmon (Tables 1 and 2). These passages include estimates for hours and days not counted. The actual number of fish observed were 114 chinook and 862 chum salmon (Tables 7 and 8). Estimated passages for hours not counted are reported in Tables 9 and 10.

Scheduled counts began 15 June and continued until 26 July when high water forced an end to operations. An array of lights were operational beginning 26 June to enhance night visibility. Complete 24-hour counts were achieved on 8 of the 43 days of operation (Tables 7 and 8). Chinook salmon were first observed on 27 June and the first chum salmon was observed on 21 June (Tables 7 and 8). The mid-point of passage for both species was 6 July. The central fifty-percent of the chinook run passed the site between 3 and 11 July (Table 1). For chum salmon, the central fifty-percent passage occurred between 1 and 9 July (Table 2). The daily peak count of 73 chinook salmon occurred on 5 July (Figure 5, Table 9), while the peak count of 295 chum salmon occurred on 6 July (Figure 6, Table 10).

The vast majority of salmon passage occurred in the South Channel. The North Channel received twenty-four hour a day counts from 15 June to 28 June, but the schedule was reduced after 28 June when it was apparent salmon seldom traveled up the North Channel. Following 525 expanded hours of counts, only three chum salmon were observed in the North Channel.

Seven complete 24-hour counts, 4 July through 10 July, were compiled to demonstrate the pattern of daily salmon passage (Tables 7 and 8). This seven-day period corresponds to half of the cumulative chinook passage for the season as well as half of cumulative chum passage. Overall, the chinook passage tended to be greatest in the late morning and early afternoon with 42% of the passage occurring between 1000 hours and 1559 hours (Figure 7). Peak chinook passage occurred during the 1400-hour count which is when 15% of the 7-day passage occurred. Chum salmon had three periods of heightened passage (Figure 8). The first pulse peaked during the 0200-hour count and two stronger pulses peaked during the 1200-hour and 2100-hour counts.

1997

The rigor of the tower operations continued to improve in 1997. The estimated cumulative chinook passage for the season increased over previous years to 1,176 (Table 1), but the chum salmon passage decreased to 1,794 (Table 2). These passages include estimates for hours and days not counted, but the need for such estimates were minimal because few scheduled counts were missed. The actual number of fish observed included 388 chinook and 595 chum salmon (Tables 11 and 12). Estimated passages for hours not counted are reported in Tables 15 and 16.

Spot counts began 15 June and 24-hour counts began 21 June. Record low water levels allowed uninterrupted counts to continue through 4 August when tower operations ended for the season. An array of lights was operational throughout the season. Complete 24-hour counts were achieved on 37 of the 51 days of operation (Tables 11 and 12). Chum salmon were first observed on 21 June and chinook salmon were first observed on 22 June. The mid-point for chinook passage was 8 July while the mid-point for chum salmon was 12 July. The central fifty-percent passage dates were 3 to 14 July for chinook salmon and 4 to 21 July for chum salmon. The daily peak count of 72 chinook salmon occurred on 3 July (Figure 5, Table 13); the daily peak count of 117 chum salmon occurred on 14 July (Figure 6, Table 14). Overall, the chinook run was more protracted in 1997 than in 1996, but the chum run was less protracted (Figure 9).

All counting effort was focused on the South Channel. Concern about passage in the North Channel was addressed by placing a diversion weir at the lower end of the North Channel that required all salmon to pass in the South Channel. No salmon were ever observed behind the North Channel weir.

Both chinook and chum salmon exhibited a much more pronounced diurnal migratory pattern than was observed in 1996 (Figures 7 and 8). The period 21 June through 31 July was used to compile the diurnal pattern data. This 41-day period corresponds with 99% of both the chinook and chum passage. Thirty percent of the chinook salmon passed the tower between 0200 hours and 0459 hours (Table 13, Figure 7). A second peak occurred mid-day from 1300 hours through 1759 hours when 33% passed the tower. The highest hourly chinook passage occurred during the 0200-hour count when 11% passed.

The chum salmon diurnal pattern shows most fish passing during the darkest hours with 63% of the total passage occurring between 0000 hours and 0459 hours (Table 14, Figure 8). Peak hourly passage occurred during the 0200-hour count when 18% passed the tower.

1998

The 1998 season was unsuccessful due to high water levels. Tables 15 and 16 report the actual unexpanded hourly counts. Five chinook and seventeen chum salmon were observed from 20 June to 6 July. The start of the tower counts was delayed because high water made panel placement difficult. Spot counts were conducted from 20 to 24 June using white sandbags to enhance visibility. Some panels were installed by 25 June that allowed for limited counts through 28 June. All panels were in place by 29 June, when 24-hour counts began. Conditions for counting were satisfactory for less than one day, afterwards increasing water level washed out some panels as well as the partial weir on the South Channel. The weir and some panels were reinstalled; however, rising water levels continued to hinder visibility. Heavy rain started 5 July and the North Channel weir washed out 6 July. Counts were suspended 7 July at 0000 hours due to high water. Rain continued over the next few days and the Takotna River rose over 36 inches (91.4 cm). For the remainder of the season, water levels never subsided to a degree that would allow tower operations to resume.

Climatological and Hydrological Conditions

The records available for climatological and hydrological data are generally incomplete and the methods used to collect the data were inconsistent. The most complete data set was collected in 1996 (Figure 10, Appendix D). The values reported in Appendix D represent the average value for the day rather than from a set time as was intended. Missed days are linearly interpolated as the average of the day before and the day after the missed days (Appendix D). The reported air temperature ranged from 11 to 29 °C. Water temperature ranged from 13 to 20 °C. The period of warmest water temperature occurred from 5 to 8 July. Water level ranged from 23 to 32 in (58.4 to 81.3 cm). The highest recorded water level occurred on 21 July and the lowest water level was reported on 8 July. There were three periods when counts were suspended or omitted due to the poor water visibility that resulted from increased water levels; these occurred on 30 June to 3 July, 11 to 13 July and 20 to 24 July. These periods correspond with water levels above 27 in (68.6 cm). Water clarity again became a problem on 26 July at which point counting was discontinued for the season.

Record low water levels occurred in 1997, which allowed for excellent visibility throughout the season. Total stream discharge at the tower site on 27 June was 619 ft^3/s (17.5 m^3/s; Attachment C); the South Channel accounted for 533.8 ft^3/s (15.1 m^3/s) and the North Channel discharge was 85.3 ft^3/s (2.4 m^3/s). The South Channel transect was 130 ft (39.6 m) wide with a maximum velocity of 4.4 ft/s (1.34 m/s) and a maximum depth of 2.1 feet (0.65 m). Most salmon were observed in the deepest and swiftest section of the river, which was approximately 15 to 50 ft (4.6 to 15.3 m) offshore of the counting tower. The North Channel transect was approximately 67 ft (20.4 m) wide with a maximum velocity of 1.8 ft/s (0.55 m/s) and a maximum depth of 1.3 ft (0.4 m).

Water level in the Takotna River was much higher in 1999 and poor water clarity precluded operation of the counting tower. Stream discharge was calculated on 21 July 1999, but from a different location than where measurements where taken in 1997 (Attachment D). The 1999 data was collected approximately 100 meters upstream of the Takotna bridge where the river is confined to a single channel. The measurements were taken as part of survey for a weir site. Discharge was estimated to be 1,231.8 ft^3/s (34.9 m^3/s). The channel was 238 ft (72.54 m) wide, maximum velocity was 5.0 ft/s (1.52 m/s), and the maximum depth was 2.1 ft (0.64 m).

Water Chemistry

Water samples were collected from the Takotna River on 7 July 1996 and 7 July 1997. In 1996 three replicate grab samples were collected for general analysis. The samples were taken from three stations. Station 1 was located in the North Channel, downstream of Gold Creek and below the community hall, at the end of the access road where boats are kept. Station 2 was located in the South Channel at the counting tower site. Station 3 was located mid-channel, approximately

0.1 mi (0.161 km) downstream of the island. A fourth sample, taken from station 3 in 1996, was used for heavy metal analysis. In 1997 two water samples were taken from the Takotna River at Station 2, one of the samples was for general analysis and the other for heavy metals. Collections from 1997 also included samples from Fourth-of-July Creek, Nixon Fork and Tatalina River. The tributary collections included samples for general processing at the ADF&G limnology lab and samples for heavy metals analysis by Elemental Research, Inc. Fewer heavy metal parameters were tested in 1997 than in 1996. Results from all the samples are presented in Table 17.

DISCUSSION

It is reasonable to have a healthy level of professional skepticism in considering the reliability of salmon passage estimates generated by a new project such as the Takotna River counting tower. The report by an ADF&G biologist of 5,000 to 8,000 spawning chum salmon in Fourth-of-July Creek in 1994 was the primary inducement for developing the counting tower (Appendix B). The subsequent passage estimates generated from the tower project of 2,794 and 1,794 chum salmon in 1996 and 1997 were unexpectedly low and warrant a closer review.

The relative abundance of the chum salmon returns to the Kuskokwim River in 1994 and 1996 were similar given the range of returns observed over the past ten to twelve years (Burkey et al. 1999). The commercial harvest in 1994 and 1996 included 271,115 and 207,877 chum salmon, and the escapement reported for Kogrukluk River was 46,192 and 48,494. Results from Aniak River sonar were passage estimates of 388,000 in 1994 and 302,000 in 1996. The information from Takotna River was even more divergent with the chum return in 1994 being at least twice that of 1996 (Appendix B, Table 2). The actual difference is probably much greater since the aerial surveys conducted in 1994 were an incomplete estimate of chum salmon escapement. Although the tower counts may be reliable, the disparity with the relative abundance found elsewhere is not reassuring.

In 1997, the Takotna River chum salmon passage was consistent with trends seen elsewhere in the Kuskokwim River basin (Burkey et al. 1999). The 1997 commercial harvest of 17,026 and the Kogrukluk River escapement of 7,937 were both among the lowest on record. Newer escapement projects such as the George River weir and the Kwethluk River counting tower also suggested very low chum salmon passages in 1997. Aniak River was the outlier in 1997 with a near average passage estimate of 262,000. The low chum salmon passage of 1,794 reported for the Takotna River appeared consistent with all except the Aniak River. Whether appropriate or not, the consistency between the Takotna River counting tower and most of the other indicators in 1997 gives some reassurance as to the level of rigor under which the tower project was operated in 1997.

The authors believe the passage estimates presented for 1996 and 1997 are reasonable approximations of the actual salmon escapement in those years. The lack of consistency seen in 1996 does not, in itself, discount the reported escapement for the Takotna River that year. The apparently lower chum salmon return in 1996 could possibly be a result of markedly lower survival for the Takotna River spawning population compared to other stocks. McGrath subsistence fishers set gillnets in the mouth of the Takotna River and a modest change in their effort or effectiveness

could easily account for the difference observed in the escapement. Still, the lack of affirmation coupled with the inoperable conditions encountered in 1998 and 1999 does put into question the adequacy of the counting tower methodology employed on the Takotna River.

RECOMMENDATIONS

The Takotna River counting tower project has had limited success over the past five years. The main goal of the project is to estimate the annual chum and chinook salmon escapement, but that goal was achieved only in 1996 and 1997. Poor water clarity and periodic high water levels are the primary impediments to success. It is difficult to detect and reliably speciate fish in the tea-colored water of the Takotna River. When water level and the load of suspended sediment increase following rainy periods, then reliable operation is impossible. Other tower projects have experienced similar difficulties (Chris and Cappiello 1999; Menard 1999). Diminished light levels in July and August also impede effective counting tower operations. Other issues inhibiting success include: the conflict of students maintaining 24-hour counting schedules concurrent with their required academic schedules, the difficulty of traveling to the South Channel tower site, limited on-site training and quality control, turnover in adult leadership, and the lack of staff with effective escapement monitoring experience.

To improve project performance the authors recommend that the counting tower be replaced with a resistance board weir. The resistance board design is better able to handle periodic high water events than tower or fixed-panel weir designs as has been demonstrated in the Middle Fork Goodnews (Menard 1999), Tuluksak (Harper 1997), Kwethluk (Harper 1998, Chris and Cappiello 1999), Andreafsky (Tobin and Harper 1998), and Gisasa Rivers (Wiswar 1998), and Beaver Creek (Collin and Kostohrys 1998). The resistance board design is not infallible, but inoperable periods are generally minimal, and material loss and damage from high water events are typically modest (Harper 1997, Tobin and Harper 1998). In one extreme case, the South Fork Koyukuk River weir (Yukon drainage) was submerged by as much as 10 feet (3.1 m) of water and left in place over the winter (Wiswar 1997). The high velocity of the water forced the weir panels to flatten against the riverbed, as designed, so the weir did not impede fish passage during the inoperable period. When the water level receded, the gravel covered weir was still in position with only moderate damage.

An added advantage to a weir operation is that it allows for more flexible staff scheduling that can better accommodate the academic schedules of students and the diminishing daylight of late summer. Another benefit of a resistance board weir is that the design allows for a greater likelihood of successful operation in late summer and fall for monitoring coho passage.

In addition to weir development, the authors recommend that measures be taken that will bring experienced adult leadership to the project with less turnover. Ideally, ADF&G or USFWS should assign an experienced technician or entry level biologist to the project to work with the locally hired crew. Other initiatives that should be pursued include periodic surveys of the drainage to document

where salmon are spawning and rearing, and investigations to determine what measures, if any, can be taken to improve salmon returns.

POST-SCRIPT

Many of the recommendations made in this report are already being pursued. Staff from ADF&G has conducted ground surveys to identify possible weir installation sites near the community of Takotna (Appendix C and E). In addition, TCSTC applied savings from the reduced operational periods in 1998 and 1999 towards the purchase and fabrication of weir components. As of this writing the fish passage chute and substrate rail for a 250 ft (76.3 m) resistance board weir have been fabricated and are being stored at the ADF&G Sport Fish shop in Palmer. Additional materials are in storage at the Bureau of Land Management facility in Anchorage pending fabrication work planned for February and March 2000. Funding avenues are being pursued to secure the final materials needed for the fabrication and transportation of the weir components to Takotna. Finally, ADF&G has received a grant from the National Oceanic and Atmospheric Association which includes support cost for assigning a Fish and Wildlife Technician to the Takotna project from 2000 through 2002.

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Table 1. Expanded daily and cumulative migration of chinook salmon past the Takotna River counting tower, Kuskokwim Area, 1995-1998.[a]

Date	Daily				Cumulative				Percent Passage		
	1995	1996	1997	1998	1995	1996	1997	1998	1995	1996	1997
15-Jun		0	0			0	0			0	0
16-Jun		0	0			0	0			0	0
17-Jun		0	0			0	0			0	0
18-Jun		0	0			0	0			0	0
19-Jun		0	0			0	0			0	0
20-Jun		0	0	0		0	0	0		0	0
21-Jun		0	0	0		0	0	0		0	0
22-Jun		0	6	0		0	6	0		0	1
23-Jun		0	0	0		0	6	0		0	1
24-Jun		0	12	0		0	18	0		0	2
25-Jun		0	30	0		0	48	0		0	4
26-Jun		0	24			0	72	0		0	6
27-Jun		9	9	0		9	81	0		2	7
28-Jun		17	33	0		26	114	0		7	10
29-Jun		8	36	0		34	150	0		9	13
30-Jun		21	57	0		55	207	0		14	18
01-Jul		18	0	0		72	207	0		18	18
02-Jul		15	30	3		87	237	3		22	20
03-Jul		12	72	3		98	309	6		25	26
04-Jul		12	66	3		110	375	9		28	32
05-Jul		73	54	0		183	429	9		46	37
06-Jul		39	54	6		223	483	15		56	41
07-Jul	4	10	33		4	233	516		3	58	44
08-Jul	7	37	54		11	270	570		7	67	49
09-Jul	2	24	69		13	294	639		9	73	55
10-Jul	8	3	51		21	297	690		14	74	59
11-Jul	41	4	74		62	301	764		40	75	65
12-Jul	8	5	48		70	305	812		45	76	69
13-Jul	12	5	24		82	311	836		53	78	71
14-Jul	17	7	66		99	318	902		64	79	77
15-Jul	9	7	27		108	325	929		69	81	79
16-Jul	6	9	12		114	334	941		73	83	80
17-Jul	0	0	36		114	334	977		73	83	83
18-Jul	12	20	48		126	353	1,025		81	88	87
19-Jul	12	11	12		138	364	1,037		88	91	88
20-Jul	6	9	15		144	374	1,052		92	93	90
21-Jul	0	8	3		144	382	1,055		92	95	90
22-Jul	9	7	12		153	389	1,067		98	97	91
23-Jul	0	5	9		153	394	1,076		98	98	92
24-Jul	0	4	24		153	398	1,100		98	99	94
25-Jul	0	3	15		153	401	1,115		98	100	95
26-Jul	0	0	18		153	401	1,133		98	100	97
27-Jul	0		12		153		1,145		98		98
28-Jul	0		6		153		1,151		98		98
29-Jul	0		15		153		1,166		98		99
30-Jul	3		0		156		1,166		100		99
31-Jul	0		-6		156		1,160		100		99
01-Aug	0		3		156		1,163		100		99
02-Aug	0		9		156		1,172		100		100
03-Aug	0		5		156		1,176		100		100
04-Aug	0		0		156		1,176		100		100
05-Aug					156				100		
06-Aug					156				100		
07-Aug	0				156				100		
08-Aug					156				100		
09-Aug					156				100		
10-Aug	0				156				100		
11-Aug					156				100		
12-Aug	0				156				100		
13-Aug					156				100		
14-Aug					156				100		
15-Aug	0				156				100		
16-Aug					156				100		
17-Aug					156				100		
18-Aug					156				100		
19-Aug					156				100		
20-Aug					156				100		
21-Aug	0				156				100		
22-Aug					156				100		
23-Aug	0				156				100		
24-Aug					156				100		
25-Aug	0				156				100		
26-Aug					156				100		
27-Aug					156				100		
28-Aug	0				156				100		
29-Aug	0				156				100		
30-Aug	0				156				100		
31-Aug	0				156				100		
01-Sep	0				156				100		

[a] Expanded daily and cumulative numbers for 1995 and 1998 do not include estimates for missed counts.

Table 2 Expanded daily and cumulative migration of chum salmon past the Takotna River counting tower, Kuskokwim Area, 1995-1998.[a]

Date	Daily				Cumulative				Percent Passage		
	1995	1996	1997	1998	1995	1996	1997	1998	1995	1996	1997
15-Jun		0	0			0	0			0	0
16-Jun		0	0			0	0			0	0
17-Jun		0	0			0	0			0	0
18-Jun		0	0			0	0			0	0
19-Jun		0	0			0	0			0	0
20-Jun		0	0	0		0	0	0		0	0
21-Jun		14	6	0		14	6	0		0	0
22-Jun		0	0	0		14	6	0		0	0
23-Jun		0	0	0		14	6	0		0	0
24-Jun		102	12	0		115	18	0		4	1
25-Jun		0	27	0		115	45	0		4	3
26-Jun		0	12			115	57	0		4	3
27-Jun		137	51	0		252	108	0		9	6
28-Jun		68	45	0		320	153	0		11	9
29-Jun		127	84	0		448	237	0		16	13
30-Jun		117	48	9		565	285	9		20	16
01-Jul		101	18	0		666	303	9		24	17
02-Jul		85	33	15		752	336	24		27	19
03-Jul		69	33	6		821	369	30		29	21
04-Jul		123	69	3		944	438	33		34	24
05-Jul		264	72	12		1,207	510	45		43	28
06-Jul		295	87	6		1,502	597	51		54	33
07-Jul	0	242	33		0	1,744	630		0	62	35
08-Jul	53	209	42		53	1,953	672		3	70	37
09-Jul	82	172	57		135	2,126	729		8	76	41
10-Jul	222	105	63		357	2,231	792		21	80	44
11-Jul	63	86	65		420	2,317	857		25	83	48
12-Jul	42	78	33		462	2,395	890		27	86	50
13-Jul	98	70	36		560	2,464	926		33	88	52
14-Jul	117	11	117		677	2,475	1,043		40	89	58
15-Jul	82	26	36		759	2,502	1,079		45	90	60
16-Jul	126	37	54		885	2,539	1,133		52	91	63
17-Jul	11	56	78		896	2,595	1,211		53	93	67
18-Jul	150	53	57		1,046	2,648	1,268		62	95	71
19-Jul	129	35	18		1,175	2,682	1,286		70	96	72
20-Jul	42	29	30		1,217	2,712	1,316		72	97	73
21-Jul	129	26	72		1,346	2,737	1,388		80	98	77
22-Jul	72	21	24		1,418	2,758	1,412		84	99	79
23-Jul	79	16	66		1,497	2,774	1,478		89	99	82
24-Jul	8	8	62		1,505	2,783	1,539		89	100	86
25-Jul	18	11	24		1,523	2,794	1,563		90	100	87
26-Jul	11	0	15		1,534	2,794	1,578		91	100	88
27-Jul	33		72		1,567		1,650		93		92
28-Jul	21		21		1,588		1,671		94		93
29-Jul	29		57		1,617		1,728		96		96
30-Jul	66		27		1,683		1,755		100		98
31-Jul	6		21		1,689		1,776		100		99
01-Aug	0		12		1,689		1,788		100		100
02-Aug	0		6		1,689		1,794		100		100
03-Aug	0		0		1,689		1,794		100		100
04-Aug	0		0		1,689		1,794		100		100
05-Aug					1,689				100		
06-Aug					1,689				100		
07-Aug	0				1,689				100		
08-Aug					1,689				100		
09-Aug					1,689				100		
10-Aug	0				1,689				100		
11-Aug					1,689				100		
12-Aug	0				1,689				100		
13-Aug					1,689				100		
14-Aug					1,689				100		
15-Aug	0				1,689				100		
16-Aug					1,689				100		
17-Aug					1,689				100		
18-Aug					1,689				100		
19-Aug					1,689				100		
20-Aug					1,689				100		
21-Aug	0				1,689				100		
22-Aug					1,689				100		
23-Aug	0				1,689				100		
24-Aug					1,689				100		
25-Aug	0				1,689				100		
26-Aug					1,689				100		
27-Aug					1,689				100		
28-Aug	0				1,689				100		
29-Aug	0				1,689				100		
30-Aug	0				1,689				100		
31-Aug	0				1,689				100		
01-Sep	0				1,689				100		

[a] Expanded daily and cumulative numbers for 1995 and 1998 do not include estimates for missed counts

Table 3. Actual unexpanded hourly chinook salmon observations at the Takotna River counting tower, Kuskokwim Area, 1995.

Date	Hour																								Total
	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Chinook
07-Jul															2										2
08-Jul																		1		0	4	0	0		5
09-Jul													0	0				0			0	1	0	0	1
10-Jul						0	0	0	0	1				0	0	1	0	0	1	0	0	0	0	0	3
11-Jul					0	0	0	0	0	1	-1	0	2	7	0	0	0	0	5	2	0	0	0	0	16
12-Jul									0	1	0	0	0	1	0	0						0	1	0	3
13-Jul									-1	0	0	0	3	0	0	0	1	0	0	0	0	2	0	0	5
14-Jul									1	0	0	0	0	2	0	0		0	0	0	1	1	0	2	7
15-Jul	0	1				0	0		0	0	0		0	0	0	0	0	2	0	0	0	1	0	0	4
16-Jul					0	0	0	0									0	0	1	1	0	0	0	0	2
17-Jul														0	0	0	0	0	0	0				0	0
18-Jul	0	0	0	0	3				0	0			0	1	0	0		0	0		0	0	0	0	4
19-Jul					0	0	0	0	0	0	0	0	1	0	2	0	1	0	0	0					4
20-Jul					0	0	0	0		0	2	0	0					0	0	0		0	0	0	2
21-Jul					0	0	0	0					0	0	0	0				0	0	0	0	0	0
22-Jul													0	0	1	2	0	0	0	0	0	0	0		3
23-Jul									0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24-Jul											0	0		0	0	0	0	0	0	0	0	0	0	0	0
25-Jul							0						0	0	0	0	0	0	0	0	0	0	0	0	0
26-Jul							0	0	0	0	0	0		0	0	0	0	0		0	0	0	0	0	0
27-Jul							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0
28-Jul							0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29-Jul									0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30-Jul									0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
31-Jul									0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01-Aug												0	0	0	0	0				0	0	0	0		0
02-Aug								0	0	0	0	0	0	0	0	0	0	0							0
03-Aug									0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0
04-Aug									0	0	0	0	0	0	0										0
05-Aug																									
06-Aug																									
07-Aug									0	0	0	0	0	0	0	0	0	0	0						0
08-Aug																									
09-Aug																									
10-Aug										0	0			0	0		0	0	0	0	0				0
11-Aug																									
12-Aug														0	0	0									0
13-Aug																									
14-Aug																									
15-Aug										0	0														0
16-Aug																									
17-Aug																									
18-Aug																									
19-Aug																									
20-Aug																									
21-Aug														0	0	0	0								0
22-Aug																									
23-Aug										0	0	0		0	0				0	0					0
24-Aug																									
25-Aug										0	0														0
26-Aug																									
27-Aug																									
28-Aug										0	0			0	0	0	0								0
29-Aug									0	0	0	0	0	0											0
30-Aug										0	0			0	0	0	0		0	0					0
31-Aug										0	0	0	0	0	0	0	0								0
01-Sep										0	0			0	0	0	0		0	0					0
Total Chinook	0	1	0	0	3	0	0	0	0	3	1	0	6	11	5	3	2	4	7	3	5	5	1	2	62

Table 4. Actual unexpanded hourly chum salmon observations at the Takotna River counting tower, Kuskokwim Area, 1995.

Date	Hour																								Total
	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Chum
07-Jul															0										0
08-Jul																		4		2	14	1	6		27
09-Jul													0	1				6			38	2	0	0	47
10-Jul						3	3	0	1	1				0	6	7	4	17	14	10	8	0	0	6	60
11-Jul					3	6	2	0	2	6	0	2	0	0	0	0	0	0	0	0	0	0	0	0	21
12-Jul									0	4	3	3	1	3	0	0						0	0	0	14
13-Jul									11	1	1	3	8	3	0	2	6	10	0	4	0	0	0	0	49
14-Jul	0	0	0	0	5	0	0	0	8	1	6	2	1	14	1	2		9	0	0	1	0	0	4	54
15-Jul	0	4				1	0		3	0	0		0	0	0	2	8	8	0	3	4	2	2	0	37
16-Jul					0	0	0	2									2	4	7	16	6	5	0	0	42
17-Jul														1	0	0	0	0	1	0				2	4
18-Jul	0	0	0	0	1				0	0			1	16	6	0		0	2		17	4	1	2	50
19-Jul					0	1	0	2	0	2	2	9	5	0	3	4	7	3	0	6					43
20-Jul					0	0	0	3		0	3	0	0						0	0	1	0	1	6	14
21-Jul					9	12	2	0					0	0	2	1				8	1	0	12	0	47
22-Jul													0	0	2	3	6	3	4	3	0	2	1		24
23-Jul									5	7	1	0	3	0	0	1	0	2	2	3	0	1	0	0	25
24-Jul											1	3		0	0	0	0	0	0	0	0	0	0	0	4
25-Jul							0						0	0	0	0	0	1	0	0	2	2	1	0	6
26-Jul							0	0	0	0	0	0		0	0	0	0	2		0	0	1	1	0	4
27-Jul							0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	4		11
28-Jul							1	0	0	0	0	0	0	4	0	2	0	0	0	0	0	0	0	0	7
29-Jul									3	0	2	4	0	1	0	0	0	0	0	0	0	0	0	0	10
30-Jul									0	0	0	6	9	0	11	0	0	0	2	0	0	0	0	0	22
31-Jul									0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2
01-Aug												0	0	0	0	0				0	0	0	0		0
02-Aug								0	0	0	0	0	0	0	0	0	0	0							0
03-Aug									0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0
04-Aug									0	0	0	0	0	0	0										0
05-Aug																									
06-Aug																									
07-Aug									0	0	0	0	0	0	0	0	0	0	0						0
08-Aug																									
09-Aug																									
10-Aug										0	0			0	0		0	0	0	0	0				0
11-Aug																									
12-Aug														0	0	0									0
13-Aug																									
14-Aug																									
15-Aug										0	0														0
16-Aug																									
17-Aug																									
18-Aug																									
19-Aug																									
20-Aug																									
21-Aug														0	0	0	0								0
22-Aug																									
23-Aug										0	0	0		0	0					0	0				0
24-Aug																									
25-Aug										0	0														0
26-Aug																									
27-Aug																									
28-Aug										0	0			0	0	0	0								0
29-Aug									0	0	0	0	0	0											0
30-Aug										0	0			0	0	0	0		0	0					0
31-Aug										0	0	0	0	0	0	0	0								0
01-Sep										0	0			0	0	0	0		0	0					0
Total Chum	0	4	0	0	18	23	8	7	33	22	19	26	28	43	31	24	33	69	34	62	91	28	29	28	644

Table 5 Expanded hourly chinook salmon migration past the Takotna River counting tower, Kuskokwim Area, 1995.*

Date	Hour																								Total
	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Chinook
07-Jul															4										4
08-Jul																		2		0	5	0	0		7
09-Jul													0	0				0			0	2	0	0	2
10-Jul						0	0	0	0	3				0	0	3	0	0	2	0	0	0	0	0	8
11-Jul					0	0	0	0	0	3	-3	0	6	21	0	0	0	0	10	4	0	0	0	0	41
12-Jul									0	3	0	0	0	3	0	0						0	2	0	8
13-Jul									-2	0	0	0	6	0	0	0	2	0	0	0	0	6	0	0	12
14-Jul	0	0	0	0	0	0	0	0	2	0	0	0	0	4	0	0		0	0	0	2	3	0	6	17
15-Jul	0	3				0	0	0	0	0			0	0	0	0	0	4	0	0	0	2	0	0	9
16-Jul					0	0	0	0									0	0	3	3	0	0	0	0	6
17-Jul														0	0	0	0	0	0	0				0	0
18-Jul	0	0	0	0	9				0	0			0	3	0	0		0	0		0	0	0	0	12
19-Jul					0	0	0	0	0	0	0	0	3	0	6	0	3	0	0	0					12
20-Jul					0	0	0	0		0	6	0	0					0	0	0		0	0	0	6
21-Jul					0	0	0	0					0	0	0	0				0	0	0	0	0	0
22-Jul													0	0	3	6	0	0	0	0	0	0	0		9
23-Jul									0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24-Jul											0	0		0	0	0	0	0	0	0	0	0	0	0	0
25-Jul								0					0	0	0	0	0	0	0	0	0	0	0	0	0
26-Jul								0	0	0	0	0		0	0	0	0	0		0	0	0	0	0	0
27-Jul								0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28-Jul								0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0
29-Jul									0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30-Jul									0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	3
31-Jul									0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
01-Aug												0	0	0	0	0	0	0	0	0	0	0	0		0
02-Aug								0	0	0	0	0	0	0	0	0	0	0							0
03-Aug									0	0	0	0	0	0	0	0	0	0	0	0	0	0			0
04-Aug									0	0	0	0	0	0	0										0
05-Aug																									
06-Aug																									
07-Aug									0	0	0	0	0	0	0	0	0	0	0						0
08-Aug																									
09-Aug																									
10-Aug										0	0			0	0		0	0	0	0	0				0
11-Aug																									
12-Aug														0	0	0									0
13-Aug																									
14-Aug																									
15-Aug										0	0														0
16-Aug																									
17-Aug																									
18-Aug																									
19-Aug																									
20-Aug																									
21-Aug														0	0	0	0								0
22-Aug																									
23-Aug										0	0	0		0	0				0	0					0
24-Aug																									
25-Aug										0	0														0
26-Aug																									
27-Aug																									
28-Aug										0	0			0	0	0	0								0
29-Aug									0	0	0	0	0	0											0
30-Aug										0	0			0	0	0	0		0	0					0
31-Aug										0	0	0	0	0	0	0	0								0
01-Sep										0	0			0	0	0	0		0	0					0
Total Chinook	0	3	0	0	9	0	0	0	0	9	3	0	15	31	13	9	5	9	15	7	7	13	2	6	156

* Estimates are not included for missed counts.

Table 6. Expanded hourly chum salmon migration past the Takotna River counting tower, Kuskokwim Area, 1995.*

Date	Hour																								Total Chum
	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	
07-Jul															0										0
08-Jul																		8		6	19	2	18		53
09-Jul													0	3				18			57	4	0	0	82
10-Jul						9	6	0	2	3				0	18	21	12	51	28	30	24	0	0	18	222
11-Jul					9	18	6	0	6	18	0	6	0	0	0	0	0	0	0	0	0	0	0	0	63
12-Jul									0	12	9	9	3	9	0	0						0	0	0	42
13-Jul									22	2	2	6	16	6	0	4	12	20	0	8	0	0	0	9	98
14-Jul	0	0	0	0	15	0	0	0	16	2	12	4	2	28	2	4		18	0	0	2	0	0	12	117
15-Jul	0	12				3	0		9	0			0	0	0	4	16	16	0	6	8	4	4	0	82
16-Jul					0	0	0	6									6	12	21	48	18	15	0	0	126
17-Jul														2	0	0	0	0	3	0				6	11
18-Jul	0	0	0	0	3				0	0			3	48	18	0		0	6		51	12	3	6	150
19-Jul					0	3	0	6	0	6	9	27	15	0	9	12	21	9	0	15					129
20-Jul					0	0	0	9		0	9	0	0					0	0	3		0	3	18	42
21-Jul					27	36	6	0					0	0	6	3				24	3	0	24	0	129
22-Jul													0	0	6	9	18	9	12	9	0	6	3		72
23-Jul									20	21	3	0	9	0	0	3	0	6	6	9	0	2	0	0	79
24-Jul											2	6		0	0	0	0	0	0	0	0	0	0	0	8
25-Jul							0						0	0	0	0	0	3	0	0	6	6	3	0	18
26-Jul							0	0	0	0	0	0		0	0	0	0	6		0	0	3	2	0	11
27-Jul							0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	0	12	0	33
28-Jul							3	0	0	0	0	0	0	12	0	6	0	0	0	0	0	0	0		21
29-Jul									9	0	6	12	0	2	0	0	0	0	0	0	0	0	0	0	29
30-Jul									0	0	0	0	27	0	33	0	0	0	6	0	0	0	0	0	66
31-Jul									0	0	0	0	0	0	0	0	0	0	6	0	0	0	0		6
01-Aug												0	0	0	0	0				0	0	0	0		0
02-Aug								0	0	0	0	0	0	0	0	0	0	0							0
03-Aug									0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0
04-Aug									0	0	0	0	0	0	0										0
05-Aug																									
06-Aug																									
07-Aug									0	0	0	0	0	0	0	0	0	0	0						0
08-Aug																									
09-Aug																									
10-Aug										0	0			0	0		0	0	0	0	0				0
11-Aug																									
12-Aug														0	0	0									0
13-Aug																									
14-Aug																									
15-Aug										0	0														0
16-Aug																									
17-Aug																									
18-Aug																									
19-Aug																									
20-Aug																									
21-Aug														0	0	0	0								0
22-Aug																									
23-Aug										0	0	0		0	0				0	0					0
24-Aug																									
25-Aug										0	0														0
26-Aug																									
27-Aug																									
28-Aug										0	0			0	0	0	0								0
29-Aug									0	0	0	0	0	0											0
30-Aug										0	0			0	0	0	0		0	0					0
31-Aug										0	0	0	0	0	0	0	0								0
01-Sep										0	0			0	0	0	0		0	0					0
Total Chum	0	12	0	0	54	69	21	21	84	64	49	70	75	110	92	66	85	176	88	179	188	54	72	60	1,689

* Estimates are not included for missed counts.

Table 7 Actual unexpanded hourly chinook salmon observations at the Takotna River counting tower, Kuskokwim Area, 1996.

Date	Hour																							Total
	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Chinook
15-Jun													0	0	0	0	0	0	0	0	0	0	0		0
16-Jun	0	a	a	a	a	0	0	0	0	0	0	0	0	0	0	0	0	0	b	b	b	b	b	b	0
17-Jun	b	a	a	a	a	b	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18-Jun	0	a	a	a	a	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19-Jun	b	a	a	a	a	b							0	0	0	0	0	0	0	0	0	0	0	0	0
20-Jun	0	a	a	a	a	0					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21-Jun	0	a	a	a	a	0	b	b	b	b	b	b	0	0	0	0	0	0	0	0	0	0	0	0	0
22-Jun	b	a	a	a	a	b	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23-Jun	b	a	a	a	a	b	0	0	0	0	0	0	0	0	0	0	0	0	b					b	0
24-Jun	b	a	a	a	a	b	0	0	0	0	0	0	0	0	0	0	0	0	b	b	b	0	0	0	0
25-Jun	b	a	a	a	a	b	0	0	0	0	0	0	0	0	0	0	0	0	b	b	b	b	b	b	0
26-Jun	b	a	a	a	a	b	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27-Jun	b	b	b	b	b	b	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	3
28-Jun	b	b	b	0	b	b	0	2	0	2	0	0	0	0	0	0	0	0	b	b	b	0	0	0	4
29-Jun	0	1	0	0	0	0		0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	3
30-Jun	0	0	1	-1	0	1	0	0	0	1	0	1	c	c	c	c	c	c	c	c	c	c	c	c	3
01-Jul	c	c	c	c	c	c	c	c	c																0
02-Jul																									0
03-Jul									c	c			0	1	0	0	1	0	b	0	0	0	0	0	2
04-Jul	0	1	0	0	0	0	0	0	0	1	0	0	0	0	-1	0	1	0	1	0	1	0	0	1	5
05-Jul	0	0	0	0	0	0	0	0	3	2	2	0	6	2	4	1	0	0	1	5	0	3	0	0	29
06-Jul	2	0	1	2	0	4	0	0	1	0	1	1	1	4	0	0	0	0	0	1	0	0	0	0	18
07-Jul	0	0	1	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	4
08-Jul	0	0	0	1	0	1	1	0	2	0	0	0	3	1	2	0	0	0	1	2	0	0	0	0	14
09-Jul	0	0	0	0	2	0	0	1	0	0	0	3	0	0	0	2	0	0	0	0	0	0	1	-1	8
10-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
11-Jul	0	-1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	c	c	c	c	c	c			1
12-Jul																									0
13-Jul													0	0	0	0	1	0	0	0	0	0	0	0	1
14-Jul	0	0	0	2	0	0	0	0					0	0	0	0	0	0	0	0	0	0	0	0	2
15-Jul	0	0	2	0	0	0				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
16-Jul	0	0	0	0	0	0		1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	3
17-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18-Jul	0	0	0	0			0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	1	2	6
19-Jul	0	0					0	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0		3
20-Jul	c	c	c	c			c	c	c	c	c	c													0
21-Jul																									0
22-Jul																									0
23-Jul																									0
24-Jul																0			1	0	0	0	0	0	1
25-Jul	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					1
26-Jul																			0	0					0
27-Jul																									
Total Chinook	2	1	6	4	2	6	1	5	9	8	4	7	11	8	7	3	3	0	4	8	4	5	3	3	114

[1] Counts deleted from 0100 - 0400 hr. due to lights not being operational. Lights were installed 7-26-96 at 2000 hrs.

[2] Counts deleted due to inadequate training of personnel.

[3] Counts deleted due to poor visibility.

Table 6. Actual unexpanded hourly chum salmon observations at the Takotna River counting tower, Kuskokwim Area, 1996.

Date	Hour																							Total
	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Chum
15-Jun													0	0	0	0	0	0	0	0	0	0	0		0
16-Jun	0	a	a	a	a	0	0	0	0	0	0	0	0	0	0	0	0	0	b	b	b	b	b	b	0
17-Jun	b	a	a	a	a	b	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18-Jun	0	a	a	a	a	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19-Jun	b	a	a	a	a	b							0	0	0	0	0	0	0	0	0	0	0	0	0
20-Jun	0	a	a	a	a	0					0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21-Jun	0	a	a	a	a	0	b	b	b	b	b	b	0	0	0	0	3	0	0	0	0	0	0	0	3
22-Jun	b	a	a	a	a	b	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23-Jun	b	a	a	a	a	b	0	0	0	0	0	0	0	0	0	0	0	0	b					b	0
24-Jun	b	a	a	a	a	b	0	0	0	0	0	0	0	0	0	0	0	0	b	b	b	0	15	8	23
25-Jun	b	a	a	a	a	b	0	0	0	0	0	0	0	0	0	0	0	0	b	b	b	b	b	b	0
26-Jun	b	a	a	a	a	b	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27-Jun	b	b	b	b	b	b	0	0	0	0	0	0	0	0	0	0	0	0	0	16	15	16	7	1	57
28-Jun	b	b	b	1	b	b	0	4	0	0	0	1	1	0	0	0	0	0	b	b	b	0	7	3	17
29-Jun	0	0	4	14	12	3		1	3	1	3	0	0	0	2	0	0	0	9	3	0	-1	0	0	54
30-Jun	0	1	4	4	1	3	2	1	0	0	0	2	c	c	c	c	c	c	c	c	c	c	c	c	18
01-Jul	c	c	c	c	c	c	c	c	c																0
02-Jul																									0
03-Jul									c	c			0	1	1	0	2	3	b	1	0	0	1	5	14
04-Jul	0	1	0	0	0	0	0	2	0	6	5	0	-1	0	0	0	3	9	7	4	6	0	7	0	49
05-Jul	0	0	0	0	0	3	4	13	12	9	11	6	16	1	2	0	13	3	0	12	11	2	1	1	114
06-Jul	8	5	14	8	9	1	3	16	1	6	8	17	12	4	0	3	1	3	5	1	11	0	5	0	141
07-Jul	2	0	16	0	1	0	2	2	0	10	1	4	0	8	0	10	0	2	7	0	0	18	0	7	90
08-Jul	0	3	2	14	2	0	1	1	1	0	6	3	18	11	4	1	0	5	3	1	0	1	0	1	78
09-Jul	1	0	1	2	2	1	6	0	6	2	6	1	3	0	4	1	3	0	0	0	7	3	3	9	61
10-Jul	1	0	1	0	0	2	0	1	0	0	0	0	4	5	6	0	0	0	3	0	0	8	4	0	35
11-Jul	2	0	2	0	4	3	1	1	0	0	1	0	0	0	1	2	c	c	c	c	c	c			17
12-Jul																									0
13-Jul													2	1	1	0	1	4	1	1	1	0	3	0	15
14-Jul	1	0	0	0	0	0	0	0					0	-1	0	0	0	1	0	0	0	0	2	0	3
15-Jul	0	1	2	2	0	2				0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	8
16-Jul	1	0	1	0	0	0		0	2	0	0	2	2	1	0	2	0	0	0	0	0	0	1	0	12
17-Jul	0	0	0	0	1	0	0	0	0	0	0	7	1	1	0	2	0	0	1	4	1	2	0	0	20
18-Jul	3	0	0	0			0	4	0	4	0	0	1	0	0	0	0	1	2	1	1	0	0	0	17
19-Jul	0	0					0	0	1	0	2	0	0	2	0	0	7	0	0	0	0	0	0		12
20-Jul	c	c	c	c			c	c	c	c	c	c													0
21-Jul																									0
22-Jul																									0
23-Jul																									0
24-Jul																0			1	0	0	0	0	0	1
25-Jul	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0					3
26-Jul																			0	0					0
27-Jul																									
Total Chum	19	11	48	45	33	18	20	46	26	38	44	37	59	34	21	21	33	31	39	44	53	51	56	35	862

[a] Counts deleted from 0100 - 0400 hr. due to lights not being operational. Lights were installed 7-26-96 at 2000 hrs.

[b] Counts deleted due to inadequate training of personnel.

[c] Counts deleted due to poor visibility.

Table 9. Expanded hourly chinook salmon migration past the Takotna River counting tower, Kuskokwim Area, 1996. [a]

Date	Hour																								Total
	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Chinook
15-Jun													0	0	0	0	0	0	0	0	0	0	0	0	0
16-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	3	9
28-Jun	0	1	1	0	1	1	0	6	0	6	0	0	0	0	0	0	0	0	1	1	1	0	0	0	17
29-Jun	0	3	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	3	0	0	8
30-Jun	0	0	2	2	0	3	0	0	0	3	0	3	1	1	3	1	0	0	1	1	1	0	1	0	21
01-Jul	0	1	1	0	1	1	0	1	1	1	1	1	1	1	3	1	0	0	1	1	1	0	1	0	18
02-Jul	0	1	1	0	1	1	0	1	1	0	1	1	1	1	2	1	0	0	1	1	1	0	1	0	15
03-Jul	0	0	0	0	0	1	0	1	0	0	1	1	0	3	0	0	3	0	0	0	0	0	0	0	12
04-Jul	0	3	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2	0	2	0	3	0	0	0	12
05-Jul	0	0	0	0	0	0	0	0	6	3	4	0	12	9	12	3	0	0	3	15	0	9	0	0	73
06-Jul	5	0	2	4	0	10	0	0	2	0	2	2	2	8	0	0	0	0	0	3	0	0	0	0	39
07-Jul	0	0	2	0	0	0	0	2	0	0	3	0	0	0	0	0	0	0	0	0	0	0	3	0	10
08-Jul	0	0	0	3	0	3	3	0	4	0	0	0	6	3	6	0	0	0	3	6	0	0	0	0	37
09-Jul	0	0	0	0	6	0	6	3	0	0	0	0	0	0	0	6	0	0	0	0	0	0	3	3	24
10-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	3
11-Jul	0	-3	0	0	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
12-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	5
13-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	5
14-Jul	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
15-Jul	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
16-Jul	0	0	0	0	0	0	0	3	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0	0	9
17-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18-Jul	0	0	0	0	1	1	0	0	3	0	0	0	0	0	0	0	0	0	0	0	6	0	3	6	20
19-Jul	0	0	0	0	0	1	0	0	3	3	0	0	0	0	3	0	0	0	0	0	0	0	0	0	11
20-Jul	0	0	0	0	0	0	0	0	0	0	1	1	1	0	1	0	0	0	0	1	0	0	1	0	9
21-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	6
22-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	7
23-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	5
24-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3	0	0	0	0	0	4
25-Jul	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
26-Jul																			0	0					0
27-Jul																									
Total Chinook	7	7	19	14	11	22	4	18	24	23	14	24	28	25	35	13	10	0	16	31	15	19	15	11	401

[a] Estimated counts are enclosed in boxes.

Table 10. Expanded hourly chum salmon migration past the Takotna River counting tower, Kuskokwim Area, 1996. *

Date	Hour																								Total
	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Chum
15-Jun													0	0	0	0	0	0	0	0	0	0	0	0	0
16-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21-Jun	0	0	1	1	0	0	0	1	0	1	1	0	0	0	0	0	9	0	0	0	0	0	0	0	14
22-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24-Jun	2	2	5	4	2	2	0	0	0	0	0	0	0	0	0	0	0	0	6	4	7	0	45	24	102
25-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27-Jun	3	2	6	6	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	32	30	36	14	3	137
28-Jun	1	1	3	3	1	1	0	12	0	0	0	2	2	0	0	0	0	0	4	3	5	0	21	9	68
29-Jun	0	0	8	28	24	9	3	2	6	2	6	0	0	0	6	0	0	0	27	9	0	3	0	0	127
30-Jun	0	2	8	8	3	9	6	3	0	0	0	6	9	7	5	3	3	5	6	4	8	9	7	5	117
01-Jul	2	2	6	4	2	2	3	4	3	4	6	3	8	6	5	3	3	4	6	4	7	8	6	4	101
02-Jul	2	1	4	4	2	1	2	3	3	4	5	2	6	5	4	2	3	4	5	3	6	7	5	3	85
03-Jul	1	1	3	3	1	1	2	3	2	3	4	2	0	3	3	0	6	6	4	3	0	0	3	15	69
04-Jul	0	3	0	0	0	0	0	6	0	12	15	0	-2	0	0	0	6	18	14	12	18	0	21	0	123
05-Jul	0	0	0	0	0	9	12	26	24	14	22	0	32	3	6	0	26	9	0	36	33	6	3	3	264
06-Jul	19	12	34	16	22	2	9	16	2	12	16	26	24	8	0	7	2	9	15	3	26	0	15	0	295
07-Jul	6	0	32	0	3	0	6	4	0	20	3	12	0	24	0	30	0	6	21	0	0	54	0	21	242
08-Jul	0	9	6	42	6	0	3	3	2	0	12	9	36	33	12	3	0	15	9	3	0	3	0	3	209
09-Jul	3	0	3	6	6	3	12	0	18	5	14	3	9	0	12	3	9	0	0	0	21	9	9	27	172
10-Jul	3	0	3	0	0	6	0	3	0	0	0	0	12	15	18	0	0	0	9	0	0	24	12	0	105
11-Jul	6	0	6	0	12	9	3	3	0	0	3	0	0	0	3	6	3	4	5	3	6	7	5	3	86
12-Jul	2	1	4	3	2	1	2	3	2	3	5	2	6	5	4	2	2	3	4	3	5	6	4	3	78
13-Jul	1	1	3	3	1	1	2	3	2	3	4	2	6	2	2	0	3	12	3	3	3	0	9	0	70
14-Jul	3	0	0	0	0	0	0	0	0	0	1	0	0	-3	0	0	0	3	0	0	0	0	6	0	11
15-Jul	0	3	6	6	0	6	1	1	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	26
16-Jul	3	0	3	0	0	0	1	0	6	0	0	6	6	3	0	6	0	0	0	0	0	0	3	0	37
17-Jul	0	0	0	0	3	0	0	0	0	0	0	17	3	3	0	6	0	0	3	12	3	6	0	0	56
18-Jul	9	0	0	0	1	1	0	12	0	12	0	0	3	0	0	0	0	3	6	3	3	0	0	0	53
19-Jul	0	0	2	1	1	1	0	0	3	0	6	0	0	6	0	0	14	0	0	0	0	0	0	1	35
20-Jul	1	0	1	1	1	0	1	1	1	1	2	1	2	2	1	1	1	1	2	1	2	2	2	1	29
21-Jul	0	0	1	1	1	0	1	1	1	1	2	1	2	2	1	1	1	1	1	1	2	2	1	1	26
22-Jul	0	0	1	1	0	0	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	2	1	1	21
23-Jul	0	0	1	1	0	0	0	1	0	1	1	0	1	1	1	0	0	1	1	1	1	1	1	1	16
24-Jul	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	3	0	0	0	0	0	8
25-Jul	0	0	2	0	3	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	11
26-Jul																			0	0					0
27-Jul																									
Total Chum	68	42	150	142	101	68	73	110	78	99	132	95	167	127	84	73	92	106	153	143	189	179	194	128	2,794

* Estimated counts are enclosed in boxes.

Table 11. Actual unexpanded hourly chinook salmon observations at the Takotna River counting tower, Kuskokwim Area, 1997.[a]

Date	Hour																								Total
	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Chinook
15-Jun																									0
16-Jun										0	0														0
17-Jun											0	0					0	0							0
18-Jun													0	0					0	0				0	0
19-Jun	0											0	0												0
20-Jun	0	0	0				0	0	0				0	0	0				0	0	0				0
21-Jun[b]	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	0
22-Jun	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
23-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24-Jun	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	4
25-Jun	1	1	0	1	3	0	0	0	0	0	0	0	1	0	0	3	0	0	0	0	0	0	0	0	10
26-Jun	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	-2	0	2	0	0	1	0	0	4	8
27-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	1	3
28-Jun	-1	0	7	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	1	0	1	11
29-Jun	0	0	3	1	3	0	0	0	2	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	12
30-Jun	5	0	0	0	1	0	0	0	0	0	3	0	4	0	0	6	0	0	0	0	0	0	0	0	19
01-Jul	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02-Jul	0	0	1	1	1	0	0	0	0	0	0	0	0	1	1	5	0	0	0	0	0	0	0	0	10
03-Jul	0	0	0	2	1	0	0	0	0	0	3	0	0	4	0	3	0	11	0	0	0	0	0	0	24
04-Jul	0	0	0	3	0	0	0	0	0	0	0	0	2	0	3	5	5	2	0	2	0	0	0	0	22
05-Jul	2	0	2	1	1	0	0	1	1	1	0	0	0	0	2	0	2	4	0	0	0	0	0	1	18
06-Jul	0	0	1	1	4	1	0	0	0	0	2	1	0	0	0	0	0	1	0	0	4	1	2	0	18
07-Jul	0	0	0	1	2	-1	1	0	0	0	3	0	2	3	0	0	-2	0	2	0	0	0	0	0	11
08-Jul	0	5	2	0	1	0	0	1	0	3	0	1	0	0	5	0	0	0	0	0	0	0	0	0	18
09-Jul	2	1	2	0	4	1	0	0	2	1	0	0	1	1	0	4	0	0	0	0	0	4	0	0	23
10-Jul	0	1	0	4	0	0	0	0	2	0	0	0	2	0	5	0	0	0	2	0	1	0	0	0	17
11-Jul	3	5	2	2	2		0	0	0	0	0	3	1	0	0	0	1	2	0	0	0	0	0	2	23
12-Jul	0	0	0		2	3	0	0	0	0	0	0	0	0	0	8	0	0	0	3	0	0	0	0	16
13-Jul	0	0	3	3	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	8
14-Jul	2	0	4	2	4	2	0	0	0	0	0	0	0	0	1	0	7	0	0	0	0	0	0	0	22
15-Jul	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	3	1	3	0	0	0	0	9
16-Jul	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	4
17-Jul	1	0	4	3	2	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	0	0	1	2	12
18-Jul	2	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	16
19-Jul	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	1		0	0	0	0	0	4
20-Jul	0	0	1	0	0	1	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0	0	5
21-Jul	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
22-Jul	0	0	1	0	1	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	4
23-Jul	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3
24-Jul	1	1	1	1	0	1							0	0			0	0	0	0	0	0	0	1	6
25-Jul	1	1	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	5
26-Jul	1	1	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	6
27-Jul	0	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
28-Jul	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	2
29-Jul	0	0	2	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	5
30-Jul	0	-1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
31-Jul	0	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	0	0	0	0	-2
01-Aug	0	0	0	0	0	0	0	0	0	0	0	0							0	0	1	0	0	0	1
02-Aug	-1	0	4	-1	0	0	0	0	0	0	0	0				0	0	1	0	0	0	0	0	0	3
03-Aug	1	0	0	0	0	0							0	0	0	0			0	0	0	0	0	0	1
04-Aug	0	0	0	-1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Chinook	20	17	48	34	38	8	1	2	7	5	14	5	14	17	21	35	25	28	11	8	8	6	3	13	388

[a] Boxed areas indicate missed counts

[b] 24 hour counts were begun 21 June 0:00.

Table 12. Actual unexpanded hourly chum salmon observations at the Takotna River counting tower, Kuskokwim Area, 1997 [a]

Date	Hour																								Total
	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Chum
15-Jun																									0
16-Jun										0	0														0
17-Jun											0	0						0	0						0
18-Jun													0	0					0	0				0	0
19-Jun	0											0	0												0
20-Jun	0	0	0				0	0	0				0	0	0				0	0	0				0
21-Jun [b]	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2	2
22-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24-Jun	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
25-Jun	0	0	2	4	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	9
26-Jun	0	3	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
27-Jun	4	0	1	0	2	0	0	0	0	0	0	0	0	5	0	0	4	0	0	0	0	0	0	1	17
28-Jun	0	0	5	0	4	0	0	0	3	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	15
29-Jun	0	3	8	2	5	2	0	1	0	0	0	1	0	0	1	0	0	3	0	0	0	0	0	2	28
30-Jun	4	0	4	4	1	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	16
01-Jul	0	2	0	1	0	0		3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
02-Jul	2	0	1	2	3	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	11
03-Jul	0	0	0	7	1	0	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	11
04-Jul	2	0	1	4	0	0	0	0	0	0	0	0	0	0	2	1	7	4	0	1	0	0	0	1	23
05-Jul	4	4	4	0	1	0	0	0	4	1	0	0	2	0	0	0	0	1	0	0	0	0	0	3	24
06-Jul	0	1	1	0	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	7	3	0	29
07-Jul	1	1	2	2	4	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	11
08-Jul	0	9	0	2	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	14
09-Jul	2	1	7	0	0	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	6	19
10-Jul	0	0	0	2	2	0	0	0	0	1	0	0	3	5	4	0	0	0	1	0	0	0	0	3	21
11-Jul	1	3	4	3	2		0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	20
12-Jul	0	0	1	4	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
13-Jul	0	0	2	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	12
14-Jul	20	1	4	3	4	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	5	0	39
15-Jul	1	0	2	1	0	0	0	0	0	1	0	0	0	0	0	0	0	7	0	0	0	0	0	0	12
16-Jul	5	4	0	5	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3	18
17-Jul	2	1	8	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	7	26
18-Jul	8	0	3	4	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3	0	19
19-Jul	0	4	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0		0	0	0	0	0	6
20-Jul	0	2	4	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	10
21-Jul	0	4	5	0	3	0	0	0	0	0	0	0	0	0	2	0	0	0	0	1	0	0	9	0	24
22-Jul	0	3	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	8
23-Jul	5	2	8	0	1	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	4	22
24-Jul	10	2	1	3	1	1							0	0			0	0	0	0	0	0	1	0	19
25-Jul	2	0	0	3	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	8
26-Jul	1	1	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
27-Jul	1	0	15	2	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	24
28-Jul	0	0	6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
29-Jul	0	2	2	1	1	3	0	0	0	0	0	0	0	0	0	0	6	0	0	0		4	0	0	19
30-Jul	1	2	2	0	0	0	0	0	0	2	0	4	0	0	0	0	0	0	0	0	0	0	6	0	9
31-Jul	0	0	0	2	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
01-Aug	0	1	1	0	0	0	0	0	0	0	0	0							0	0	1	0	0	1	4
02-Aug	1	1	-1	0	0	0	0	0	0	0	0	0				0	0	0	0	0	1	0	0	0	2
03-Aug	0	0	-1	1	0	0							0	0	0	0			0	0	0	0	0	0	0
04-Aug	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Chum	77	61	104	73	62	16	1	6	9	5	4	0	8	13	9	7	21	15	2	10	12	13	31	36	595

[a] Boxed areas indicate missed counts

[b] 24 hour counts were begun 21 June 0:00.

Table 13. Expanded hourly chinook salmon migration past the Takotna River counting tower, Kuskokwim Area, 1997.*

Date	Hour																							Total
	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Chinook
15-Jun																									0
16-Jun										0	0														0
17-Jun											0	0					0	0							0
18-Jun													0	0					0	0				0	0
19-Jun	0											0	0												0
20-Jun	0	0	0				0	0	0				0	0	0				0	0	0				0
21-Jun	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-3	0
22-Jun	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
23-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24-Jun	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
25-Jun	3	3	0	3	9	0	0	0	0	0	0	0	3	0	0	9	0	0	0	0	0	0	0	0	30
26-Jun	0	0	3	3	0	0	0	0	0	0	0	0	0	3	0	-6	0	6	0	0	3	0	0	12	24
27-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	3	0	0	3	9
28-Jun	-3	0	21	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	3	0	3	33
29-Jun	0	0	9	3	9	0	0	0	6	0	0	0	0	3	0	0	0	0	6	0	0	0	0	0	36
30-Jun	15	0	0	0	3	0	0	0	0	0	9	0	12	0	0	18	0	0	0	0	0	0	0	0	57
01-Jul	0	0	0	0	9	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02-Jul	0	0	3	3	3	0	0	0	0	0	0	0	0	3	3	15	0	0	0	0	0	0	0	0	30
03-Jul	0	0	0	6	3	0	0	0	0	0	9	0	0	12	0	9	0	33	0	0	0	0	0	0	72
04-Jul	0	0	0	9	0	0	0	0	0	0	0	0	6	0	9	15	15	6	0	6	0	0	0	0	66
05-Jul	6	0	6	3	3	0	0	3	3	3	0	0	0	0	6	0	6	12	0	0	0	0	0	3	54
06-Jul	0	0	3	3	12	3	0	0	0	0	6	3	0	0	0	0	0	3	0	0	12	3	6	0	54
07-Jul	0	0	0	3	6	-3	3	0	0	0	9	0	6	9	0	0	-6	0	6	0	0	0	0	0	33
08-Jul	0	15	6	0	3	0	0	3	0	9	0	3	0	0	15	0	0	0	0	0	0	0	0	0	54
09-Jul	6	3	6	0	12	3	0	0	6	3	0	0	3	3	0	12	0	0	0	0	0	12	0	0	69
10-Jul	0	3	0	12	0	0	0	0	6	0	0	0	6	0	15	0	0	0	6	0	3	0	0	0	51
11-Jul	9	15	6	6	6	5	0	0	0	0	0	9	3	0	0	0	3	6	0	0	0	0	0	6	74
12-Jul	0	0	0	0	6	9	0	0	0	0	0	0	0	0	0	24	0	0	0	9	0	0	0	0	48
13-Jul	0	0	9	9	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	3	24
14-Jul	6	0	12	6	12	6	0	0	0	0	0	0	0	0	3	0	21	0	0	0	0	0	0	0	66
15-Jul	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	3	0	9	3	9	0	0	0	0	27
16-Jul	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	3	12
17-Jul	3	0	12	9	6	0	0	0	0	0	0	0	0	0	0	0	-3	0	0	0	0	0	3	6	36
18-Jul	6	3	3	6	0	0	0	0	0	0	0	0	0	0	0	0	30	0	0	0	0	0	0	0	48
19-Jul	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	6	0	3	0	0	0	0	0	0	12
20-Jul	0	0	3	0	0	3	0	0	0	0	0	0	0	3	0	0	0	6	0	0	0	0	0	0	15
21-Jul	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
22-Jul	0	0	3	0	3	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	12
23-Jul	0	0	3	3	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	9
24-Jul	3	3	3	3	0	3	0	0	0	0	2	0	0	0	5	0	0	0	0	0	0	0	0	3	24
25-Jul	3	3	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	15
26-Jul	3	3	0	0	6	0	0	0	0	0	0	0	0	0	3	0	0	0	3	0	0	0	0	0	18
27-Jul	0	3	6	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
28-Jul	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	6
29-Jul	0	0	6	3	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15
30-Jul	0	-3	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0
31-Jul	0	-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-3	0	0	0	0	0	0	0	-6
01-Aug	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	3
02-Aug	-3	0	12	-3	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	9
03-Aug	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	5
04-Aug	0	0	0	-3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Chinook	60	51	144	102	114	29	3	6	21	15	44	15	42	51	68	105	77	84	33	24	24	18	9	39	1,176

* Estimated counts are enclosed in boxes

Table 14. Expanded hourly chum salmon migration past the Takotna River counting tower, Kuskokwim Area, 1997. [a]

Date	Hour																								Total Chum
	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	
15-Jun																									0
16-Jun										0	0														0
17-Jun											0	0					0	0							0
18-Jun													0	0					0	0				0	0
19-Jun	0											0	0												0
20-Jun	0	0	0				0	0	0				0	0	0				0	0	0				0
21-Jun	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-6	6
22-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24-Jun	0	0	6	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
25-Jun	0	0	6	12	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	27
26-Jun	0	9	6	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
27-Jun	12	0	3	0	6	0	0	0	0	0	0	0	0	15	0	0	12	0	0	0	0	0	0	3	51
28-Jun	0	0	15	0	12	0	0	0	9	0	0	0	3	6	0	0	0	0	0	0	0	0	0	0	45
29-Jun	0	9	24	6	15	6	0	3	0	0	0	3	0	0	3	0	0	9	0	0	0	0	0	6	84
30-Jun	12	0	12	12	3	0	0	0	0	0	6	0	3	0	0	0	0	0	0	0	0	0	0	0	48
01-Jul	0	6	0	3	0	0	0	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18
02-Jul	6	0	3	6	9	0	0	0	3	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	33
03-Jul	0	0	6	21	3	0	0	0	0	0	0	6	0	0	0	0	3	0	0	0	0	0	0	0	33
04-Jul	6	0	3	12	0	0	0	0	0	0	0	0	0	0	6	3	21	12	0	3	0	0	0	3	69
05-Jul	12	12	12	0	3	0	0	0	12	3	0	0	6	0	0	0	0	3	0	0	0	0	0	9	72
06-Jul	0	3	3	0	18	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	30	21	9	0	87
07-Jul	3	3	6	6	12	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	33
08-Jul	0	27	0	6	3	0	3	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	42
09-Jul	6	3	21	0	0	6	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	18	57
10-Jul	0	0	0	6	6	0	0	0	0	3	0	0	9	15	12	0	0	0	3	0	0	0	0	9	63
11-Jul	3	9	12	9	6	5	0	0	0	0	0	0	0	0	0	0	0	0	0	21	0	0	0	0	65
12-Jul	0	0	3	12	9	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	33
13-Jul	0	0	6	3	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	36
14-Jul	60	3	12	9	12	3	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	15	0	117
15-Jul	3	0	6	3	0	0	0	0	0	3	0	0	0	0	0	0	0	21	0	0	0	0	0	0	36
16-Jul	15	12	0	15	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	9	54
17-Jul	6	3	24	9	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	21	78
18-Jul	24	0	9	12	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	9	0	57
19-Jul	0	12	0	0	3	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	18
20-Jul	0	6	12	6	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	30
21-Jul	0	12	15	0	9	0	0	0	0	0	0	0	0	0	6	0	0	0	0	3	0	0	27	0	72
22-Jul	0	9	0	0	3	6	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	3	0	0	24
23-Jul	15	6	24	0	3	0	0	0	0	0	0	0	3	0	0	3	0	0	0	0	0	0	0	12	66
24-Jul	30	6	3	9	3	3	0	3	0	0	0	0	0	0	0	2	0	0	0	0	0	0	3	0	62
25-Jul	6	0	0	9	0	0	0	6	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	24
26-Jul	3	3	6	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15
27-Jul	3	0	45	6	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	72
28-Jul	0	0	18	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21
29-Jul	0	6	6	3	3	9	0	0	0	0	0	0	0	0	0	0	18	0	0	0	0	12	0	0	57
30-Jul	3	6	6	0	0	0	0	0	0	6	0	-12	0	0	0	0	0	0	0	0	0	0	18	0	27
31-Jul	0	0	0	6	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21
01-Aug	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	3	12
02-Aug	3	3	-3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	6
03-Aug	0	0	-3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04-Aug	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Chum	231	183	312	219	186	53	3	21	27	15	12	0	24	39	27	23	63	45	6	30	36	39	93	108	1,794

[a] Estimated counts are enclosed in boxes.

Table 15. Actual unexpanded hourly chinook salmon observations at the Takotna River counting tower, Kuskokwim Area, 1998. [a]

Date	Hour																								Total
	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Chinook
15-Jun																									
16-Jun																									
17-Jun																									
18-Jun																									
19-Jun																									
20-Jun								0	0											0					0
21-Jun								0	0																0
22-Jun								0	0																0
23-Jun								0	0																0
24-Jun								0	0																0
25-Jun	0	0	0	0	0	0	0	0							0	0	0	0							0
26-Jun																									0
27-Jun									0	0	0	0			0	0	0	0							0
28-Jun								0									0	0	0	0	0	0			0
29-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0
30-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0
01-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					0	0	0	0	0
02-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0		0	0	0	0	0	0	1
03-Jul	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
04-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	1	0	0	0	0	0	0	0	1
05-Jul		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0				2	0	0	0	0	0	0	0	2
07-Jul																									
08-Jul																									
09-Jul																									
10-Jul																									
11-Jul																									
12-Jul																									
13-Jul																									
14-Jul																									
15-Jul																									
16-Jul																									
17-Jul																									
18-Jul																									
19-Jul																									
20-Jul																									
21-Jul																									
22-Jul																									
23-Jul																									
24-Jul																									
25-Jul																									
26-Jul																									
27-Jul																									
28-Jul																									
29-Jul																									
30-Jul																									
31-Jul																									
Total Chinook	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	3	0	0	0	0	0	0	0	5

[a] Operations suspended 7 July due to high water.

Table 16. Actual unexpanded hourly chum salmon observations at the Takotna River counting tower, Kuskokwim Area, 1998. *

Date	Hour																								Total Chum
	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	
15-Jun																									
16-Jun																									
17-Jun																									
18-Jun																									
19-Jun																									
20-Jun								0	0											0					0
21-Jun								0	0																0
22-Jun								0	0																0
23-Jun								0	0																0
24-Jun								0	0																0
25-Jun	0	0	0	0	0	0	0	0							0	0	0	0							0
26-Jun																									0
27-Jun									0	0	0	0			0	0	0	0							0
28-Jun								0									0	0	0	0	0	0			0
29-Jun	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			0
30-Jun	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0			3
01-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					0	0	0	0	0
02-Jul	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	5
03-Jul	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2
04-Jul	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	0	0	1	0	0	0	0	0	1
05-Jul		0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	4
06-Jul	0	1	1	0	0	0	0	0	0	0	0	0	0				0	0	0	0	0	0	0	0	2
07-Jul																									
08-Jul																									
09-Jul																									
10-Jul																									
11-Jul																									
12-Jul																									
13-Jul																									
14-Jul																									
15-Jul																									
16-Jul																									
17-Jul																									
18-Jul																									
19-Jul																									
20-Jul																									
21-Jul																									
22-Jul																									
23-Jul																									
24-Jul																									
25-Jul																									
26-Jul																									
27-Jul																									
28-Jul																									
29-Jul																									
30-Jul																									
31-Jul																									
Total chum	0	1	1	0	1	6	2	0	0	0	0	2	0	0	2	0	0	0	1	0	0	0	0	1	17

* Operations suspended 7 July due to high water.

Table 17. Chemical analysis of water samples collected from Takotna River drainage basin

Parameter	EPA Std. [a] (µg/L)	Lab	Date Sampled							
			7/7/1996	7/7/1996	7/7/1996	7/7/1996	7/7/1997	7/7/1997	7/8/1997	7/9/1997
Depth			Surface	Surface	Surface	Surface	Surface	Surface	Surface	Surface
Location			Takotna [f] Station 1	Takotna [f] Station 2	Takotna [f] Station 3	Takotna [f]	Takotna [g]	4th of July rm 0.5	Nixon Fork rm 20	Tatalina [h]
Specific Conductance (µmhos cm)		ADFG [b]	116	118	118		120	131	227	161
pH	6.5 to 9.0 [d]	ADFG [b]	7.0	7.0	7.2		7.6	7.6	7.5	7.6
Alkalinity (mg/L)		ADFG [b]	50.0	51.0	51.0		58.2	59.9	110.5	71.6
Turbidity (NTU)		ADFG [b]	6.2	6.3	6.5		4.0	2.0	9.0	4.0
Color (Pt units)		ADFG [b]	38	37	38		24	15	38	37
Calcium (mg/L)		ADFG [b]	12.1	12.1	12.1					
Magnesium (mg/L)		ADFG [b]	5.1	5.7	5.7					
Iron (µg/L)	1000 [d]	ADFG [b]	1202	1045	1089					
Reactive silicon (µg/L Si)		ADFG [b]	1708	1660	1672		3037	2989	4591	4018
Aluminum (µg/L)		ER [c]				40				
Antimony (µg/L)	1600 [d]	ER [c]				<0.1				
Arsenic (µg/L)	48 [d]	ER [c]				2	<50	<50	<50	
Barium (µg/L)	1000 [e]	ER [c]				49.6				
Beryllium (µg/L)	5.3 [d]	ER [c]				<0.1				
Bismuth (µg/L)		ER [c]				<0.05				
Boron (µg/L)		ER [c]				11				
Europium (µg/L)		ER [c]				<0.05				
Cadmium (µg/L)	1.1 [d]	ER [c]				<0.1	<2	<2	<2	
Caesium (µg/L)		ER [c]				<0.05				
Calcium (µg/L)		ER [c]				13400	14000	14300	31100	
Cerium (µg/L)		ER [c]				0.17				
Chromium (µg/L)		ER [c]				<0.5	<5	<5	<5	
Cobalt (µg/L)		ER [c]				0.2				
Copper (µg/L)	12 [d]	ER [c]				1.1	<2	<2	<2	
Dysprosium (µg/L)		ER [c]				<0.05				
Erbaim (µg/L)		ER [c]				<0.05				
Gadolinium (µg/L)		ER [c]				0.06				
Gallium (µg/L)		ER [c]				<0.1				
Germanium (µg/L)		ER [c]				<0.5				
Gold (µg/L)		ER [c]				<0.1				
Hafnium (µg/L)		ER [c]				<0.05				
Holmium (µg/L)		ER [c]				<0.05				
Iridium (µg/L)		ER [c]				<0.05				
Iron (µg/L)	1000 [d]	ER [c]				1680				
Krypton (µg/L)		ER [c]				<1				
Lanthanum (µg/L)		ER [c]				<0.1				
Lead (µg/L)	3.2 [d]	ER [c]				<0.1	<2	<2	<2	
Lithium (µg/L)		ER [c]				3.4				
Lutetium (µg/L)		ER [c]				<0.1				
Magnesium (µg/L)		ER [c]				5670	5880	6630	9710	
Manganese (µg/L)		ER [c]				46.8				
Mercury (µg/L)	0.012 [d]	ER [c]				<0.05				
Molybdenum (µg/L)		ER [c]				<0.1				
Neodymium (µg/L)		ER [c]				<0.05				
Nickel (µg/L)	160 [d]	ER [c]				<0.5				
Niobium (µg/L)		ER [c]				<0.1				
Palfadium (µg/L)		ER [c]				<0.2				
Phosphorous (µg/L)		ER [c]				<50				

- continued -

Table 17. (page 2 of 2)

Parameter	EPA Std. [a] (µg/L)	Lab	Date Sampled							
			7/7/1996	7/7/1996	7/7/1996	7/7/1996	7/7/1997	7/7/1997	7/8/1997	7/9/1997
Pladium (µg/L)		ER [c]				<0.05				
Potassium (µg/L)		ER [c]				580				
Praseodymium (µg/L)		ER [c]				<0.05				
Rhenaium (µg/L)		ER [c]				<0.1				
Rhodium (µg/L)		ER [c]				<0.05				
Rubidium (µg/L)		ER [c]				0.4				
Ruthenium (µg/L)		ER [c]				<0.1				
Samarium (µg/L)		ER [c]				<0.05				
Scandium (µg/L)		ER [c]				0.5				
Silicon (µg/L)		ER [c]				1950				
Silver (µg/L)	0.12	ER [c]				<0.05				
Sodium (µg/L)		ER [c]				2880				
Strontium (µg/L)		ER [c]				60.7				
Tantalum (µg/L)		ER [c]				<0.1				
Tellurium (µg/L)		ER [c]				<0.5				
Terbium (µg/L)		ER [c]				<0.05				
Thallium (µg/L)	40	ER [c]				0.15				
Thorbium (µg/L)		ER [c]				<0.05				
Thutium (µg/L)		ER [c]				<0.05				
Tin (µg/L)		ER [c]				<0.1				
Titanium (µg/L)		ER [c]				2.5				
Tungsten (µg/L)		ER [c]				<0.1				
Uranium (µg/L)		ER [c]				0.10				
Vanadium (µg/L)		ER [c]				1				
Yuerbium (µg/L)		ER [c]				<0.05				
Yurium (µg/L)		ER [c]				0.22				
Zinc (µg/L)	110	ER [c]				<1	<4	<4	<4	
Zirconium (µg/L)		ER [c]				<0.1				

[a] United States Environmental Protection Agency (EPA 1986).

[b] Alaska Department of Fish and Game, Limnology Unit, Soldotna, AK.

[c] Elemental Reseach Inc., North Vancouver, B.C., Canada.

[d] Freshwater chronic criteria

[e] Drinking water criteria

[f] Three stations across the river channel just upstream of the community of Takotna.

[g] Mainstem Takotna River at the tower site.

[h] Lower Tatalina River, exact location undocumented.

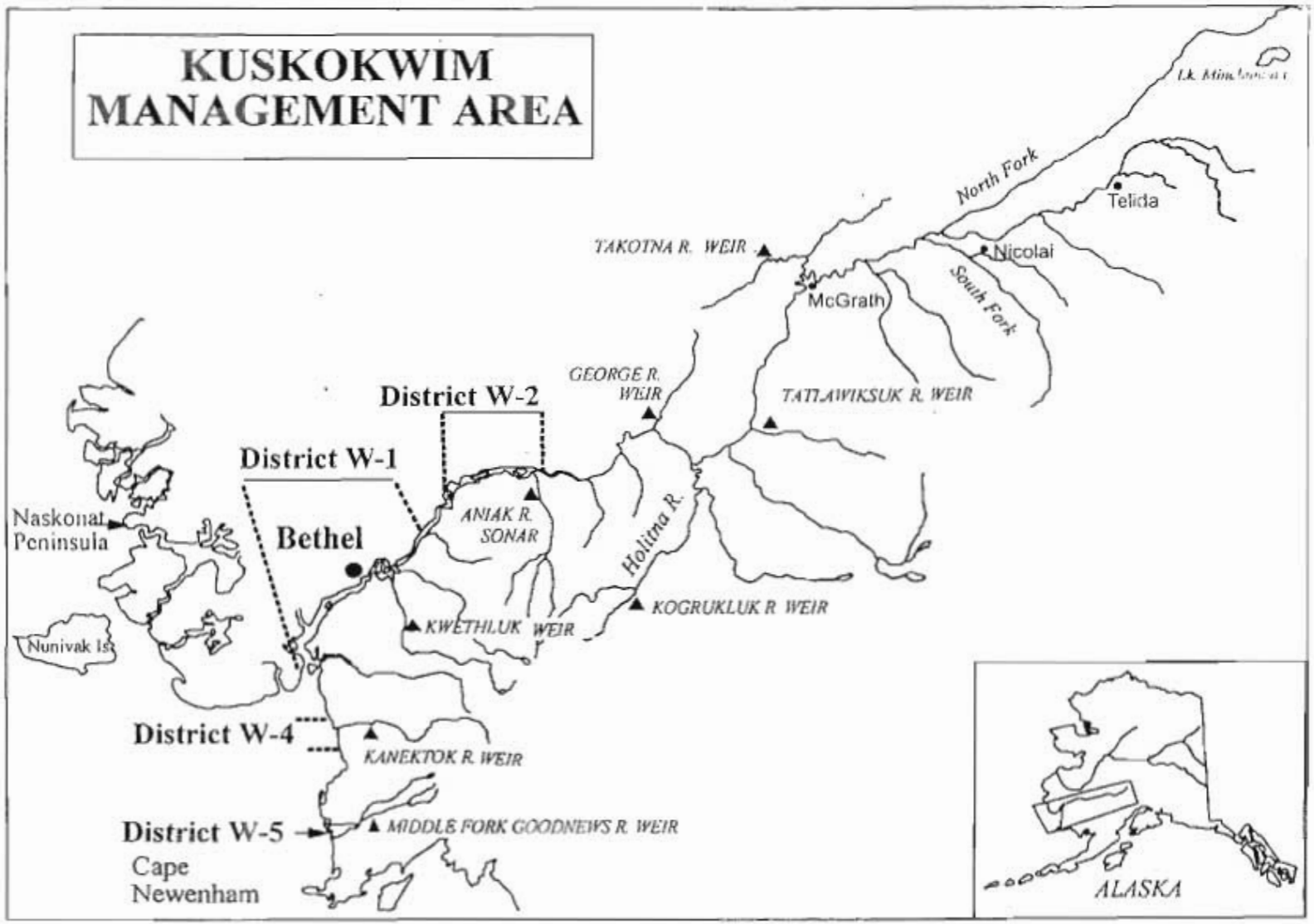


Figure 1. Kuskokwim Area map showing salmon management districts and escapement monitoring projects.

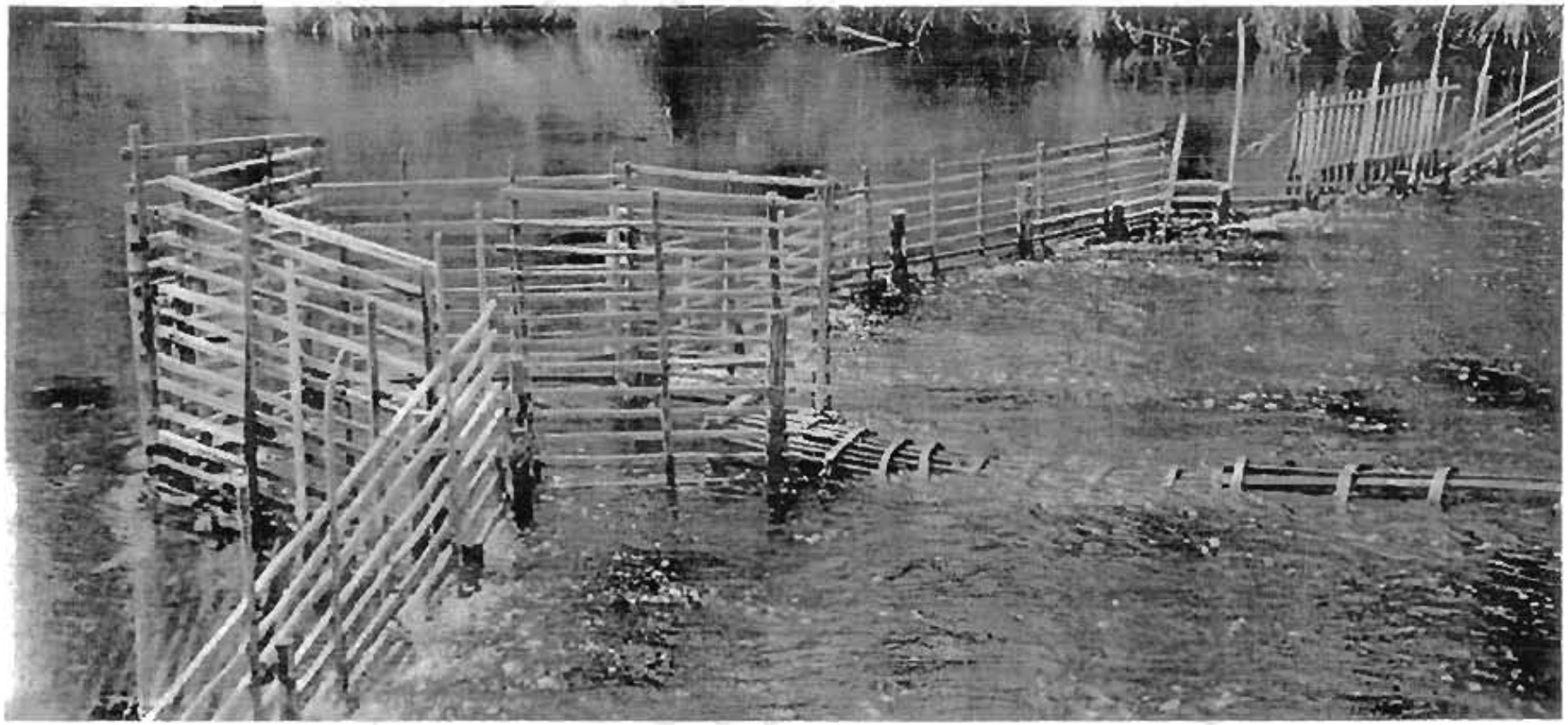


Figure 2. Traditional Athabaskan fish fence (weir) on the Salmon River (Pitka Fork) of the upper Kuskokwim River basin, 1964 (photo by Ray Collins).

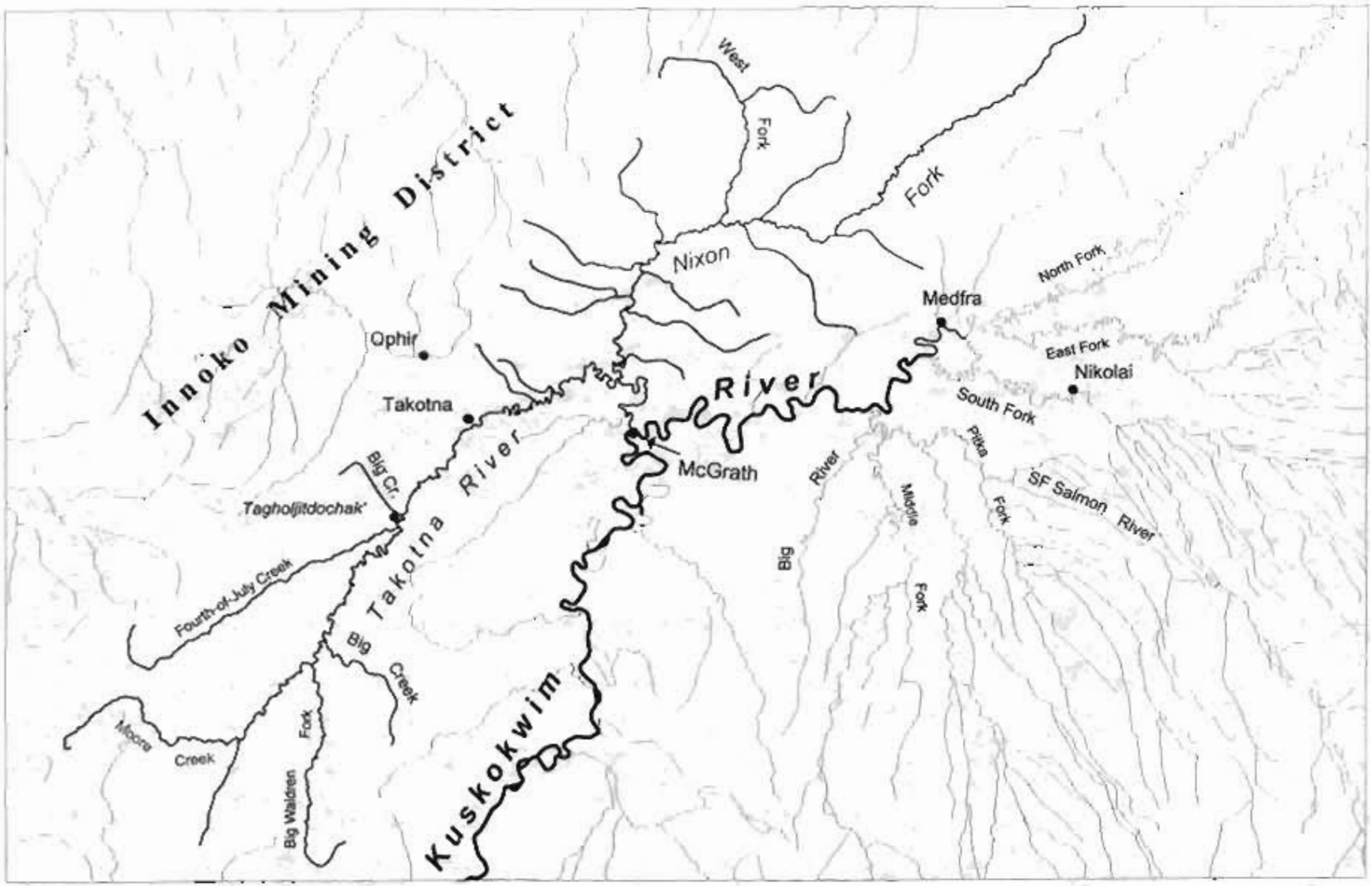


Figure 3. Takotna River drainage, upper Kuskokwim River basin.

Figure 4. Takotna River counting tower and flash panels, 1996 (photo by Larry DuBois).

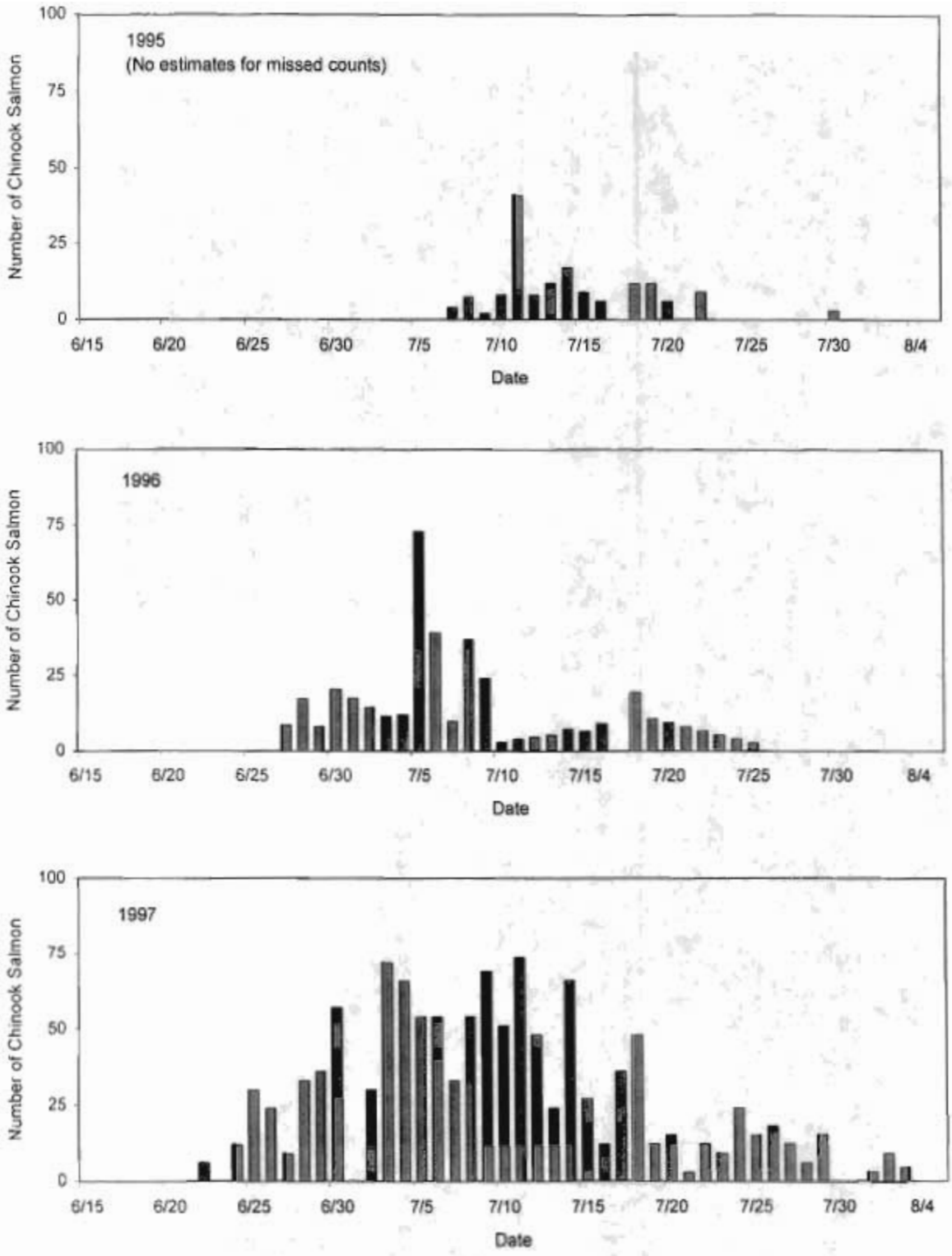


Figure 5. Daily chinook salmon migration past the Takotna River counting tower, Kuskokwim Area 1995-1997.

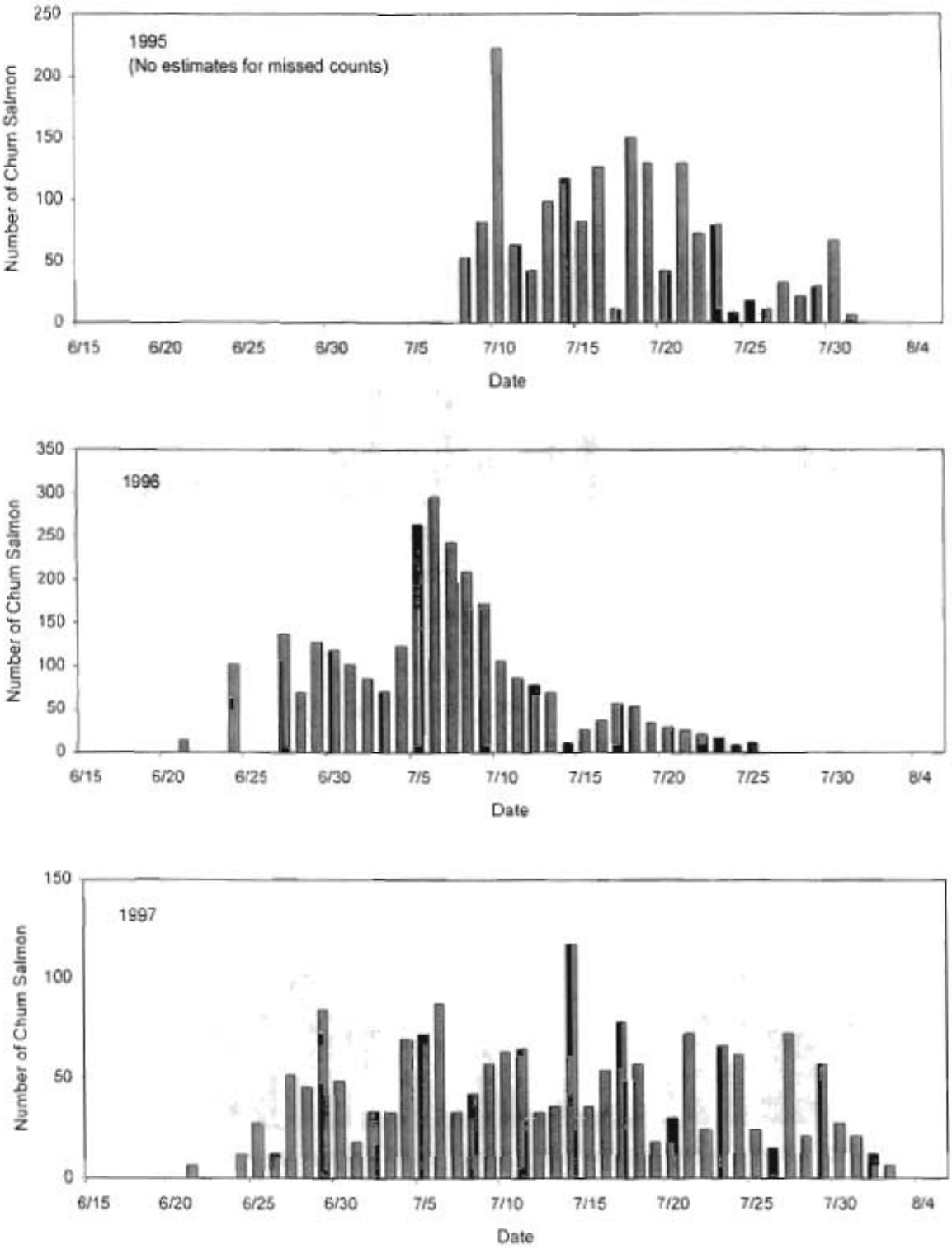


Figure 6. Daily chum salmon migration past the Takotna River counting tower, Kuskokwim Area 1995-1997.

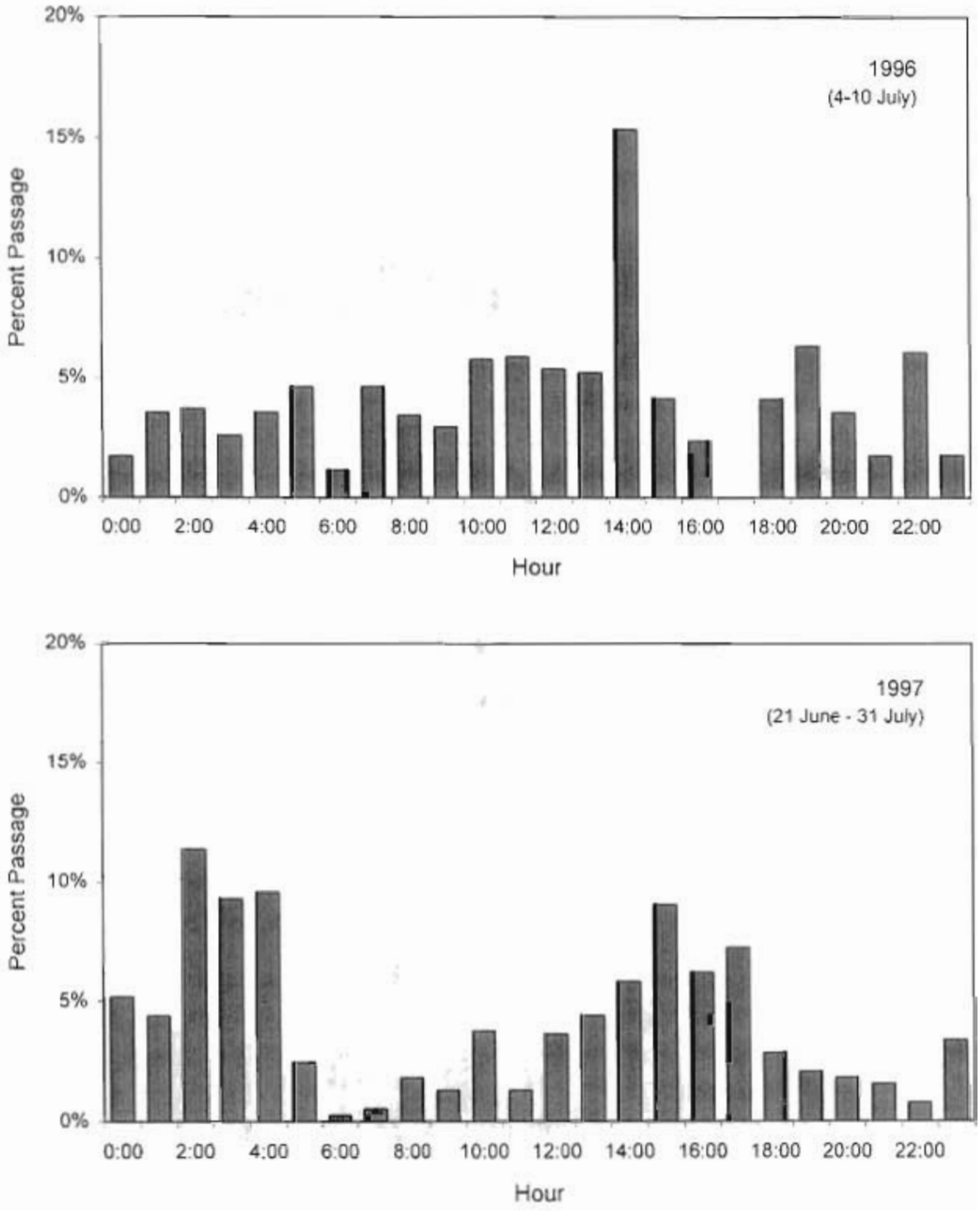


Figure 7. Diurnal pattern of chinook salmon migration past the Takotna River counting tower, Kuskokwim Area, 1996-1997.

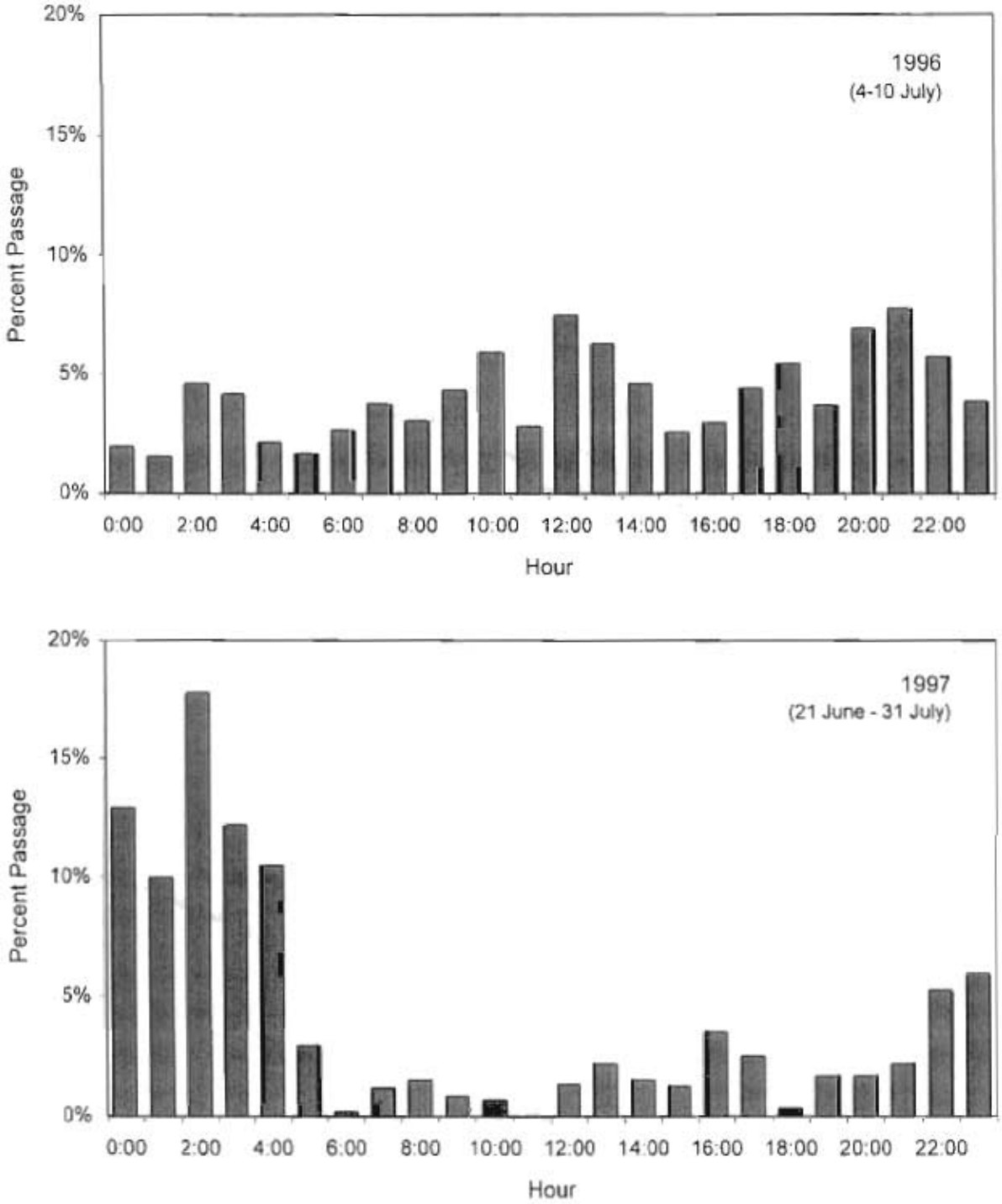
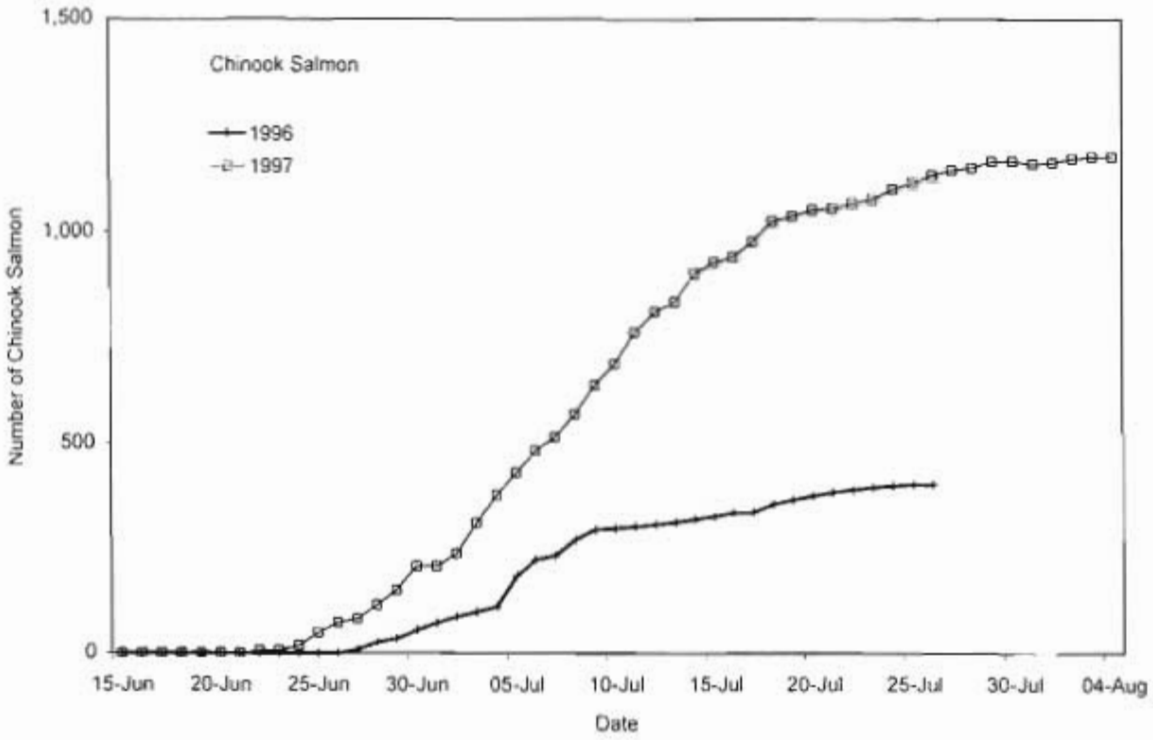


Figure 8. Diurnal pattern of chum salmon migration past the Takotna River counting tower, Kuskokwim Area, 1996-1997.



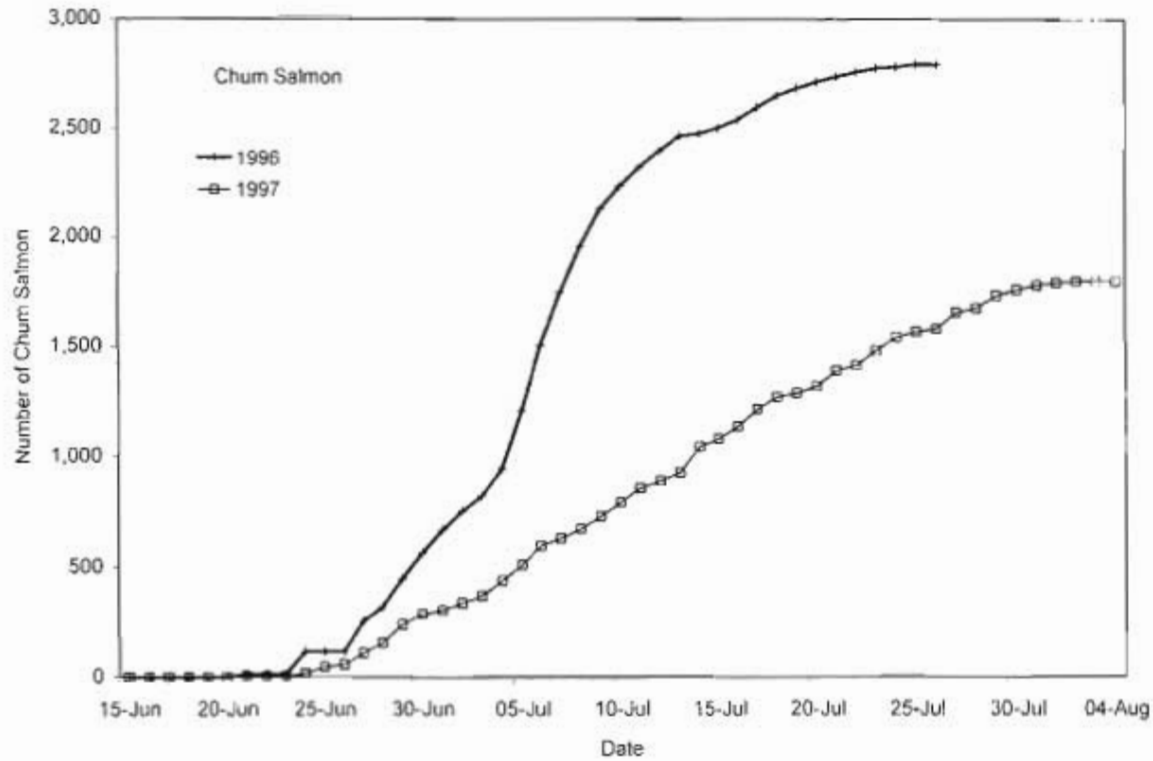


Figure 9. Cumulative migration of chinook and chum salmon past the Takotna River counting tower, Kuskokwim Area, 1996-1997.

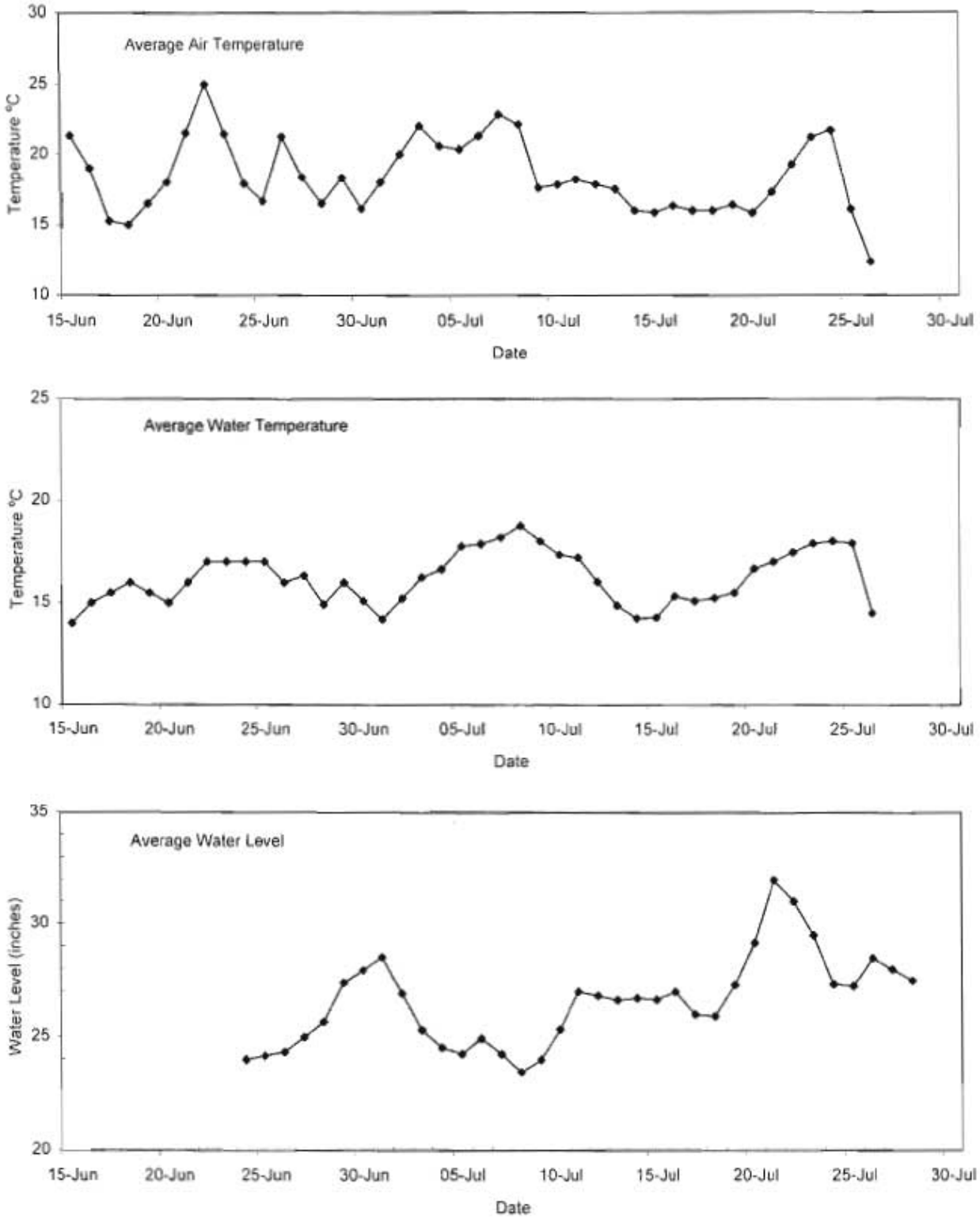


Figure 10. Climatological and hydrological observations at the Takotna River counting tower, Kuskokwim Area, 1996.

Appendix A. Takotna Investigations: Interviews

1) Ricky Hoff, BIA Archeology, January 13 - 15, 1998
   - Regarding Taholsitna or Fourth of July Creek Village (Doyon Region #AA12368) which is described as a 'winter camp'
   - Ken Pratt (ANCSA) and Matt ? same office provided archeological findings about Fourth of July Creek Village along with investigations about Big Creek village - all in the Takotna River drainage.
   - Fourth of July Creek village site was recommended for approval as a registered archeological site, but Big Creek was not (thought to have been more of a white settlement, native activities were probably in association with Fourth of July Creek village - e.g. a satellite summer camp. The two sites are in relatively close proximity. The Big Creek is the 'lower' Big Creek on Takotna drainage. There is another Big Creek farther upstream, also associated with a white establishment.
   - Based on BLM records (Site AA12368; National Register of Historic Places Inventory Nomination Form) Re: "a story has been handed down to the Nikolai people of an elderly upper Kuskokwim Native alive in the 1880's who stated that when he was very young his group migrated from the Holy Cross region on the Yukon to the Takotna by way of the Innoko River (Hosley 1966: 5)....Between 1900 and 1910 disease, primarily diphtheria, decimated the settlement (Hosley 1966:54)
   - Doyon Report ("Mouth of Fourth of July Creek"): ".... The site was a large and important village, ...[*for Athabaskan communities, a large village may have 20 or 30 residents*].
2) Joan Dale; Alaska Heritage Resource Survey, State Office of History and Archeology; January 15, 1998.
   - Regarding Taholsitna or Fourth of July Creek Village (Doyon Region #AA12368)
   - Checked Orth (Dictionary of Alaska Place Names, USGS Professional Paper 567;
   - Recommend I speak with Sally Collins USFWS, Innoko NWR 524-3251
3) Sally & Ray Collins
   - corroborated existence of a weir in association with Fourth-of-July Creek village for catching king salmon; fish were for personal use and sold to miners.
   - went on to explain that although FOJ village is described as a winter village, the occupants, or at least some of them, remained in the Takotna valley during the fishing season, but just spread out more. Trail linked FOJV with Vinasale
   - Suggested checking with Lidia Black about the possible existence of dairies from Kolmakovs travels up the Takotna River in 1800's.
4) Pete Shepherd, (former Game Bio from McGrath, 1971 - 1981) interviewed 1/29/98.
   - 'Takotna / Nixon Fork drainage was dead to salmon the entire time I worked out of McGrath'
   - on rare occasion I would see a king salmon in the Takotna. The very few seen over 10 years were in 4th of July Creek. About the same for dog salmon [*Pete was suprized at the number of fish being seen at Takotna Tower*]
   - I may have seen one coho salmon in the Takotna in 10 years
   - People use to use fish traps on the Takotna way back in the early 1900's.
   - Lots of beaver dams in 4th of July Creek.
   - South Fork Kusko use to have lots of king salmon back in the early 70's, not any more. Since the 80's kings have been much reduced.
   - Hoholitna (have a guide camp there) does not have any late run of chum salmon, but there is a very late run of bright silvers. Otters bring them up through the ice. Lots of silvers and chum spawn in the first 80 miles of the Hoho. 1996 was especially strong. Coho all over the place and thick.
   - Tatlawiksuk River (have a cabin there and have floated entire river) has lots of coho salmon. Lots of chums in the lower portion of the river. Good run of kings too. Lots of bears - brown bears.
   - Natives use to do a lot of netting at the mouths of all these rivers.
   - The lower Takotna and Holitna were heavily logged back in the early 1900's in order to feed the steam ships. All along the main Kuskokwim too. Nearly all of the trees are second growth. Head waters of stream did not get touched by loggers much.

- Gregory family were big cutters of wood for steam ships. [related to Big Senka - the legend - and Athempka and Wasillie at Swift Fork - the guys that run the lumber mill at Big Senka's near the Tatlawiksuk River]
- A trader named Shepard (same spelling) use to supply a lot of the fish for Innoko miners. His records, if you can find them, may give some clues as to fish being caught in the Takotna. He probably served as the middle man buying fish and reselling them to the miners
- Winters on the Tatlawiksuk and Hoholitna R.

5) Dick Bishop, ADF&G Game Bio. in McGrath (1969 - 1971) recalled stories that people use to fish above the T (Nixon Fork confluence) for kings a long time ago.
   - Villagers - they fished.
   - see Kusko Times

Appendix B. ADF&G 1994 trip report regarding genetic stock identification sampling in the Kuskokwim Area.

D.B. MOLYNEAUX

Kuskokwim River Chum Salmon GSI Sampling Trip
July 26 to August 5, 1994.

David Sarafin
ADF&G, Genetics, Anchorage
October, 1994

A special trip was conducted during the 1994 field season to collect genetic tissue samples from chum salmon populations of the Kuskokwim River drainage. A total of 8 spawning populations were sampled on this trip from systems throughout the drainage (Figure 1.). Provided is a summary of these tissue collections made by myself and chartered helicopter pilot Jonathan Larrivee, July 26 through August 5.

All sampling was conducted by one two-person crew. Access to all locations was by helicopter (Robinson R22). Sampling and scouting was conducted as day trips from McGrath or Bethel which functioned as operational bases for the project. The initial step at each location involved scouting for spawning chum salmon and suitable sampling sites. On finding areas for sampling, spawning fish were captured primarily by 30-60 ft. beach seine, occasionally by spear. A desired sample size of 100 individuals (minimum of 70) was the goal for each collection. Tissues were obtained using standard GSI sampling techniques, preserved on site by freezing on dry ice, and then stored in liquid nitrogen until received by the Genetics Lab in Anchorage.

Of the 8 populations sampled, six of these collections were complete to the desired 100/70 fish goal, another consists of 58, and one of 10 (Table 1.). In addition, notes were recorded on flight routes and chum abundance within sampled and non-sampled drainages (Table 2., for additional information contact D.Sarafin).

The trip began in McGrath where we used the State Forestry camp as an operational base. The initial trip involved perimeter scouting of several systems that were within the helicopter's ideal range. Subsequent trips combined scouting and sampling. In scouting surveys the waters seemed high and often turbid. On some trips this combined with poor lighting to limit scouting and sampling opportunities. However, these factors were probably not to the extent to exclude significant spawning populations from showing in our surveys. Overall, spawning populations were widespread and difficult to locate. Nearly all possible chum streams were surveyed in the local McGrath area. At the time of our scouting trips there were, and had been, significant subsistence chum catches in the McGrath area. This suggests the possibility of significant chum spawning occurring in the turbid waters throughout the main Kuskokwim or further up in the headwaters beyond the range of our surveys.

After sampling 4 populations from the McGrath base, a move was made to Bethel. The Oskawalik River was sampled en route. During this sampling, heavy rains caused the water level to rise beyond our workable level while we were actually on site. A total of 58 fish were sampled prior to aborting efforts.

Once in Bethel, a scouting trip was flown to observe the Kisaralik, Kasigluk, Kwethluk, and Eek Rivers. Samples were obtained from the Kisaralik, Kasigluk, and Kwethluk. The sampling location on the Kisaralik had the densest concentration of chum observed on the trip. As time and budget funds neared the limits for the project, only a short stretch (approx.14 miles) of the mid-upper Eek River was flown; there were many sockeye spawners but no definite sightings of chum.

This years trip provided the first opportunity to get a close look at several remote Kuskokwim tributaries. The attempt was to scout as much possible chum spawning area as possible, yet still obtain GSI collections. The use of the Robinson helicopter proved to be a successful and relatively economically feasible method for both of these purposes. Suggestions for similiar trips in the future include: targeting fall spawners to compare to those of mid-summer; increasing the emphasis on scouting with longer range flights to search the upper Kuskokwim headwaters (this could likely be combined with a fall trip); scouting and sampling various mid-river drainages (basing from Aniak?); or sampling other known populations (Eek River would likely be quite feasible).

Table 1. GSI Tissue Collections Obtained.

POPULATION	N	DATE	GPS COORDINATES
Nunsatuk River	96	7/29,31	N62 17.77' W156 16.63' N62 18.25' W156 41.55'
Fourth of July Cr., Takotna River	100	7/30	N62 46.31' W156 36.61'
Talawiksuk River	100	7/31	N62 18.25' W156 18.61'
Selatna River	10	8/2	N62 25.80' W155 37.84'
Oskawalik River	58	8/3	N61 43.09' W158 01.42'
Kwethluk River	100	8/4	N60 24.92' W161 06.74'
Kisaralik River	100	8/5	N60 45.66' W160 35.03'
Kasigluk River	70	8/5	N60 46.98' W160 46.94'

Table 2. 1994 Chum Spawning Ground Scouting/Surveying Observations.

Drainage	Date	Fish Obs'd.	Area Surveyed	Comments
North Fork Kusko.	7/28	0	20mi.	searched from Soda Cr. to Hardscrabble Cr. Water muddy brown, 0 vis.
Soda Cr.	7/28	20 K	lower 1/2	20 Kings.
East Fork Kusko.	7/28	0	15mi.	Tonzana R. to Jones Cr. glacial gray-brown water, 0 vis.
Slow Fork	7/28	0	5mi.	above Tonzana R. Mud bottom, muddy brown water.
Jones Cr.	7/28	0	3mi.	up from mouth.
South Fork Kusko.	7/28	0	crossed	Gray/brown, 0 vis.
Little Tonzana R.	7/28	0	3mi.	Semi-clear but slightly murky.
Middle Fork	7/28	K	22mi.	Several kings late in spawn. 0 chum. Semi-murky.
Salmon River	7/28	K	7mi.	Several kings.
Pitka Fork	7/28	0	4mi.	Murky.
Big River	7/28		crossed	Murky water, 0 vis.
unnamed Trib.	7/28	30K	3mi.	Beaver dams. Kings.
Blackwater Creek	8/1	0	3mi.	Muddy, poor light conditions, little flow.
Crooked Creek	8/1	0	5mi.	Low flow slough.
Nixon Fork	7/28	4 CH	15mi.	water slightly brownish, decent
Nixon Fork	8/1	0	25mi.	Mouth to W.Fork and Mystery Cr. to headwaters. visibility.
John Reek Cr.	7/30	0	2mi.	
Ivy Cr.	7/30	0	2mi.	
Broken Snowshoe	7/30	0	2mi.	
West Fork	8/1	0	12mi.	Muddy, high water, poor vis.
Washington Cr.	8/1	0	crossed	
Takotna River	7/30	20 CH 2K	50mi.	
Fourth July Cr.	7/30	5-8000 CH,K	20mi.	Few Chum in lower river, most were in a 2 mi. stretch mid river. Some kings, mostly in lower river. While sampling, easily caught 100 chum within 100 ft. stretch of stream.
Moore Cr.	7/30	30 CH	15mi.	Midway up river.
Big Waldren Fork	7/30	0		Clear water, brown bottom.
Big Creek	7/30	0		

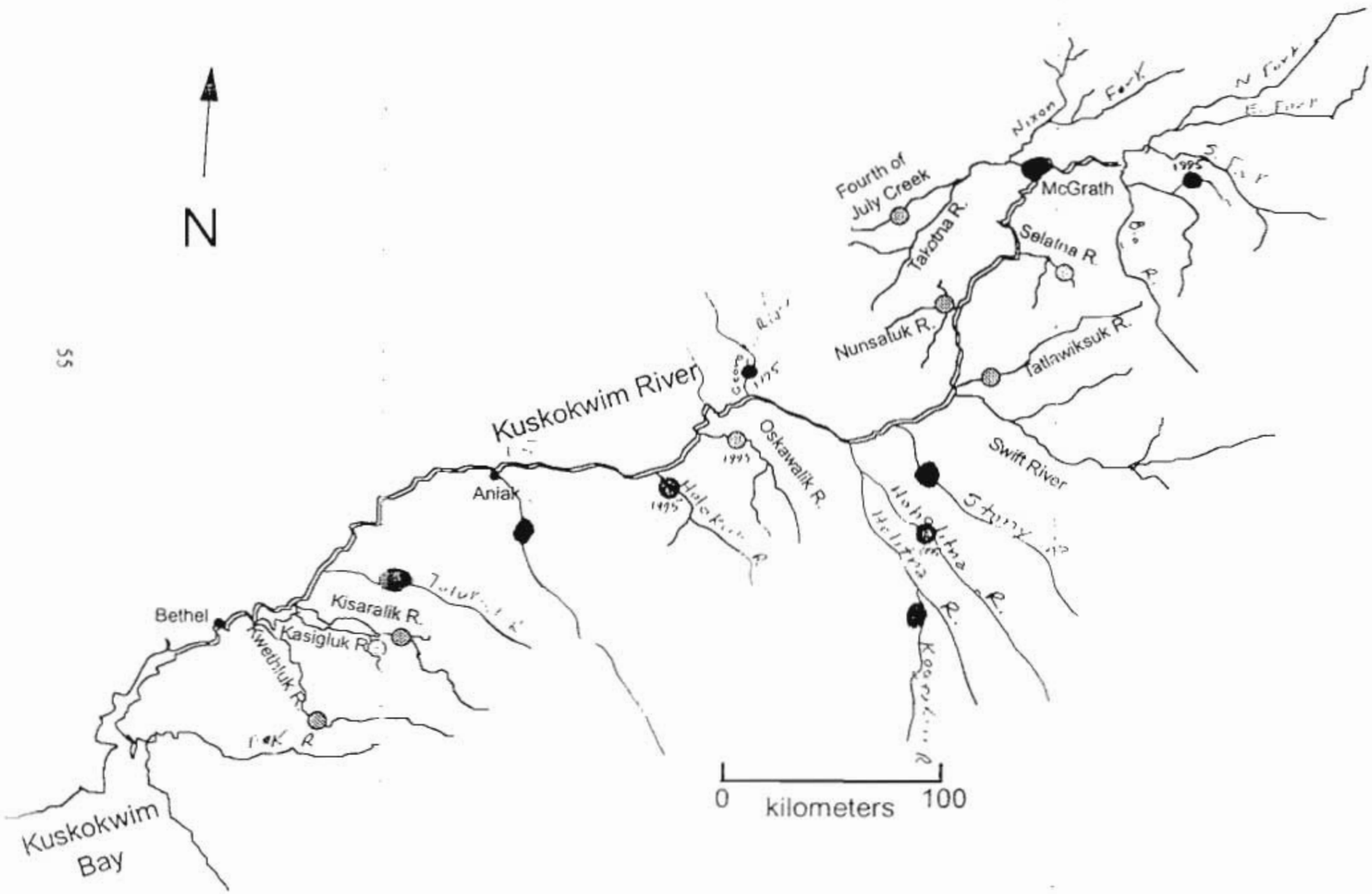
Table 2. 1994 Chum Spawning Ground Scouting/Surveying Observations. cont'd.

Drainage	Date	Fish Obs'd.	Area Surveyed	Comments
Tatalina River	7/30	0	9mi.	Fair vis., brown bottom.
Katlitna River	7/28	0	20mi.	Brown water, 0 vis.
Black River	7/29	0	5mi.	Fair vis., mud-brown.
Selatna River	7/31	7000 CH	15mi.	Chums count 50% morts.
Selatna River	8/2		18mi.	Low light conds. water high, slightly muddy, poor vis.
First Fork	7/31	1 CH		
Nunsatuk River	7/29	2000 CH	8mi.	Saw fish in NW fork of stream. Late in spawn. Clear water, brown bottom.
	7/31	2000 CH	8mi.	Saw fish in NW fork of stream. Late in spawn. Clear water, brown bottom.
Rohn River	7/29	0	5 mi.	
Tatlawiksuk River	7/29	10000 CH	6 mi.	Lower river stretch. several thousand chum very late in spawn. Semi-clear, brown bottom.
	7/31	20,000 CH	15mi.	Lots of morts. Rough estimate of 20-40,000 in river.
Swift River	7/29	2 CH	5mi.	Mostly murky, limited vis. 2 chum below Gagaryah. Very murky near mouth.
Cheeneetnuk R.	7/29	CH,K	7mi.	Several kings, few chum. Clear water.
Gagaryah R.	7/29	8 CH,K	7mi.	Several kings, 8 chum.
Fuller Creek	8/3	CH	5mi.	Near Red Devil. Saw a few dead chum, no live ones.
Oskawalik River	8/3	CH	50mi.	Many thousand chum morts in upper waters, very few still kicking. Found a few groups (2-600) of fresher spawners lower in river, 7mi up from mouth. Water quite high, muddy.
Holokuk River	8/3	0	1mi.	Very poor light conds.

Table 2. 1994 Chum Spawning Ground Scouting/Surveying Observations. cont'd.

Drainage	Date	Fish Obs'd.	Area Surveyed	Comments
Kisaralik River	8/4	10000 CH	25mi.	Chum concentrated in one 2mi. area about 20 mi. up river.
Kasigluk River	8/4	300 CH	20mi.	Very few chum and kings in upper waters. 300 chum near and within 2mi. of inflow from Kisaralik R. High water, poor vis.
Kwethluk River	8/4	5000 CH S	30mi.	5000 chum in 2mi. stretch downstream of Elbow Mtn. Some chum and reds upstream.
Eek River	8/4	S,CH	14mi.	Sockeye spawning in river. Possibly very few chum.

Figu Map of Kuskokwim Chum Salmon GSI Sa e Locations
of July-August Helicopter Sampling Trip, 1994.



Appendix C. ADF&G 1997 trip report regarding surveys for weir installation sites on the Takotna River at the tower site and downstream of the counting tower.

State of Alaska
Department of Fish and Game
Commercial Fisheries Management and Development Division
Memorandum

TO: Douglas B. Molyneaux
Kuskokwim Area Research Biologist
CFMD / Anchorage

DATE: December 3, 1997

FILE: TAKTRIP.DOC

PHONE: 267-2386

FROM: Larry DuBois
Fisheries Biologist
CFMD / Anchorage

SUBJECT: Takotna River
Weir Survey

This memo describes two potential weir sites located on the Takotna River, downstream of the village of Takotna. I was stationed in Takotna from June 23 until July 11 to oversee the third year of operation of the Takotna River Counting Tower. When I arrived the water level was low and dropped during my visit. When I departed the water was extremely low. Below average water levels allowed counting operations to continue nonstop throughout the 1997 season. In a normal season counting operations are halted when the water level and turbidity increases.

On June 25, Terry Huffman drove me downstream 25 miles, to familiarize me with the channel. Since the Takotna River is shallow with numerous sandbars, outboard motors equipped with jet drives are commonly used. A brush pile located 25 miles downstream of Takotna (1'15" travel time) is the upstream limit for outboards equipped with props. The objective was to find a weir site as close to McGrath (50 miles downstream, 2'30" travel time) as possible. The thought was to stage out of McGrath and find a weir site below the confluence with the Nixon Fork (see map Attachment 1). After a survey of the lower river I agreed with Mr. Huffman that the best sites would be located closer to Takotna. The lower river above the Nixon Fork is slow and deep with mud banks. The river below the Nixon Fork is influenced by the level of the Kuskokwim River as well as being unsuitable for a weir site due to depth, velocity, water clarity, and substrate type. On the return upstream I noted a dozen sites that looked promising with gravel showing on both banks, all of them being within 12 river miles of Takotna. Mr. Huffman reported that a weir located at Gallickson Creek would be accessible by ATV from Takotna.

I ruled out the present tower site as a viable weir site. The counting tower is located opposite the village of Takotna on a 10 ft high cut bank of the south channel. overlooking the main channel of the Takotna River. A discharge of 619 ft^3/sec was calculated on July 27 for both channels of the Takotna River (Attachment 2). A weir at the tower site would require the shallow north channel to be weired, as well as the south channel. The maximum velocity in the south channel is high at 4.37ft/sec, even with a low water level. During counting tower operations in 1995 and 1996, it was found that the south channel rises quickly after a rain and becomes turbid halting counting operations.

During the next two weeks I conducted several trips downstream of Takotna to find the best sites for a weir. Since the water level was very low, and I was able to wade across and examine many sites. I used the Takotna Community School boat, an 18 ft flat bottom river boat with a 40hp Yamaha jetdrive. Any potential site with water depth over 2.5 ft I ruled out. Two sites are identified here as suitable locations for a weir.

Site 1 is located four river miles downstream from Takotna, at the end of a wide bend. Maximum depth is 1.76 ft, maximum velocity is 2.02 ft/sec, width is 211 ft, and a discharge of 366.2 ft^3/sec was calculated (Attachment 3). Substrate is small to medium sized gravel. The site is only 1.5 air miles from Takotna and ATV access is feasible.

Site 2 is located upstream from the mouth of Galickson Creek approximately 10 river miles downstream from Takotna. It is again located near the end of a wide bend. Although a discharge was not calculated for this location several point velocity measurements are reported. Maximum depth is 2.35 ft, maximum velocity is 1.51 ft/sec, and width is 170 ft (Attachment 3). Substrate is similar to site 1. Note that the horizontal scale on this river profile chart is not proportional to the distance from the bank.

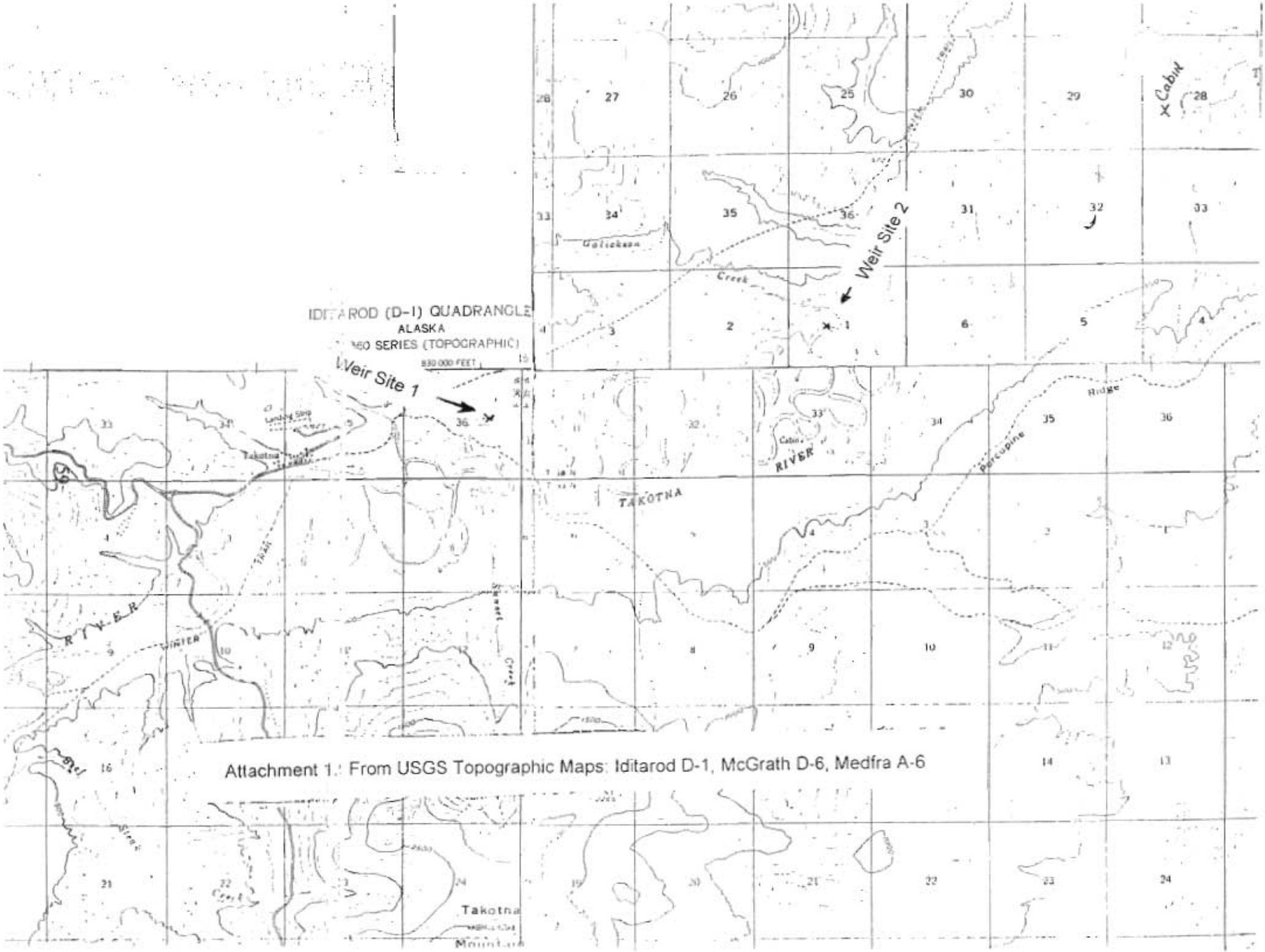
It can be seen by comparing the two river profile charts that site 2 has the more uniform depth across the channel. Both sites have similar substrate types, areas for camp, potential ATV access, and a shallow gravel slope on one bank. Site 1 is 40 ft wider which may be an advantage when the water rises. Since site 1 was surveyed 10 days after site 2, and the river level dropped during this time frame, water depths and channel widths are not precisely comparable.

There are sawmills located in both Takotna and McGrath. A road connects Takotna with Sterling Landing on the Kuskokwim River (11 river miles below McGrath). Takotna has an 1100 ft runway with plans for expansion. A road (or at least ATV access) with either site would facilitate staffing and logistic support from the village of Takotna. The people of Takotna have been very supportive of the counting tower project and have expressed interest in a weir. One advantage of a weir would be increasing operational time during high water and turbid conditions. Given the scarcity of appropriate sites for fishery monitoring projects in the upper Kuskokwim River drainage, continuation of the counting tower or replacing it with a weir may prove useful to fishery managers.

Additional samples collected include general and heavy metal water samples from the Takotna River, Fourth of July Creek, and Tatalina River. Also, seven benthic macroinvetebrate samples were collected from the Takotna River and two from Fourth of July Creek.

I wish to thank Gene Avery, Principal of Takotna Community School and Training Center, for his hospitality and use of the school facilities. Steve Howe, crewleader for the tower project, assisted with surveys and assured tower operations ran smoothly. Terry Huffman, who has assisted with the tower project since the start, shared his knowledge of the river and provided logistical support.

cc: Avery (TCSTC), Burkey, Cappiello, Menard



Attachment 1: From USGS Topographic Maps: Iditarod D-1, McGrath D-6, Medfra A-6

Attachment 2

Takotna River (south and north channels combined) 619.1 ft^3/s

DISCHARGE

File No. 97TAK Page 1 of 2
Crew L. DuBois, S. Howe Date June 27, 1997
Habitat Sampling South Channel, River Meter
Location S34N36W35CD Site Takotna River Mile 50 Type Price AA No.
HUC 19030403 Gage Number Height 3.25 inches
Description South channel Takotna River at Takotna, 10 ft upstream of counting panels, head pin LB.
Weather Wind 10-15 from E, water temp 16.2°C, 1500 hrs, clear

Distance from Head Pin (ft.) LB	RB	Angle	Angle Coef.	Vel Depth (ft.)	Stream bed Elev.	Obs. Depth %	No. Revo-lutions	Time (sec)	Velocity fps Point	Mean Vertical	Mean Cell	Mean Cell Depth (ft.)	Cell Width (ft.)	Cell Area (ft^2)	Flow (ft^3/s)
0				0.00					0.000						
3			1	0.10					0.144	(est.)	0.07	0.05	3	0.2	0.0
7			1	0.15					0.201	(est.)	0.17	0.13	4	0.5	0.1
11			1	0.28					0.431	(est.)	0.32	0.22	4	0.9	0.3
15			1	0.41		0.6	15	59	0.574		0.50	0.35	4	1.4	0.7
19			1	0.45		0.6	20	45	0.989		0.78	0.43	4	1.7	1.3
23			1	0.40		0.6	20	43	1.034		1.01	0.43	4	1.7	1.7
27			1	1.05		0.6	30	42	1.577		1.31	0.73	4	2.9	3.8
31			1	0.80		0.6	40	51	1.732		1.65	0.93	4	3.7	6.1
35	15	0.966	0.45			0.6	40	40	2.200		1.97	0.63	4	2.5	4.7
39	10	0.985	0.70			0.6	48	50	2.113		2.16	0.58	4	2.3	4.9
43	5	0.996	1.00			0.6	60	41	3.206		2.66	0.85	4	3.4	9.0
47	2.5	0.999	1.30			0.6	60	41	3.206		3.21	1.15	4	4.6	14.7
51	2.5	0.999	1.30			0.6	60	41	3.206		3.21	1.30	4	5.2	16.7
55			1	1.40		0.6	60	44	2.989		3.10	1.35	4	5.4	16.7
59			1	1.30		0.6	60	53	3.305		3.15	1.35	4	5.4	17.0
63			1	1.40		0.6	60	53	3.305		3.31	1.35	4	5.4	17.8
67			1	1.50		0.6	60	39.5	3.326		3.32	1.45	4	5.8	19.2
71			1	1.55		0.6	60	45	3.888		3.61	1.53	4	6.1	22.0
75			1	1.65		0.6	60	47	3.724		3.81	1.60	4	6.4	24.4
79	5	0.996	1.60			0.6	60	44	3.975		3.85	1.63	4	6.5	24.9
83			1	1.68		0.6	60	47	3.724		3.85	1.64	4	6.6	25.3
87			1	1.75		0.6	60	46	3.804		3.76	1.72	4	6.9	25.8
91			1	1.80		0.6	60	44	3.975		3.89	1.78	4	7.1	27.6
95			1	1.95		0.6	60	42	4.163		4.07	1.88	4	7.5	30.5
99	2.5	0.999	2.12			0.6	60	45	3.888		4.03	2.04	4	8.1	32.7
103	2.5	0.999	2.02			0.6	60	42	4.163		4.09	2.07	4	8.3	33.3
107	2.5	0.999	2.08			0.6	100	60	4.370		4.27	2.09	4	8.2	35.0
111	5	0.996	2.05			0.6	80	43	4.067		4.22	2.07	4	8.3	34.7
115	5	0.996	1.93			0.6	80	46	3.804		3.94	1.99	4	8.0	31.2
119			1	1.50		0.6	80	50	3.502		3.65	1.72	4	6.9	25.1
127			1	0.80		0.6	30	46	1.442		2.47	1.15	8	9.2	22.7
130			1	0.65		0.6	30	41	1.615		1.53	0.73	3	2.2	3.3
131.5			1	0.00					0.000	(est.)	0.81	0.33	1.5	0.5	0.4

Depth		Velocity			
Average	1.47 ft	Average	3.31 ft/sec	South Channel, Takotna River	533.8
Maximum	2.12 ft	Maximum	4.37 ft/sec		

Notes: Average depth and average velocity are calculated using data from 27 ft through 127 ft, which is approximately 76 percent of stream width. Estimates for a given row apply to point velocity, mean cell velocity, and flow.

akotna River (cont.)

DISCHARGE
AH-81-04

File No. 97TAK — Page 2 of 2
Crew L. DuBois — Date June 27, 1997
Habitat — Sampling — North Channel, — River — Meter
Location S34N36W35CD — Site Takotna River — Mile 50 — Type Price AA — No.
HUC 19030403 — Gage Number — Height
Description North channel Takotna River at Takotna, 5 ft upstream of weir. Head pin LB.
Weather Wind 10-15 from E, 1700 hrs, clear

Distance from Head Pin (ft) LB	RB	Angle	Angle Coef.	Vel Depth (ft.)	Stream bed Elev.	Obs. Depth %	No. Revo-lutions	Time (sec)	Velocity fps Point	Mean Vertical	Mean Cell	Mean Cell Depth (ft.)	Cell Width (ft.)	Cell Area (ft^2)	Flow (ft^3/s)
0				0.00					0.000						
3.25			1	0.85		0.6	30	47	1.411	(est.)	0.71	0.43	3.25	1.4	1.0
6			1	1.18		0.6	30	39.5	1.676		1.54	1.02	2.75	2.8	4.3
9			1	1.15		0.6	30	46	1.442		1.56	1.17	3	3.5	5.4
12		5	0.9962	0.96		0.6	30	44	1.506		1.47	1.06	3	3.2	4.6
15			1	1.14		0.6	30	43	1.541		1.52	1.05	3	3.2	4.8
18		2.5	0.999	1.07		0.6	30	40.5	1.635		1.59	1.11	3	3.3	5.3
21		2.5	0.999	1.12		0.6	25	42	1.318		1.48	1.10	3	3.3	4.8
24			1	1.12		0.6	20	48	0.928		1.12	1.12	3	3.4	3.8
27			1	1.31		0.6	25	46	1.205		1.07	1.22	3	3.6	3.9
30			1	1.19		0.6	30	42	1.577		1.39	1.25	3	3.8	5.2
33			1	1.11		0.6	30	45	1.473		1.53	1.15	3	3.5	5.3
36			1	1.05		0.6	30	40	1.655		1.56	1.08	3	3.2	5.1
39			1	1.04		0.6	30	45	1.473		1.56	1.05	3	3.1	4.9
42			1	1.01		0.6	40	49	1.801		1.64	1.03	3	3.1	5.0
45			1	1.11		0.6	40	51	1.732		1.77	1.06	3	3.2	5.6
48			1	0.95		0.6	30	43	1.541		1.64	1.03	3	3.1	5.1
51			1	0.70		0.6	20	42	1.058		1.30	0.83	3	2.5	3.2
54			1	0.65		0.6	30	44	1.506		1.28	0.68	3	2.0	2.6
57			1	0.60		0.6	20	43	1.034		1.27	0.63	3	1.9	2.4
60			1	0.52		0.6	20	46	0.968		1.00	0.56	3	1.7	1.7
63			1	0.40		0.6	15	59	0.574		0.77	0.46	3	1.4	1.1
66			1	0.10					0.144	(est.)	0.36	0.25	3	0.8	0.3
67			1	0.00					0.000	(est.)	0.07	0.05	1	0.1	0.0

Depth — Average 0.99 ft — Maximum 1.31 ft
Velocity — Average 1.42 ft/sec — Maximum 1.80 ft/sec
North Channel, Takotna River 85.3

Notes: Average depth and average velocity are calculated using data from 3.25 ft through 60 ft, which is approximately 85 percent of stream width. Estimates for a given row apply to point velocity, mean cell velocity, and flow.

Attachment 3

Takotna River Discharge (weir site 1) 366.2 ft^3/sec

DISCHARGE
AH-81-04

File No. 97TAKWR1 Page 1 of 1
Crew L. DuBois Date 7/10/97
Habitat Sampling Weir Site 1, River Meter
Location S34N36W36DB Site Takotna River Mile 46 Type Price AA No.
HUC 19030403 Gage Number Height 1.0 in

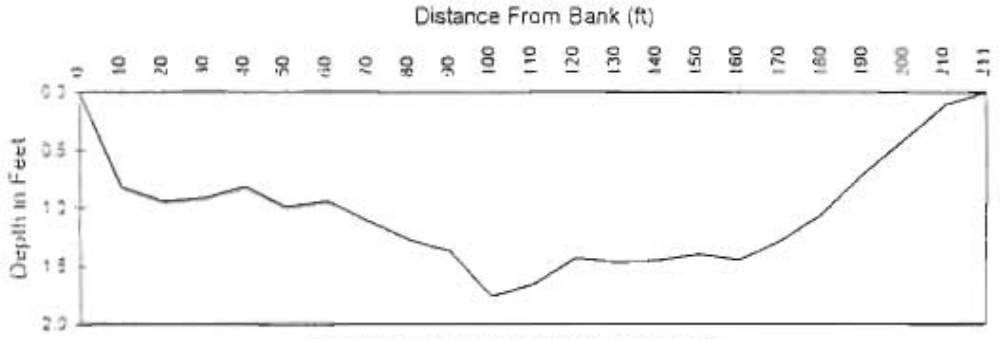
Description Number one weir site 4 river miles downstream from Takotna. Site is located on a north bend 1.5 air miles from Takotna. Several transects were done to find the one measured. 'Best' transect is near the end of wide bend, upstream of a wide channel (250-300 ft) with riffles and gravel bars. Area can be reached by ATV from town. Left bank is 8 ft cut bank, downstream and upstream are areas of gravel (20-30° slope), alternating with cutbanks. Right bank is an inside gravel bend with 50 ft of exposed gravel (5° slope). Takotna River is at extreme low water.

Weather Clear, calm, air 20°C, water 17.5°C.

Distance from Head Pin (ft.) LB	RB	Angle	Angle Coef.	Vel Depth (ft.)	Stream bed Elev.	Obs. Depth %	No. Revo-lutions	Time (sec)	Velocity fps Point	Mean Vertical	Mean Cell	Mean Cell Depth (ft.)	Cell Width (ft.)	Cell Area (ft^2)	Flow (ft^3/s)
0				0.00					0.000						
10			1	0.83		0.6	20	48	0.928	(est.)	0.46	0.42	10	4.2	1.9
20			1	0.95		0.6	20	49	0.910		0.92	0.89	10	8.9	8.2
30		2.5	0.999	0.92		0.6	20	41	1.083		1.00	0.94	10	9.4	9.3
40		15	0.966	0.82		0.6	20	37.5	1.183		1.13	0.87	10	8.7	9.5
50		7.5	0.991	1.00		0.6	30	47	1.411		1.30	0.91	10	9.1	11.7
60		15	0.966	0.95		0.6	30	42.5	1.559		1.49	0.98	10	9.8	14.0
70		10	0.985	1.12		0.6	40	47	1.877		1.72	1.04	10	10.4	17.5
80		5	0.996	1.28		0.6	35	45	1.716		1.80	1.20	10	12.0	21.5
90		5	0.996	1.38		0.6	45	49	2.023		1.87	1.33	10	13.3	24.8
100		5	0.996	1.76		0.6	40	47.5	1.857		1.94	1.57	10	15.7	30.3
110			1	1.65		0.6	35	40	1.928		1.89	1.71	10	17.1	32.3
120			1	1.43		0.6	40	45	1.959		1.94	1.54	10	15.4	29.9
130			1	1.47		0.6	35	42	1.837		1.90	1.45	10	14.5	27.5
140			1	1.45		0.6	30	40	1.655		1.75	1.46	10	14.6	25.5
150		5	0.996	1.40		0.6	35	47	1.643		1.65	1.43	10	14.3	23.4
160			1	1.45		0.6	30	40	1.655		1.65	1.43	10	14.3	23.5
170			1	1.28		0.6	30	44	1.506		1.58	1.37	10	13.7	21.6
180			1	1.05		0.6	25	40.5	1.366		1.44	1.17	10	11.7	16.7
190			1	0.71		0.6	22	46	1.063		1.21	0.88	10	8.8	10.7
200			1	0.41		0.6	15	44	0.763		0.91	0.56	10	5.6	5.1
210			1	0.10		0.6			0.191	(est.)	0.48	0.26	10	2.6	1.2
211			1	0.00					0.000	(est.)	0.10	0.05	1	0.1	0.0

Depth		Velocity		Takotna River	366.2
Average	1.23 ft	Average	1.56 ft/sec		
Maximum	1.76 ft	Maximum	2.02 ft/sec		

Notes: Average depth and average velocity are calculated using data from 10 ft through 180 ft, which is approximately 81 percent of stream width. Estimates for a given row apply to point velocity, mean cell velocity, and flow.



Takotna River Profile (Weir Site 1)

Takotna River (weir site 2, Galickson Creek)

DISCHARGE
AH-81-04

File No. 97TAKWR2 Page 1 of 1
Crew L. DuBois, S. Howe Date 6/29/97
Habitat Sampling Galickson Creek, River Meter
Location K26S15E01CB Site Takotna River Mile 40 Type Price A No.
HUC 19030403 Gage Number Height

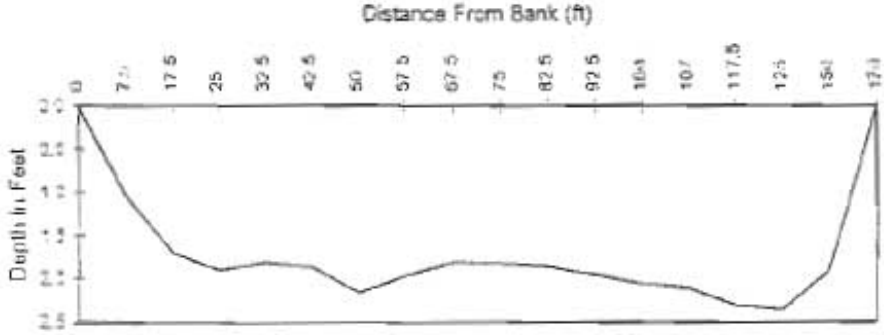
Description Upstream 1/4 mile from Galickson Creek mouth, on a northerly bend 4 air miles downstream from Takotna. Reported as probable ATV access from village. Identified as good weir site by T. Huffman, during survey from village of Takotna downstream to Nixon Fork. Located near downstream end of a wide bend. Six transects were done in this immediate area; upstream of transect the channel is 2.5-3.5 ft deep. About 100 ft downstream of this transect is a gravel bar in midstream; 1/4 mile downstream the river widens to 250-325 ft with riffles and gravelbars. Right bank (south) consists of 40 ft of gravel and sand (gradient < 5°), then willows. North bank is a 7.5 ft cut bank with mixture of small spruce, birch, alders and brush. North bank upstream of transect is 75 ft of cut bank (5 ft high) with 20 ft of moderately sloping (10-20°) gravel. Upstream of of this is a 50 ft section of cut bank, then another 250 ft length of cut bank (5 ft high) with 10 ft of steeply sloping (30°) exposed gravel. Four photographs were taken. Substrate Classes: 3 & 4 - 20% ; 5 - 70%; 6 - 10%. Embeddedness - 2; Percent vegetation - 0. Excellent camp sites on north bank. Relative river level at 10-year low.

Weather Ptly sunny, air 21°C (est.), water 18°C (est.), wind 0-5, 1700 hrs.

Distance from Head Pin (ft.) LB RB	Angle	Angle Coef.	Vel Depth (ft.)	Stream-bed Elev.	Obs. Depth %	No. Revo-lutions	Time (sec)	Velocity fps Point	Velocity fps Mean Vertical	Velocity fps Mean Cell	Mean Cell Depth (ft.)	Cell Width (ft.)	Cell Area (ft^2)	Flow (ft^3/s)
0			0.00											
7.5		1	1.05											
17.5		1	1.70											
25		1	1.90			23	41	1.243						
32.5		1	1.80											
42.5		1	1.85											
50		1	2.15			23	42	1.214						
57.5		1	1.95											
67.5		1	1.80											
75		1	1.82			30	44	1.506						
82.5		1	1.85											
92.5		1	1.95											
100		1	2.05			30	45	1.473						
107		1	2.10											
117.5		1	2.30											
125		1	2.35			30	45	1.473						
150		1	1.90			21	44	1.060						
170		1	0.00											

Depth		Velocity	
Average	1.91 ft	Average	1.33 ft/sec
Maximum	2.35 ft	Maximum	1.51 ft/sec

Notes: Measurements were taken to provide a stream profile and indicate velocity; discharge calculations are not applicable. Average depth and average velocity are calculated using data from 7.5 ft through 150 ft, which is approximately 84 percent of stream width. Estimates for a given row apply to point velocity, mean cell velocity, and flow.



Takotna River Profile (Weir Site 2)

Appendix D. Climatological and hydrological observations, Takotna River, 1996.

Date	Avg. Water Temp °C		Avg. Air Temp °C		Avg. Water level (in)	
15-Jun	14.0		21.3			
16-Jun	15.0		19.0			
17-Jun	15.5	*	15.3			
18-Jun	16.0		15.0			
19-Jun	15.5	*	16.5	*		
20-Jun	15.0		18.0			
21-Jun	16.0	*	21.5	*		
22-Jun	17.0		25.0			
23-Jun	17.0	*	21.5	*		
24-Jun	17.0		17.9		24.0	
25-Jun	17.0		16.7		24.2	*
26-Jun	16.0		21.3		24.3	
27-Jun	16.3		18.4		25.0	
28-Jun	14.9		16.5		25.7	
29-Jun	16.0		18.3		27.4	
30-Jun	15.1	*	16.1		28.0	*
01-Jul	14.2		18.0		28.5	
02-Jul	15.2	*	20.0	*	26.9	*
03-Jul	16.2		22.0		25.3	
04-Jul	16.6		20.6		24.5	
05-Jul	17.8		20.3		24.3	
06-Jul	17.9		21.3		24.9	
07-Jul	18.2		22.8		24.3	
08-Jul	18.8		22.1		23.4	
09-Jul	18.0		17.6		24.0	
10-Jul	17.3		17.8		25.3	
11-Jul	17.2		18.2		27.0	
12-Jul	16.0	*	17.9	*	26.8	*
13-Jul	14.9		17.5		26.6	
14-Jul	14.3		16.0		26.7	
15-Jul	14.3		15.9		26.6	
16-Jul	15.3		16.3		27.0	
17-Jul	15.1		16.0		26.0	
18-Jul	15.3		16.0		25.9	
19-Jul	15.5		16.4		27.3	
20-Jul	16.7		15.8		29.2	
21-Jul	17.0	*	17.3	*	32.0	
22-Jul	17.4	*	19.2	*	31.0	
23-Jul	17.9	*	21.2	*	29.5	
24-Jul	18.0		21.7		27.3	
25-Jul	17.9		16.1		27.3	
26-Jul	14.5		12.4		28.5	
27-Jul					28.0	*
28-Jul					27.5	
29-Jul						
30-Jul						

* estimate

Appendix E. ADF&G 1999 trip report regarding surveys for weir installation sites on the Takotna River upstream of the counting tower.

State of Alaska
Department of Fish and Game
Commercial Fisheries Division
Memorandum

TO: Douglas B. Molyneaux
Kuskokwim Area Research Biologist
CF / Anchorage

DATE: January 4, 2000

FILE: TAKTRIP.DOC

PHONE: 267-2386

FROM: Larry DuBois
Fisheries Biologist
CF / Anchorage

SUBJECT: Takotna River Weir

This memo describes a weir site survey on the Takotna River conducted in July 1999. The people of Takotna have been supportive of the counting tower project (operational 1995-1997) and have expressed interest in replacing the tower with a weir. One advantage of a weir would be increasing operational time during high water and turbid conditions. Given the scarcity of appropriate sites for fishery monitoring projects in the upper Kuskokwim River drainage, replacing the counting tower with a weir may prove useful to fishery managers.

Residents of Takotna expressed views that installing a weir near the bridge would simplify access. Also, because the bridge is upstream of Takotna, boat traffic between McGrath and Takotna would be unaffected.

The Takotna River had high water during the first week of July 1999. When I arrived on 19 July the water level had decreased but was still above average. The weather was overcast with intermittent rain during most of my stay in Takotna.

A potential weir site was investigated just upstream of the bridge. The site is 3 mi (4.8 km) from the town of Takotna and 53 rm (rkm 85) from the confluence with the Kuskokwim River. The bridge is on an all weather road connecting Takotna with Sterling Landing (rm 490, rkm 789) on the Kuskokwim River (Attachment 1). The bridge site allows for convenient road access and minimal boat traffic. The site is at the lower end of a wide reach of riffles. This area is shallow and has been used for transporting large equipment that cannot be moved across the bridge. A discharge was done approximately 400 ft (131 m) upstream of the bridge (Attachment 2). Maximum depth was 2.31 ft (0.7 m), maximum velocity was 5.02 ft/sec (1.5 m/s), width was 237.5 ft (72.5 m), and a discharge of 1,232 ft^3/sec (34.9 m^3/s) was calculated. Substrate consists of small to medium sized cobble. Photo 1 shows a view of the discharge site from the left bank. The clear area on the right bank at the end point of the discharge transect is an overgrown trail. The right bank is a brushy mud bank approximately three feet in height. The left bank is

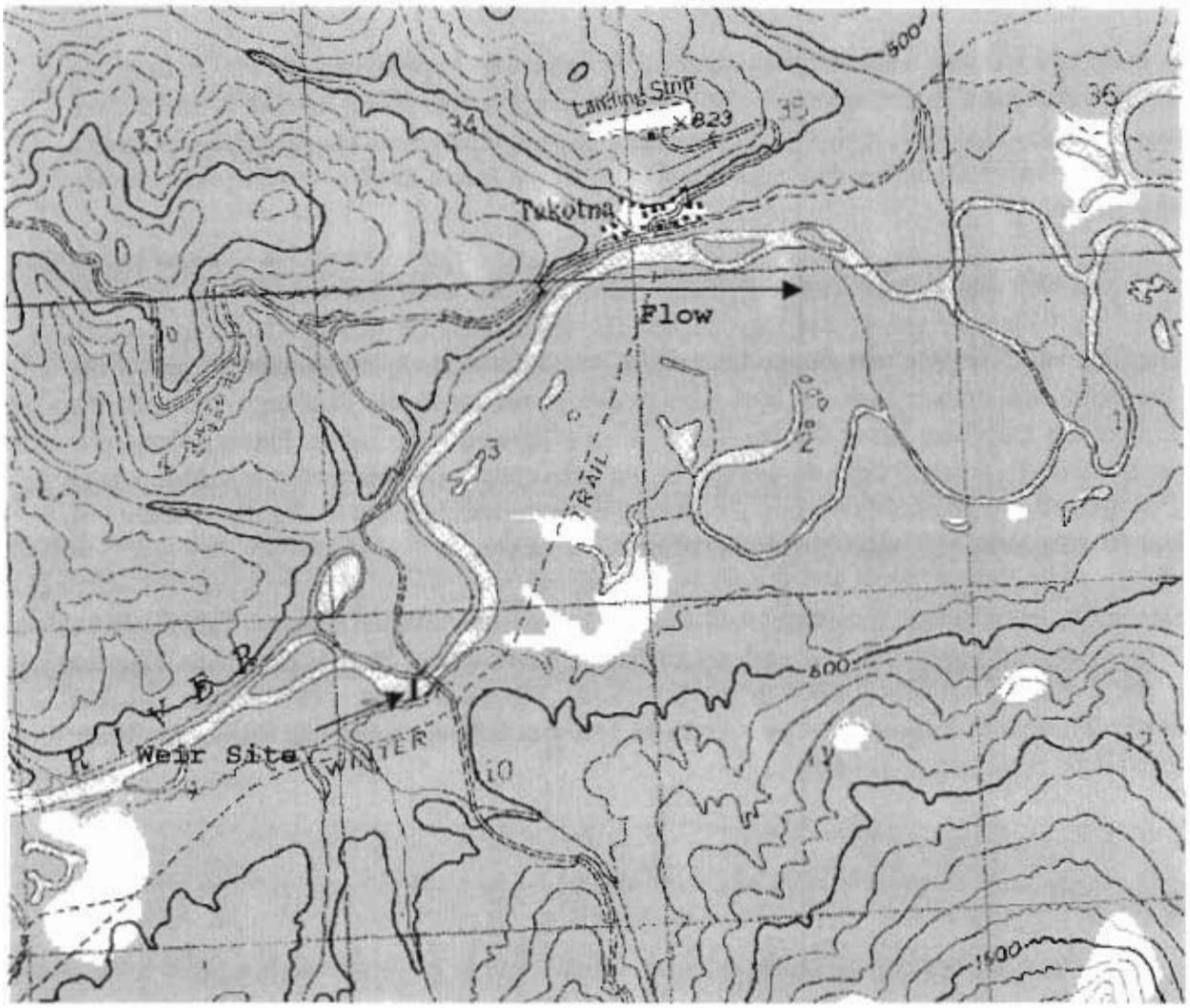
composed of medium and larger cobble and is adjacent to a rough access road (Photo 2). A view of the left bank taken from the bridge is shown in Photo 3.

At the discharge transect a submerged gravel bar is intersected approximately 100 ft from the right bank (Attachment 2). Decreasing water levels may expose this gravel bar and divide the site into two channels. Photo 4 is a view from upstream showing this gravel bar extending towards a stake placed at 140 ft along the discharge transect. A rough access road is visible just upstream from the bridge.

The preferred weir site is approximately 100 ft below the discharge transect in order to avoid complications which the gravel bar may cause. The exact location will be determined when installing the weir. This site was chosen by wading downstream along the submerged gravel bar until the depth was greater than 1.5 feet. The profile is similar to the discharge site with the exception of the gravel bar being deeper. The width is estimated to be 250 ft. Photo 5 shows the right bank viewed upstream from the bridge. In the left center a disturbed area is visible where heavy equipment was transported across the river. The preferred weir site is slightly upstream of this disturbed area near the partially submerged logs.

Several options are available for transport of weir materials and logistical support. Takotna has a short gravel airstrip serviced by several air carriers. River travel from McGrath to Takotna during the summer is usually limited to jet-drive boats. An all-weather road connects Takotna with Sterling Landing (Kuskokwim River, mile 490). About halfway along this road is a military controlled 4000 ft runway at Tatalina.

Attachments



Attachment 1. Takotna area, Kuskokwim River drainage, showing weir site (from USGS Iditarod D-1)

Attachment 2

Takotna River Discharge

Page: 1 of 1

Crew: L. DuBois

Date: 7/21/99

GPS Coordinates: N62°58'05.6" W156°05'37.2"

Sampling Site: Upstream of Bridge Takotna River

River Mile: 53

Meter Type: Price AA

Description: Transect is approximately 400 ft upstream of the bridge and 2.8 road miles from village of Takotna. Left bank is head pin when facing downstream. Left bank consists of 38 ft of small to medium cobble with < 5° slope and adjacent to a rough access road. Right bank consists of mud and silt with approximately 30° slope and 3 ft in height. Both banks are covered with willows and shrubs.

During this transcect maximum depth at tower site was approximately 3.2 ft (relative water level above average). Discharge during low water on 6/27/97 was 619 ft³/sec with a maximum depth at the tower site of 2.12 ft.

Weather: Air 16°C, water 17.8°C, 1700 hrs, 100% cloud cover, wind S @ 10.

Distance from Head Pin (ft.) LB RB	Angle	Angle Coef.	Vel Depth (ft.)	Stream-bed Elev.	Obs. Depth %	No. Revo-lutions	Time (sec)	Velocity fps Point	Mean Vertical	Mean Cell	Mean Cell Depth (ft.)	Cell Width (ft.)	Cell Area (ft.²)	Flow (ft³/s)
0			0.00					0.000						
5		1	0.45					1.786	(est.)	0.89	0.23	5	1.1	1.0
10		1	0.75		0.9	55	40.5	2.977		2.38	0.60	5	3.0	7.1
20	15	0.9659	0.95		0.8	70	39	3.925		3.45	0.85	10	8.5	28.3
25		1	0.85					3.565	(est.)	3.75	0.90	5	4.5	16.9
30	15	0.9659	1.35		0.6	60	41	3.206		3.39	1.10	5	5.5	18.0
35		1	1.75		0.6			3.603	(est.)	3.40	1.55	5	7.8	26.4
40	20	0.9397	1.78		0.6	75	41	4.000		3.80	1.77	5	8.8	31.5
45		1	1.72		0.6			4.081	(est.)	4.04	1.75	5	8.8	35.4
50	15	0.9659	1.92		0.6	80	42	4.163		4.12	1.82	5	9.1	36.2
55		1	1.95		0.6			4.214	(est.)	4.19	1.94	5	9.7	40.5
60		1	1.95		0.6	80	41	4.264		4.24	1.95	5	9.8	41.3
65		1	1.88		0.6			4.500	(est.)	4.38	1.92	5	9.6	42.0
70		1	1.85		0.6	90	41.5	4.736		4.62	1.87	5	9.3	43.1
75		1	1.81		0.6			4.877	(est.)	4.81	1.83	5	9.2	44.0
80		1	1.65		0.6	100	43.5	5.019		4.95	1.73	5	8.7	42.8
85		1	1.60		0.6			4.877	(est.)	4.95	1.63	5	8.1	40.2
90		1	1.80		0.6	90	41.5	4.736		4.81	1.70	5	8.5	40.9
95		1	1.88		0.6			4.577	(est.)	4.66	1.84	5	9.2	42.8
100		1	2.02		0.6	90	44.5	4.419		4.50	1.95	5	9.8	43.9
105		1	2.08		0.6			4.549	(est.)	4.48	2.05	5	10.3	46.0
110		1	2.10		0.6	90	42	4.680		4.61	2.09	5	10.5	48.2
115		1	1.98		0.6			4.552	(est.)	4.62	2.04	5	10.2	47.1
120		1	1.80		0.6	80	39.5	4.425		4.49	1.89	5	9.5	42.4
125		1	1.55		0.6			4.178	(est.)	4.30	1.68	5	8.4	36.0
130		1	1.02		0.6	80	44.5	3.931		4.05	1.29	5	6.4	26.1
135		1	1.09		0.6			3.789	(est.)	3.86	1.06	5	5.3	20.4
140		1	0.90		0.6	70	42	3.647		3.72	1.00	5	5.0	18.5
145		1	0.71		0.6			2.814	(est.)	3.23	0.81	5	4.0	13.0
150		1	0.71		0.6	40	44.5	1.981		2.40	0.71	5	3.6	8.5
155		1	0.82		0.6			1.559	(est.)	1.77	0.77	5	3.8	6.8
160		1	0.95		0.6	21	41	1.137		1.35	0.89	5	4.4	6.0
165		1	1.12		0.6			1.014	(est.)	1.08	1.04	5	5.2	5.6
170		1	1.28		0.6	18	45	0.892		0.95	1.20	5	6.0	5.7
175		1	1.38		0.6			1.165	(est.)	1.03	1.33	5	6.7	6.8
180	15	0.9659	1.45		0.6	27	41.5	1.438		1.30	1.42	5	7.1	8.9
185		1	1.52		0.6			2.074	(est.)	1.76	1.49	5	7.4	13.0
190	20	0.9397	1.78		0.6	50	40.5	2.709		2.39	1.65	5	8.3	18.5
195		1	1.78		0.6			2.761	(est.)	2.73	1.78	5	8.9	24.3
200	25	0.9063	1.85		0.6	50	39	2.812		2.79	1.82	5	9.1	22.9
205		1	1.95		0.6			2.884	(est.)	2.85	1.90	5	9.5	27.1
210	10	0.9848	2.31		0.6	60	44.5	2.956		2.92	2.13	5	10.7	30.6
215		1	2.18		0.6			3.162	(est.)	3.06	2.25	5	11.2	34.3
220		1	1.70		0.6	60	39	3.368		3.27	1.94	5	9.7	31.7
225		1	1.80		0.6	70	40.5	3.781		3.57	1.75	5	8.8	31.3
230		1	1.35		0.6	50	51.5	2.137		2.96	1.58	5	7.9	23.3
235		1	1.10		0.6	0	40	0.020	(est.)	1.08	1.23	5	6.1	6.6
237.5			0.00						(est.)	0.01	0.55	2.5	1.4	0.0

Total Discharge (ft³/sec) **1,231.8**

Depth		Velocity	
Average	1.61 ft	Average	3.41 ft/sec
Maximum	2.31 ft	Maximum	5.02 ft/sec

Notes: Average depth and average velocity are calculated using data from 30 ft through 230 ft, which is approximately 84 percent of stream width.

Estimates for a given row apply to point velocity, mean cell velocity, and flow.

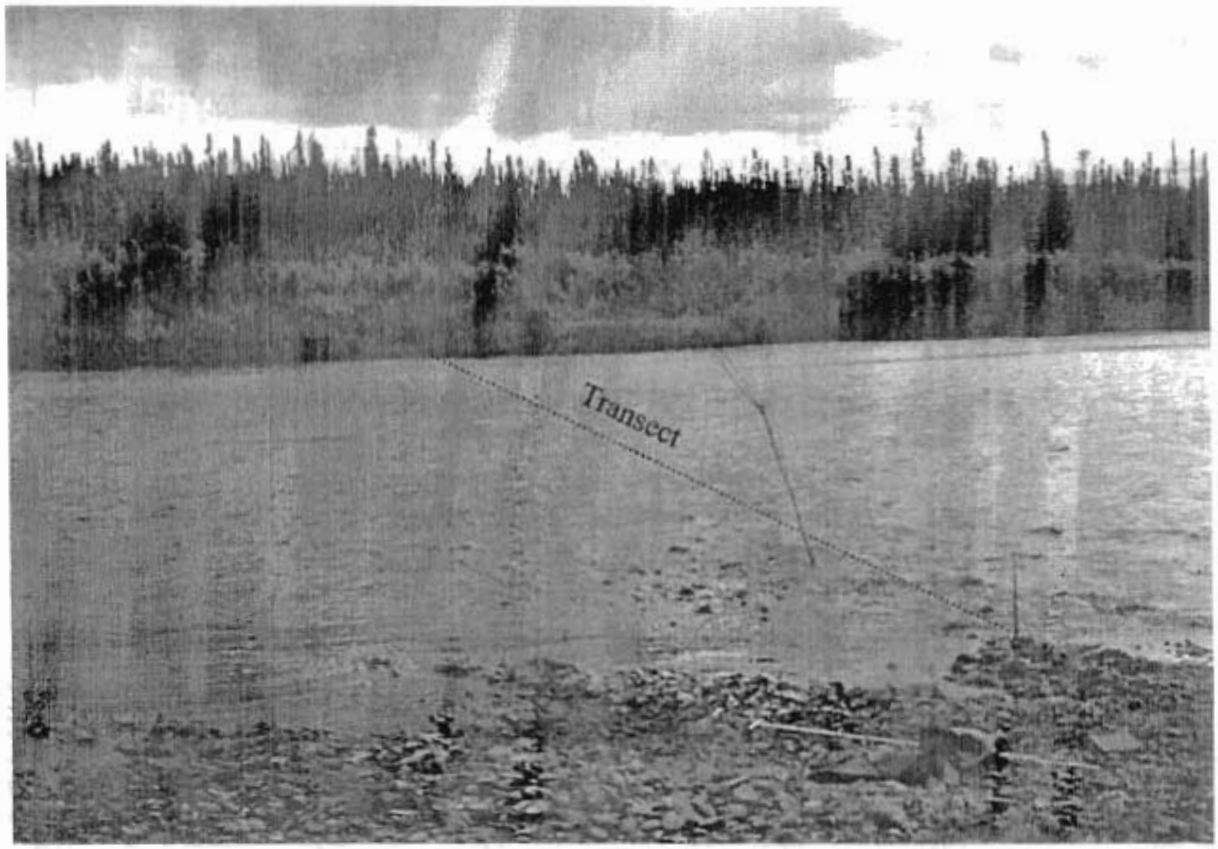


Photo 1. Discharge site from left bank.

Photo 2. Access road on left bank.

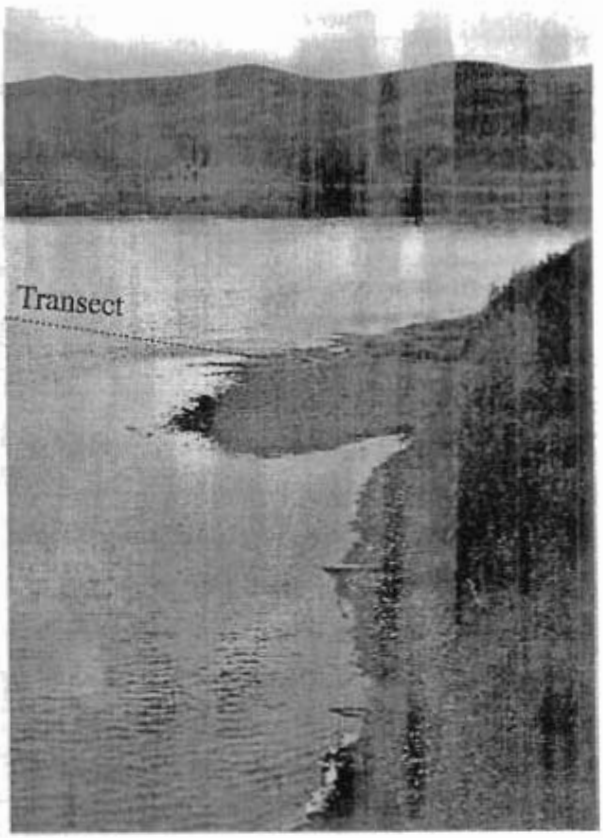


Photo 3. View of left bank from bridge.

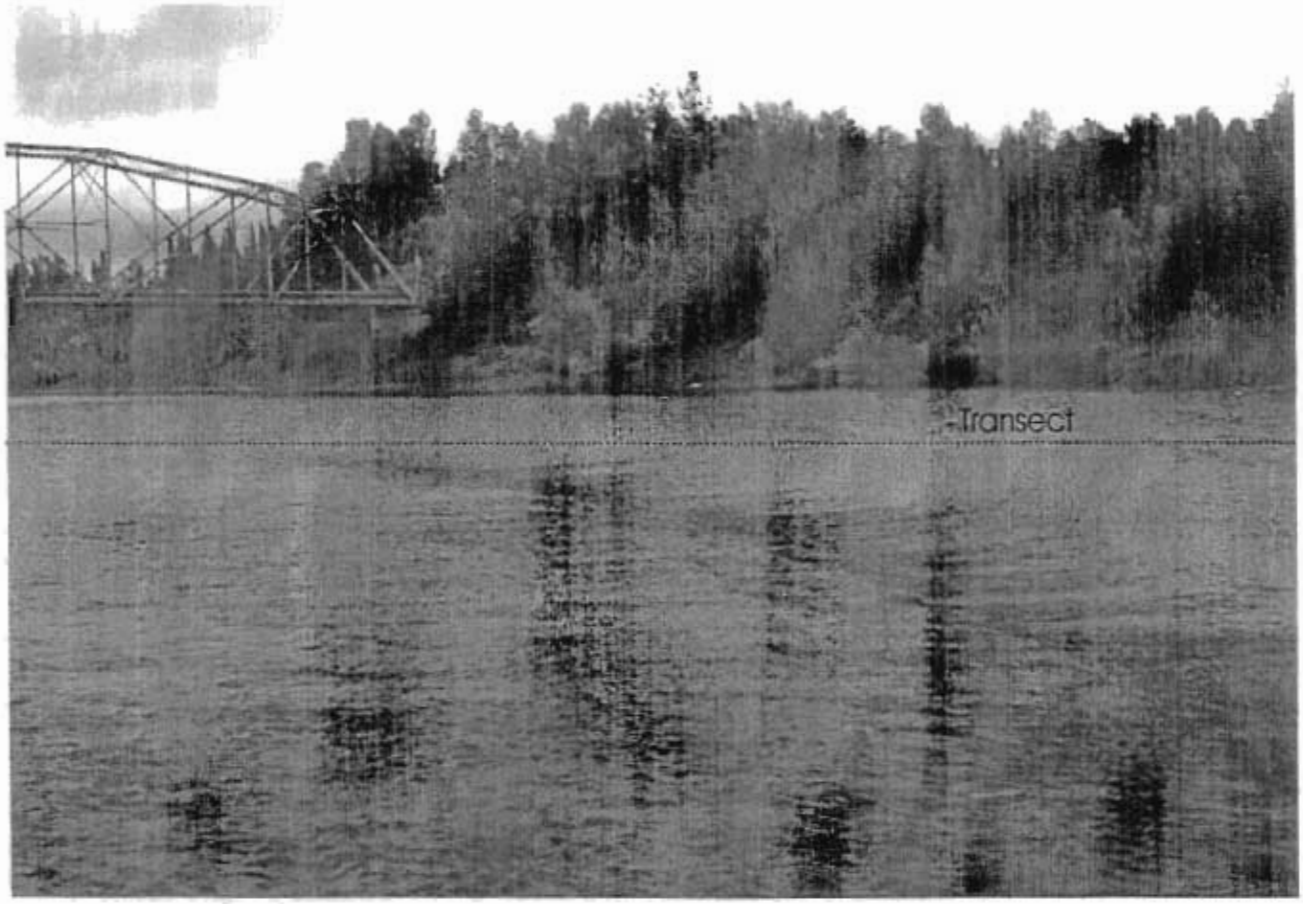


Photo 4. Gravel bar extending downstream towards discharge transect.

Photo 5. Right bank viewed from bridge.